THURSDAY, MARCH 11, 1897.

THE NEED OF ORGANISING SCIENTIFIC OPINION.[1]

II.

WHATEVER may be the deductions from statistics, it cannot be denied that, as a rule, the attitude of our manufacturers has hitherto been antagonistic to the introduction of a scientific element into our industries; and it is beyond question that the country at large has never learnt to favour the introduction of such an element into our affairs generally.

Admitting that our strongly-marked individuality, our insular habits and prejudices, over-reliance on our powers, and our prosperity and unchallenged commercial preeminence throughout a long period, in some or even a large measure account for our worship of King Rule of Thumb and our apathy as a nation to science, we must go further to find the full explanation.

There can be no doubt that such apathy arises from the fact that "the idea of *science* has been absent from the whole course and design of our education"—words used thirty years ago by Matthew Arnold. It is still true that, as the same writer said, "we hardly even know the use of the word science in its strict sense, and only employ it in a secondary and incorrect sense." We are, in fact, an uncultured nation; which is mainly, if not entirely, the fault of our Universities—for although but a small proportion of English attend the Universities, it is from the Universities that the teachers, as well as the heads of our public schools, are taken, and these set an example which permeates our whole educational system.

Whilst, however, our Universities have *failed* to help us, Germany undoubtedly *owes her success* to her Universities; but hers are real Universities, not "superior boarding-schools"—"places where the youth of the upper class prolong to a very great age, and under some very admirable influences, their school education." They are Universities in which "*Lehrfreiheit* and *Lernfreiheit*, liberty for the teacher and liberty for the learner, and *Wissenschaft*, science, knowledge systematically pursued and prized in and for itself are the fundamental ideas."

Although, in comparing the condition of education in the two countries, Arnold recognised that our Universities were in the main but superior schools, he failed to point out the origin of the difference—that long before he wrote, at the beginning of the century, in fact, they had succumbed to the colleges, so that we had no Universities in the German sense; whilst Germany, happily, was without colleges. But this fact was recognised over fifty years ago by Charles Lyell, who drew special attention to it and discussed the consequences in a most interesting chapter in his "Travels in North America," published in 1845.

Higher education in Germany, in so far as secondary schools are concerned, may be said to date from the reforms introduced by Wilhelm von Humboldt during the brief period (1810–12) in which he was Prussian Minister of Education. Although less well known than his renowned younger brother Alexander, he appears to have been a man of remarkable philosophical power and insight, whose administration of public instruction was clearly based on the fullest understanding of its immense importance, and who recognised that it must be conducted scientifically. We should probably be well satisfied even now if we could secure a Minister of Education, and he were no more than an animated phonograph; one who could repeat with understanding words the Prussian Minister of Education used near ninety years ago—"The thing is *not* to let the schools and Universities go on in a drowsy and impotent routine; the thing is, to raise the culture of the nation ever higher and higher by their means"—words so striking that Arnold attaches them as a motto to his report, would throw the whole body of educational enthusiasts among us into wild delirium, but the country at large would certainly rate him unpractical, if not as a lunatic.

Probably the greatest service to education rendered by von Humboldt was the establishment of a State examination for all schoolmasters; he also, as Arnold points out, took the most important step towards making the *Abiturienten* or school-leaving examination—which plays so vital a part in the German system—what it now is. But von Humboldt was not the only statesman in Germany to take the most enlightened and active interest in the affairs of higher education, and those who followed him in the work of organising public secondary education were able to achieve success because German Universities generally had laid the necessary foundation: otherwise, a satisfactory system could not have been called into life. In witness of this, take the following passage in Carlyle's review of Heeren's "Life of Heyne," in reference to the celebrated scholar's activity, now a century ago, at Göttingen:—

> "We have long details of his procedure in managing the Library, the Royal Society, the University generally, and his incessant and often rather complex correspondence with Münchhausen, Brandes, or other ministers who presided over this department. Without detracting from Heyne's skill in such matters, what struck us most in this narrative of Heeren's was the singular contrast which the 'Georgia Augusta,' in its interior arrangements, as well as its external relations to the Government, exhibits with our own Universities. The Prime Minister of the country writes thrice weekly to the director of an institution for learning! He oversees all; knows the character not only of every professor, but of every pupil that gives any promise. He is continually purchasing books, drawings, models; treating for this or the other help or advantage to the establishment. He has his eyes over all Germany; and nowhere does a man of any decided talents show himself, but he strains every nerve to acquire him. And seldom even can he succeed; for the Hanoverian assiduity seems nothing singular; every state in Germany has its minister for education, as well as Hanover. They correspond, they inquire, they negotiate; everywhere there seems a canvassing, less for places than for the best men to fill them. Heyne himself has his Seminarium, a private class of the nine most distinguished students in the University; these he trains with all diligence, and is in due time most probably enabled, by his connexions, to place in stations fit for them. A

[1] Continued from page 411.

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hundred and thirty-five professors are said to have been sent from this Seminarium during his presidency. These things we state without commentary; we believe that the experience of all English and Scotch and Irish university-men will, of itself, furnish one. The state of education in Germany, and the structure of the establishment for conducting it, seems to us one of the most promising inquiries that could at this moment be entered on."

So wrote Carlyle in 1828! In truth, a lesson is slowly learnt in this country. And how many of us even now are able to appreciate the value of the services rendered to their nation by Wilhelm and Alexander von Humboldt and by Liebig, and the way in which they have been the true founders of Germany's industrial success—the Moltkes of scientific method.

One of the requirements of a teacher who is a candidate for the Government certificate of *Oberlehrer* in Germany is that he has spent *at least three years* in study at one or more of the Universities; and in the memorandum submitted by Mr. Findlay to the late Secondary Education Commission, we are told that most candidates spend four, many five years there, before presenting themselves for the test. I cannot discover that they are required to prove capacity to take part in the school games—either cricket or football—the primary qualification in an English secondary schoolmaster, if I am not wrongly informed. The difference appears marvellous when we note the extraordinary extent to which the teacher is required to prepare himself for his office in Germany and then reflect on the conditions prevailing here—on the fact that but a few months ago, through a great Royal Commission, we openly confessed to the world that we had absolutely no organisation of secondary education, no check whatever on the competency of the teachers in our schools; and the indifference with which such disclosures have been received, shows what is still worse—that as yet we have no public opinion formed throughout the country which can be brought into operation to enforce the necessary changes.

Nor is this surprising when we consider what our Universities have done for us. To take the case of Oxford. At the close of last century, owing to the operation of causes which cannot be considered here, both teachers and students were thoroughly demoralised, and it became necessary to introduce drastic reforms: examinations having proved useful in some few of the colleges in maintaining orderly habits, to improve matters, in 1800 an examination statute was enacted for the University; but it soon turned out that this had been so framed that it was to be worked by the College tutors, on whose behalf the range of studies was advisedly restricted, all the more progressive branches of knowledge being excluded. As Lyell tells us, the new statute did not pass without a severe struggle. The rector of Lincoln College, in particular, opposed it, as a measure that would extinguish all "thirst of knowledge." "There would thenceforth," he said, "be no *University* at all, but a system of cramming and partial teaching, after which the student would go out into the world with a narrow mind and darker understanding." Never was prediction more thoroughly fulfilled!

It is clear, indeed, that there was "wisdom" at disposal even in those black days; and had wisdom been allowed to govern, the nation might now have been in a very different position. Instead, the horrible system of competitive examinations was allowed to grow up, and worst of all, a new aborted species of teacher, the "coach" or "crammer" was evolved, and the highly lucrative business of "cramming" was established.

"The examinations for degrees were made more and more stringent, and emulation at length stimulated to so high a pitch that health was often sacrificed in the effort to gain the prize. Useful habits of application were often acquired, but the system was not calculated to foster a love of knowledge for its own sake. To some there was even danger of injury both bodily and mental; for if they succeeded, they were tempted to believe that they had already achieved something great; if they failed, their abilities were underrated, both by themselves and their contemporaries."

Notwithstanding the many changes introduced within recent years, whereby some of the defects which Lyell deplored have been remedied, these words of his still afford an accurate presentment of the state of affairs. Moreover, the professoriate still occupy an entirely subordinate although an improved position: for how can they be otherwise than mere mechanical units in a system so long as we fail to recognise that the sole aim of University education should be to develop faculties and to give training in research—so long as "students are treated more as boys and children than as men on the very point of entering on their several duties in life, and who ought, without loss of time, to be acquiring habits of thinking and judging for themselves." We are so absolutely given over to dogmatic and didactic methods of teaching in order to meet the inexorable requirements of examiners, that research work is an entirely post-graduate exercise—a luxury in which but very few indulge, therefore, and the consequence is that a nation priding itself on individuality and originality has an educational "system" in which everything operates towards deadening and maiming the spirit of inquiry, of self-helpfulness, and of thoughtfulness.

How different is the University system abroad. There examinations occupy an entirely subordinate position. From the outset, the student has forced upon him the fact that he cannot gain admission to the degree examination until he has completed a satisfactory thesis embodying some piece of original work; his *Arbeit* is the one absorbing subject of contemplation filling his mind, and the almost daily topic of conversation; and knowing that he cannot count on completing it in any fixed period, and desiring to economise time as much as possible, he devotes himself to his preliminary studies with assiduity and care in order that he may as early as possible secure the necessary permission to commence research. The work accomplished may often be very trivial as a contribution to science, but this matters little: the spirit it evokes is the main consideration—of chiefest importance is the fact that thoughts are always directed forwards with the desire to solve a problem, and that instead of attention being confined to text-books original literature is freely consulted and studied.

It is not surprising that teachers so trained have evoked in turn the proper spirit in their pupils, and that with such material at their disposal manufacturers have been successful in maintaining their businesses fully abreast of the times.

The post-graduate career is equally different abroad. A graduate is not worshipped as a young god because he happens to have passed examinations with distinction, nor is he damned for life by being termed a second or third class man because he did indifferently well. Nor is he a prig, for although sufficiently proud of being dubbed "*Herr Doctor*," he knows full well that his future success depends on what he does, not on what he has done in some examination. In fact the examination is forgotten almost as soon as over, and if a professional career at the University be adopted, a man has to work very hard for every step of promotion, and is rewarded only if he manifest originality and activity in research.

And manufacturers have also recognised that they cannot expect to obtain all the material they need ready made from the Universities; the true technical school in Germany is in connection with the works, each of which has its research department, in which men certified by the Universities as likely to do well are set to work under competent leaders and gradually learn to do what is required of them in practice: those who manifest technical skill being gradually drafted off into the works proper. The English manufacturer too often expects the scientific assistant he engages to be already conversant with the industry—to be a practical man; he will rarely be at the pains to educate his staff. He derides college-bred material, and yet will do nothing towards producing a genuine article.

It is clear that if we are to fit ourselves to carry on the work in the world we have undertaken, and to justify our having taken so vast a burden of imperial responsibility on our shoulders, an entire reform of our educational system, starting from the Universities, must be brought about. We have long since reached the point "where toleration sinks into sheer baseness and poltroonery"; and we must no longer allow mediocrity to be our ideal. The attempt must be made to awaken the public generally to a more thorough understanding of the position in which the country is placed. It must be shown that we also have an "aristocracy of talent" capable of advising honestly and well and with understanding; that the methods hitherto adopted have too often been unsound; but that sound methods are now available, and their use must be insisted on. If those who are capable of working in such a cause—and there are very many—will but cooperate, there need be no great delay in formulating and carrying out the changes that are most urgently and imperatively called for: but how are we to effect the necessary organisation of scientific opinion, and secure that its decisions shall be carried into practice? It will be very difficult, and yet it must be done, and without delay. It can only be done if—to use words uttered by Helmholtz—"each of us think of himself, not as a man seeking to gratify his own thirst for knowledge, or to promote his own private advantage, or to shine by his own abilities, but rather as a fellow-labourer in one great common work bearing upon the highest interests of humanity." HENRY E. ARMSTRONG.

(*To be continued.*)

THE GASES OF THE ATMOSPHERE.

The Gases of the Atmosphere: the History of their Discovery. By William Ramsay, F.R.S., Professor of Chemistry in University College, London. Pp. 240. (London: Macmillan and Co., Ltd., 1896.)

THE reading public will be grateful to Prof. Ramsay for this book, for he has explained in a simple and attractive manner the nature of the great discovery about which they have heard much and understood little; and besides telling the story of argon, he has woven it into a history of the great discoveries of the past concerning the chemistry of the atmosphere. We believe that the book will be acceptable also to more scientific people who desire to gain a clear idea of the problems connected with the new gas.

One of the peculiarities of the discovery of argon is the entire absence of anything about it of the "practical" kind, present or prospective. It is so far a mere scientific discovery, and has no telephone or bone-photographing features to arouse a hollow intellectual interest. A book likely to enlist the public sympathy for scientific research, irrespective of its practical application, is to be heartily welcomed, and is probably no less a need of the times than it was a generation since. It is not well that the public esteem for physics and chemistry should depend wholly on a dim appreciation of their commercial value.

The account which Prof. Ramsay gives of the earlier discoveries is very readable, abounding with quotations from the original memoirs, and affording pleasant glimpses of the lives and characteristics of the philosophers concerned. The volume is embellished with a number of portraits, the honour of appearing in the frontispiece being accorded to Stephen Hales. This selection appears surprising, not only because of the slender connection of the work of Hales with the chemistry of the atmosphere, but from the feeling that in a book dealing with the history of the air in special relation to argon the conspicuous figure is that of Henry Cavendish. The merits of Cavendish have indeed been fully recognised by Lord Rayleigh and Prof. Ramsay in their Royal Society memoir, and the statement "that, if there is any part of the phlogisticated part of our atmosphere which differs from the rest and cannot be reduced to nitrous acid, we may safely conclude that it is not more than $\frac{1}{120}$th part of the whole," will remain for ever memorable. It was the same respect for minutiæ and strict loyalty to experiment as are embodied in the foregoing words, that led Lord Rayleigh, rather more than a century later, to raise again the question whether any part of the phlogisticated part of our atmosphere differs from the rest. The habitual attitude of chemists towards the clue contained in the above words of Cavendish is shown very well by the following passage from Dr. G. Wilson's "Life of Cavendish": "He proceeded to test this by trying whether a given volume of the phlogisticated part was entirely converted into nitric acid by explosion with oxygen. *He found that it was*, and thus supplied a demonstration of the homogeneous nature of nitrogen such as none of his contemporaries could have given."

The last hundred pages of the book contain an account of the discovery of argon, and of the physical and chemical properties of the new gas. Prof. Ramsay explains clearly the splendid initiatory work of Lord Rayleigh on the density of the simple gases, and then records the successive steps by which the disturbing element was tracked and isolated. Though told in the plainest way, this story cannot fail to prove of dramatic interest even to the non-scientific reader. The account of the properties of argon, and of the difficulties which it raises in respect to the classification of the element, is in a more difficult strain than the rest of the book, and it is possible that a somewhat more extended treatment of the subjects of specific heat and the periodic law would have helped the general reader to a better understanding of the problems presented. At the same time it is right to say that, considering the bounds within which it is compressed and the difficulty of the subject, the account is very lucid, and it will be valuable to all readers who have some acquaintance with science.

In the last few pages of the book Prof. Ramsay gives some play to his scientific fancy, and attempts to offer an explanation of the anomaly presented by argon in respect to the periodic law. He concludes as follows:—

"It therefore appears to me not impossible that the mass of the atoms may be affected by the various and different properties which they possess, some to a greater, some to a lesser extent. It must be admitted that atoms differ from each other in the readiness with which they combine with those of the same kind to form molecules; and that molecules of different elements differ from each other in their capacity to form molecular aggregates. Take for example such cases as cæsium and fluorine, each intensely active, but towards different objects: cæsium the most electro-positive of the metals, and fluorine the most electro-negative of elements. Surely their activity must be due to some cause which cannot but exert influence on their other properties, such as their mass and their gravitational attraction, as it doubtless has influence on their specific heats and on many of their other physical properties. And contrast these instances with helium and with argon the most indifferent of substances, the atoms of which are unwilling to pair even with themselves; it is hardly conceivable that these peculiarities should leave their other, and, as we are in the habit of thinking, invariable, properties unaffected. I venture to suggest that these powers of combination, due to some configuration or to some attractive force, tend to lessen the gravitational attraction by which we measure their atomic weights; that helium and argon, which possess little, if any, of such power to combine, show what may be termed the normal atomic weights, inasmuch as their gravitational attraction is subject to no deduction attributable to their reacting powers."

We cannot reproduce the considerations which lead up to the expression of this remarkable conjecture, and can therefore hardly do the author justice. Prof. Ramsay describes his suggestion as of a wholly speculative character. He expresses his "firm conviction that no true progress in knowledge has been made without such speculations."

With this last statement in itself we are not inclined to disagree; the mind, baffled by difficulties in the paths of orthodoxy, may well be allowed to have its flights and seek more open ways, and there is a well-recognised scientific use of the imagination. But it is impossible to appraise any such speculation as the one before us, and we venture to think that it is rather presented as a *finale* to an interesting story—a sort of last chapter where all ends happily—than intended for scientific criticism. Prof. Ramsay likens it to the doctrine of phlogiston; and certainly the assumption of "levity" is a point of resemblance. Otherwise we think the comparison unfair to the phlogistians. The idea of phlogiston was doubtless at its birth a speculation, but in science it ranks as a working hypothesis that guided several generations of investigators from point to point in their inquiries, that linked together a vast number of facts, and that even to the acute and sober mind of Cavendish appeared to throw as good a light on facts as the newer doctrine of Lavoisier. If Prof. Ramsay's speculation proves fruitful, it may claim kinship with Becher's; but hardly till then. The author recognises this, no doubt, as fully as any one. Meanwhile the situation between argon and the periodic law is not eased in any practical sense, and we are afraid that the book, which in many respects is an admirable exposition of the methods of scientific discovery, may prove somewhat misleading to the general reader in this one particular.

We cannot conclude this notice of a work dealing with the history of chemical discoveries relating to the atmosphere, without remarking upon the momentous part they have played in the development of chemical science. Viewing the discovery of argon in the light of earlier discoveries respecting the air, we feel that it is worthy to rank with the best of them, both in the manner of its inception and of its experimental realisation. The discovery has already raised questions of fundamental interest in physics and chemistry, and there seems no reason to believe that it will not prove as fruitful in important consequences as any of the earlier masterpieces of experimental work relating to the gases of the atmosphere.

A. S.

THE FENS OF SOUTH LINCOLNSHIRE.

A History of the Fens of South Lincolnshire. By W. H. Wheeler. Second edition. Pp. 489, and appendices. (Boston: J. M. Newcomb. London: Simpkin, Marshall, and Co.)

THIS book, which is nominally a second edition of a book published in 1868, but has in reality been entirely re-written and enlarged, relates merely to the fens of Lincolnshire, situated between the Steeping River and the Nene, comprising an area of 363,000 acres, and does not refer to the fens of Norfolk, Cambridgeshire, and the adjacent counties, or to the rivers Ouse and Nene, which, with the rivers Witham and Welland, are known as the fen rivers. In fact, the author naturally deals with the fen districts in his near neighbourhood, having resided for many years past at Boston, on the Witham. The history of these fens is traced back to the time of the Britons, and more particularly to the Roman settlement which was made very early in the Christian era; and to the Romans in the time of Severus, are attributed the construction of the first banks protecting the district from the sea, the land being from 1½ to 12½ feet below the level of high-water of spring tides, to which probably the appellations North and South Holland, denoting certain portions of the fens, are due. Lands outside the Roman banks have been gradually raised by the process of warping, or accretion, from the deposit of materials brought down the fen rivers in flood-time, and have then been enclosed and drained. The area of land thus reclaimed from the sea, since the formation of the first sea banks about 1700 years ago, amounts to 63,300 acres, or an average yearly addition of 37¼ acres. Mr. Wheeler points out that the reclamations must be gradual, owing to the limited quantity of fertilising alluvium brought down by the rivers, and that the schemes which have occasionally been brought forward for enclosing large areas of the sandy foreshores of the Wash, adjoining the fens, would be financial failures on account of the barren nature of the sands before they are covered over with warp.

The subject is dealt with in seventeen chapters, followed by eight appendices; and it is illustrated by fourteen maps of the various districts, and two diagrams exhibiting the strata, levels, and rainfall of the fens. Unfortunately, no pages are given in the table of contents, which renders reference to the different chapters and illustrations a tedious search; and marginal headings in small print only partially compensate for the absence of top headings to the pages, and the entire omission of notes. A general early history of the fens is given in the first chapter, and the several drainage districts are described in turn; and special chapters are devoted to the river Witham, the river Welland, the estuary and its reclamation, Boston Harbour, and the Witham Outfall, with which the author has long been professionally connected, the geology and water-supply of the fens, and a concluding chapter on the natural history, products, climatology, and health of the district. The inhabitants of the fens have had to maintain a constant struggle with nature, first in rescuing and preserving these fertile lands from the sea, and by degrees increasing their extent by fresh enclosures; and secondly, in improving the drainage of these flat low-lying districts by straightening, enlarging, and embanking the channels of their rivers, and supplementing them by numerous straight drains, so as to prevent the inundation of the lands in times of heavy rainfall. Pumps also have been extensively introduced to remove the water from the lands, and to assist in the drainage of the district, which, owing to the small fall, cannot be wholly effected by gravitation. Sluices placed across the rivers in the neighbourhood of their outfalls, with gates to arrest the tidal flow, and thus secure the land above from any chance of an inroad of the sea, through breaches in the embankments along the river banks, have naturally, in conjunction with silting in the Wash, produced a deterioration in the depth of the outfalls, which has been detrimental to drainage as well as navigation. The straightening, however, of the outfall channels has effected some improvement; and the formation of a more direct outlet for the Witham, by cutting a new channel for the river, in 1880-84, two and a quarter miles long, through a projecting clay bank below Boston to deep water in the Wash, has effected a great amelioration in the navigable channel between Boston and the sea, and in the outflow of the drainage waters, which latter was at the same time further facilitated by an enlargement of the Grand Sluice above Boston.

The author being an engineer, has perhaps given more prominence to the engineering features of the history of the fens than another writer might have done; but unquestionably the prosperity, and even the existence of the fens are almost wholly dependent on engineering works. The book, however, does not pretend to give detailed descriptions of the works carried out, which have been recorded by Mr. Wheeler and others in engineering publications; and the book will chiefly interest archæologists and topographists, and especially those who live in the neighbourhood of the districts described. Though Mr. Wheeler, as an old inhabitant, has given somewhat too rosy a description of the attractions of the fens on pages 2 and 486-487, where the features of the landscape are banks, drains, windmills, and occasional church towers, and keen north-east winds often prevail through the spring up to June, he shows great interest in the country he resides in, extending to minute details on a variety of topics, and has produced a volume exhibiting considerable labour and research.

OUR BOOK SHELF.

Bacteria of the Sputa and Cryptogamic Flora of the Mouth. By Filandro Vincentini, M.D. Translated by Rev. E. J. Stutter and Prof. E. Saieghi. Pp. x + 239. (London: Ballière, Tindall, and Cox, 1897.)

THIS volume is a collection of three monographs and an appendix, viz. First memoir: On the Sputa of Whooping Cough. Second memoir: Recent Bacteriological Researches on the Sputa. Third memoir: On *Leptothrix racemosa*.

Without in the least wishing to detract from the earnestness, enthusiasm and laudable industry of Dr. Vincentini, we are sorry to have to confess that this book is what, in Germany, would be called an overcome standpoint—*ein überwundener Standpunkt*. Fifteen years ago, prior to the introduction, by Koch, of exact methods of bacteriological study, this book, dealing with the purely microscopic examination as to size and shape of micro-organisms in the sputa and of the mouth, would have had some *raison d'être*; not so at the present time. Everybody knows that if you talk of a bacterial species, of pathogenic and non-pathogenic organisms, you mean not merely the size and shape of a microbe, but that you have studied its biological, chemical and cultural characters, and that you have ascertained whether or not, and under what conditions, it possesses, or is devoid of, pathogenic properties when introduced in one way or another, experimentally or otherwise, into the animal system. Of all this, Dr. Vincentini is quite innocent. To assert, as he does from purely microscopic examination, that a host of microbes—bacilli, cocci, vibrios, and spirilla, occurring in the sputa and in the fluid of the mouth—are all derived from, or are parts of, a single species "leptothrix," requires either tremendous courage, or is due to a want of appreciation of the enormous amount of exact work hitherto accomplished. The discussion in the appendix, by Dr. Vincentini, of the views of antiquated authors on spontaneity of origin of infectious diseases, and, further, his extraordinary derivation of the tubercle bacillus, spirillum of relapsing fever, gonococcus and pneumococcus from the indifferent leptothrix, is an anachronism of a curious and, we had hoped, extinct type. E. KLEIN.

Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus. Nos. 7-9. Edited by Prof. Dr. G. Hellmann. (Berlin: A. Asher and Co., 1897.)

THESE reproductions in facsimile of classic papers in meteorology and terrestrial magnetism are attractive in appearance, and Prof. Hellmann's introductions and notes make them most instructive publications. No. 7 of the series contains papers of prime importance in the history of meteorological instruments, viz. the correspondence between Torricelli and Ricci on the measurement of atmospheric pressure, in which Torricelli announced the invention of the barometer (1644); and the paper "Saggi di naturali esperienze fatte nell' Accademia del Cimento," in which the first continuous observations with the thermometer and hygrometer are described. This paper appeared in 1666 and passed through eight Italian editions, and was translated into English (1684), Latin (1731), and French (1754). Prof. Hellmann gives a list of the most important works upon the invention of the barometer, thermometer, and hygrometer, and adds some interesting historical notes.

No 8 of the "Neudrucke," entitled "Meteorologische Karten," contains facsimiles of the first wind-chart, isotherms, isobars, and synoptic weather-map, with an introduction in which the various charts are described. The wind-chart is Halley's (1686); the isotherm map is Humboldt's (1817); and the synoptic chart is Loomis' (1846). Two maps of Le Verrier's show the distribution of barometric pressures on September 7, 10, and 16, 1863, as telegraphically communicated to the Paris Observatory from different parts of Europe on those days; and M. Renous' map (1864) of mean atmospheric pressure over France is given as the first chart of mean isobars.

The discovery of the secular variation of magnetic declination is told in Gellibrand's "Discourse mathematical on the variation of the magnetical needle," which appeared in 1635, and is reproduced in facsimile as No. 9 of Prof. Hellmann's "Neudrucke."

The three reprints are worthy additions to a very attractive and serviceable series.

Colliery Surveying: a Primer designed for the Use of Students and Colliery Manager Aspirants By T. A. O'Donahue. Pp. 163. (London: Macmillan and Co., Ltd., 1896.)

WITH a view to reducing the number of colliery accidents, the law now requires that an accurate plan shall be kept of the workings of each mine. This has led to increased attention being devoted to the subject of mine surveying. Hitherto, it is true, mine surveying has not kept pace with the advances made in other branches of surveying. Great improvements have, nevertheless, been made during the last decade. Colliery managers are now submitted to a severe educational test before certificates are granted to them, and surveying classes are now held at most mining centres. For elementary students attending such classes, Mr. O'Donahue has written this concise little primer. Taking for granted that his readers have merely a knowledge of arithmetic, he has endeavoured to compress into his pages a complete course of instruction in surface surveying, mine surveying and levelling, together with the requisite preliminary information regarding mechanical drawing, geometry, mensuration and the determination of inaccessible heights and distances. With so comprehensive a scheme, and with so small and inexpensive a book, the instructions are necessarily brief and, for the most part, unaccompanied by theoretical explanations. It is to be feared, therefore, that an elementary student working with this book without guidance might be led to learn by heart details without having grasped principles. Used under the supervision of a capable teacher, however, it should prove useful as an *aide-mémoire* to young students. The absence of an index is a serious drawback, whilst the superfluous section on the mensuration of solids could easily have been spared. Numerous typographical errors in the figures have escaped the author's notice. Thus in the first example, worked out on p. 34, there are three mistakes in one line, and in the next line the correct value of 15° is stated to be 1 in 3·74, whilst in the table of incline measure, on p. 142, it is 1 in 3·73. In that table itself there is often an uncertainty about the final figures; for example, the correct inclines for 3°, 4° and 5° are 1 in 19·08, 14·30 and and 11·43 respectively, not 1 in 19·09, 14·29 and 11·42, as stated. On p. 140 the reduced level given is 50·3, but the measurement plotted in the drawing is 55 3. Again, the base line of the Trigonometrical Survey was measured in 1784, not 1874, as stated on p. 29. Trifling misprints of this kind, whilst perfectly obvious to the advanced student, are apt to prove stones of stumbling to the beginner.

The British Mercantile Marine. By Edward Blackmore. Pp. xix + 248. (London: Griffin and Co., Ltd., 1897.)

MESSRS. CHARLES GRIFFIN AND CO., Ltd., in their nautical series, have here a book not only serviceable to the men of the mercantile marine, but interesting and enlightening to those who wish to know the true state of our merchant service, which, to a great extent, and especially in smaller vessels, is manned by foreigners.

The history commences with the infancy of the mercantile marine, giving the different laws passed, the state of trade, the different classes of vessels, and the modes of discipline at various times. Further on, the attention of the reader is drawn to the fact that our mercantile marine is suffering from the want of proper education, in that the examinations held for testing the efficiency of the masters and mates can practically only be passed by them through the medium of a "crammer," who teaches them by rule of thumb, what is taught scientifically to the same class of men in other countries by their respective Governments.

It is pointed out, further, that the apprentice, who is on board to learn his profession, at the commencement of his sea career performs only manual labour, seldom, if ever, having the opportunity of learning the art of navigation as opposed to seamanship; this holds good even for mates of smaller vessels.

The book concludes with a postcript, entitled "The serious decrease in the number of British seamen: a matter demanding the attention of the nation," in which the author, in a few words, enumerates some of the points to which the decrease of British seamen is probably due.

Bulletin of the Philosophical Society of Washington. Vol. xii. 1892–94. Pp. xxix + 567. (Washington: D. C. Jude and Detweiler, 1895.)

THIS volume, though dated 1895, was only received a few days ago. A number of very interesting papers, some of which have been already referred to in the columns of NATURE, are contained in it, among them being the following:—"The Mexican Meteorites," by J. R. Eastman; "Peculiarities in the Rainfall of Texas," by A. W. Greely; "The Origin of Igneous Rocks," by J. P. Iddings; "The Moon's Face, a study of the origin of its features," by G. K. Gilbert; "The Texan Monsoons," by M. W. Harrington; "The Earliest Isoclinics and Observations of Magnetic Force," by L. A. Bauer; "Mean Density of the Earth," by E. D. Preston. Mr. Preston's observations were made at Hawaii by two different methods, one depending upon triangulation and astronomical latitudes, and the other upon the diminution of gravity from the sea-level to the summit of a mountain, as revealed by a pendulum. The former method, carried out on Haleakala, gave for the mean density of the earth the value 5·57; the latter method, carried out on Mauna Kea, gave 5·13 as the density. The adopted mean is 5·35.

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.*]

Dynamical Units.

WITHIN the moderate dimensions of a letter it is hard to give due weight to every aspect of a complicated matter, and while trying to emphasise one side I have somewhat overstated the case, as is evident from the way in which Prof. Lodge has taken me up. I was only considering the teaching of elementary dynamics to engineering students. I do not object to a teacher explaining that inertia is such an important constant property of matter, that equality of inertia is our *definition* of equal quantities of matter. What I do object to is, a common inversion of this, by which equality of inertia is *explained* by saying that the quantities of matter are equal. In addition, I urge that teachers of elementary *dynamics* should call what is usually called mass, inertia, so as constantly to bring before the student the fact that this is *the* property with which the dynamics of motion deals. I do not plead guilty in this to confusing the issues. The issues of Prof. Perry's review have been overlaid with a discussion as to one of the greatest advances of modern physics, namely the possibility of representing physical quantities by algebraic symbols; but I was trying to recall the original issue, as to the way dynamics should be taught to engineering students. Babes must be treated babyishly, and as long as engineering students are what they are now, and have to attend a variety of lecturers, and read engineering books as they are, I agree with Prof. Perry in recommending that the engineer's unit of inertia be used by their teachers. I have already explained that a multiplicity of units is a very minor difficulty to those who have once grasped what it is that is being measured, but I do think it confuses them, while getting these ideas, for one teacher to use one system, and another another system, and for each teacher to call the system of the others by hard names. GEO. FRAS. FITZGERALD.

Definite Variations.

MR. F. A. BATHER, in the January number of *Natural Science*, has some remarks on Prof. Cope's "Factors of Evolution" which seem to call for further comment. The case is cited of sheep taken from Ohio to Texas losing the fine quality of their wool, and this definite variation, due to environment, being apparently inherited and cumulative, in spite of selection by the breeders of those lambs which least present the new character. Such facts as these are not new, and it seems to me that they represent simply a phase of atavism. On July 23, 1890, I was present at a meeting of the Royal Horticultural Society, at Chiswick, and heard Mr. E. J. Lowe give an interesting address on ferns. In the course of it, he told how he had a great number of varieties of the hart's-tongue fern, which, on changing his place of residence, he moved into new and poorer soil. They all reverted to the typical form, and it was not until they were again transplanted to good soil that they consented to exhibit their varietal characters! Now in the case of the sheep, the fine wool of the Ohio breed is not a specific character, but a varietal one produced under domestication; and it is not surprising, therefore, that removal to a locality less favourable, and, perhaps, more resembling that of the original type of the species, should produce reversion. But it is probable that, as in the case of Mr. Lowe's ferns, the varietal character could be made to reappear by transference to the former kind of environment. The precise explanation of such facts as these may probably be found in Dr. Weismann's principle of germinal selection, which has surely been more or less understood for a long time. The sheep is born with two or three distinct possibilities, as to its wool; one locality favours one of these possible developments, one another. It is a case parallel to that of an amphibious *Ranunculus*, which can be made to assume one form or the other, according to the terrestrial or aquatic environment.

It is worth while to add, that here in New Mexico, one frequently sees small, usually pale yellowish-brown, horses, with extremely well-marked leg-stripes. These are descendants of the horses which ran wild in former years over this country; and there can be little doubt, I think, that they represent an atavistic variety.

While it is probable that really new variations are equally in all directions, practically the variation of most organisms is remarkably definite, because so largely atavistic. And these definite atavistic variations may be perpetuated, in new combinations, in new races. It is precisely this which gives rise to "kaleidoscopic characters" in a group. A character may appear here and there, and species may be represented by different combinations of the same characters, as words are composed of combinations of the same letters.

To cite an illustrative instance, the wings of bees present frequently one marginal, three submarginal, and three discoidal cells. The submarginals may be reduced to two, or even to one, and the discoidals to two. All sorts of combinations, as to the number, shape, and size of these cells will be found, but the marginal will *not* be found lacking, nor the first discoidal or first submarginal absent, nor will the number of submarginals be found increased.[1] Really new variations, as new ones running out to form a second marginal or a fourth submarginal, appear in slight degree, but doubtless sufficiently to afford material for selection, under new environment; but the old and common variations may occur suddenly, so that there may even be a radical difference between the opposite wings of the same specimen. Very rarely, a remarkable sport will occur, not in accordance with our expectations, but these are much too rare to have selective value. In other hymenoptera, as the sawflies, the range of common variation is quite different; but still the variations to be looked for in each family are not miscellaneous, but run along certain well-recognised lines. To show that new, not atavistic, variations take definite lines is another matter, and I do not believe it can be done.

T. D. A. COCKERELL.

Mesilla, New Mexico, U.S.A., February 18.

The Coral Reef at Funafuti.

THE report on the coral reef at Funafuti that was read to the Royal Society on February 11, will doubtless be of very great interest to all who have studied the very difficult problems concerning the origin of reefs and atolls.

At the same time, many will wonder why Prof. Sollas characterises the boring as a failure. Scientific expeditions very rarely accomplish all that is anticipated or even expected of them, but they are not necessarily failures in consequence. It is true that the borings at Funafuti could not be carried to a depth of more than 105 feet, and that the structure they revealed was not "what a field geologist might have anticipated"; but they revealed the very important fact that underlying a coral reef of 50 feet in thickness, there was a stratum of sand containing a few coral blocks.

It is perhaps premature to consider, until further details are published, whether this fact supports the views of Mr. Murray or his followers; but what is perfectly clear at once, is that it lends no support to the well-known subsidence theory.

I think it is of importance to call the attention of the scientific public to this at once, because, after dismissing the boring as a failure, Prof. Sollas gives the results of the soundings made in the neighbourhood of the island by H.M.S. *Penguin*, and concludes by the statement that, in his opinion, these soundings support Darwin's theory of coral atolls.

I should not like at this stage to take upon myself the responsibility of saying they do not, but I should like to ask, after the negative evidence afforded by the borings, upon what grounds Prof. Sollas bases his opinions. SYDNEY J. HICKSON.

Owens College, Manchester, February 20.

Two Unfelt Earthquakes.

REFERRING to Prof. John Milne's interesting communication on "Two Unfelt Earthquakes," asking for information as to whether these disturbances have been instrumentally recorded elsewhere, Dr. Copeland requests me to say that an examination of the photographs of the oscillation-curve of the bifilar pendulum at this observatory shows several disturbances on February 7, the first of the dates mentioned by Prof. Milne. These are as follows:—At 7.37 a.m. an abrupt movement of the pendulum towards the north; from 8.24 to 8.41 a.m. a distinct reduction in the intensity of the colour of the photographic

[1] *Melipona* and *Trigona* are exceptional, and in many ways depart widely from the normal type, so that they hardly come within the range of typical bee-modification.

trace, doubtless due to tremor of the mirror, and, though not so well marked, yet quite similar in character to the gaps described in a previous letter (NATURE, No. 1410, November 5, 1896); at 5.32 p.m. another abrupt movement to the north, and a similar one at 1h. 20m. after midnight. The three abrupt movements have been compared with the mean of two measures of the sensitiveness of the instrument, and show tilts in the mirror frame of 1·6, 1·1, and 1·3 seconds of arc respectively. In each case the mirror returned to the normal position slowly after a period of from 2 to 4 hours.

On the other date given by Prof. Milne—February 13—there is only a slight trace of irregularity in the curve, consisting of a bend towards the north at 8h. 2m. a.m., the mirror returning to its original position three hours later.

On dates more recent than those to which Prof. Milne calls attention, several disturbances have been recorded here. Of these the most strongly marked are: an abrupt north movement on February 16 at 8 p.m., and another on the 17th at 3 a.m. On the 18th there is a similar movement to the south at 6.15 a.m., followed by two smaller oscillations in the opposite direction, the three covering a period of 1½ hours. On February 19 there are two well-marked gaps, precisely similar in character to those described in the letter above referred to.

THOMAS HEATH.

Royal Observatory, Edinburgh, March 2.

The Origin of Manna.

THE note in NATURE, p. 349, concerning the "manna," reminds me of a passage in Daniele Bartoli's "Asia."

Speaking of the island of Ormuz—which is described as one of the places in the world worst supplied in even commonest necessities of life, and scarcely having any water—the historian tells us that "not even thorns and briars could grow on its barren soil; no animals or birds (*sic*) are seen there all the year round, but every morning a dew falls which congeals into grains, has a very sweet taste, and is called 'manna.'"

Now, tamarisks affect sandy soils or brackish shores; and as *T. mannifera* grows in Arabia, it may be that the exudations from the plants were blown from Oman, on the eastern shore of Arabia, across the Persian Gulf; or, perhaps, from the nearer coast of Persia. This would seem to confirm the belief that manna is the product of the tamarisk, and not of a lichen.

Tooting College, S.W., February 26. B. TIMOTHY.

"Heterocephalus glaber" in North Somaliland.

IN reference to the note given in NATURE (vol. lv. p. 301) on the mammals collected in North-east Africa by Dr. Donaldson Smith, it may interest some of your readers to learn that in October 1892 Captain V. Bóttego obtained no less than eighteen specimens of that most singular rodent, *Heterocephalus glaber*, in one day, at the Wells of Herrer, near Archeisa, in North Somaliland. Sixteen specimens, well preserved in alcohol, were forwarded by him to Marquis Giacomo Doria, and have been distributed to various museums through the learned Director of the Museo Civico of Genoa. In his book ("Il Giuba esplorato," pp. 38–41, Roma, 1895) Captain Bóttego figures the *Heterocephalus*, and also one of their colonies of singular conical mole-hills.

Florence, February 24. HENRY H. GIGLIOLI.

THE CAUCASUS.[1]

LITTLE though the methods and spirit of sport have in common with those of science, each subject is greatly indebted to the other. Our knowledge of the habits of big game is mainly due to hunters; and for the first great advances in mountain cartography and in the study of high mountain regions, we are indebted to climbers. In the early days of the Alpine Club some of its members, at the suggestion of John Ball, placed instruments on summits that were accessible only to trained mountaineers, and thus obtained meteorological records much wanted at that time. Subsequently, another group of members of the Alpine Club turned their attention to the Caucasus, where their explorations resulted in the first accurate knowledge of its lofty summits and its great snow-fields and glaciers. Of the Alpine climbers who have taken part in this work, Mr. Douglas Freshfield was one of the earliest, was the best qualified as a geographer, and has been by far the most persistent. His "Central Caucasus and Bashan" (1869), which has taken place as an Alpine classic, helped to rouse the first interest in England regarding the former mountains; and now, after thirty years' further work has been done, he has collected the principal results into a monograph, which is unquestionably the best illustrated book in the literature of mountaineering.

[*From a photograph by Vittorio Sella.*

FIG. 1.—Ushkul.

Mr. Freshfield begins with a chapter on the "Dis-

[1] "The Exploration of the Caucasus." By Douglas W. Freshfield. With illustrations by Vittorio Sella. Imp. 8vo. 2 vols. Pp. xxiii + 278; pp. x + 295; with 3 maps and 76 full-page illustrations, and 2 mountain panoramas. (London: Edward Arnold, 1896.)

coverers of the Caucasus," occupied largely by reference to the English expeditions, to which our knowledge of its highest peaks is due. He then describes "the characteristics of the Caucasus," comparing the range with the Alps, and referring to the most striking features in its flora, and stating the extent of its glaciers. After a brief summary of the political history of the region, he proceeds to his main task—a description of the principal peaks or groups of peaks, and a narrative of the first and, sometimes also of one or two, later ascents. In the second volume the chapters on the mountains and mountaineering are continued, and include contributions by Messrs. H. W. Holder, J. G. Cockin, Hermann Woolley, and Maurice de Déchy. The chapter in the book of most special interest to naturalists, both from its subject and the originality of its treatment, is that contributed by Prof. Bonney. It deals with "the physical history of the Caucasus," and is illustrated by a geological map prepared by Mr. Reeves. Prof. Bonney points out that the Caucasus agrees more closely with the Pyrenees than with the Alps: for it is approximately a single chain formed by an isoclinal fold, and is much simpler than the Alps, both in history and structure. Thus, although part of the Caucasian region was occupied by land at intervals during the Palæozoic and Mesozoic eras, it was not until between the Eocene and the Miocene that a mountain chain was formed there. The height was increased by a second series of earth-movements, which happened in the Pliocene. In structure the main chain consists of a band of gneiss, flanked by crystalline schists, which, at two localities, form the central watershed. On the southern side the schists are succeeded by Palæozoic clay slates, while parallel to the main range, and on both sides of it, there are belts of Jurassic, Cretaceous, and Cainozoic deposits. Some of the later deposits rise to a considerable height on the flanks: thus some fossils found by Sella on the summit of the Laila, prove the presence there of some Neozoic deposit; this is said to be Lower Jurassic or Cretaceo-Eocene. As Fournier's recent section shows that there are Eocene rocks only a little to the south of the Laila, and that they occur as a monoclinal fold, of which the northern limb is lost, there is nothing impossible in the view that the fossils belong to the later period.

[From a photograph by W. F. Donkin.

FIG. 2.—The Zanner Passes.

Prof. Bonney's lucid sketch of Caucasian history is the first of the appendices, the rest of which include the climbing record, tables of temperature and rainfall, a list of the heights at which the glacier snouts occur, and a very short list of literature. One of the principal features of the book is its illustrations. Most of them are Signor Sella's photographs reproduced by the Meisenbach Company; a few, including one or two of the best, such as the view of Ushba and the Chalaat Glacier, are by the Swan Electric Engraving Company. Mr. Freshfield has accepted photographs, as indispensable in such a work as the present, where precision of detail is required; but he frankly confesses his personal preference for engravings. This, however, as he aptly remarks, is not to be taken as a preference for art to accuracy, but for general truth to local detail. The photographs are so numerous and so superbly reproduced, that they show local detail in extraordinary fulness; and the views are so well chosen, that they are as beautiful as they are instructive, as accurate as they are artistic. By the courtesy of the publishers, two of the half-tone illustrations are here reproduced.

With the exception of the journals of Alpine gymnasts, the average book on mountaineering takes a higher place as literature than that of any other class of travel. The author's literary style is too well known to need any commendation here, and it need only be remarked that the present work ranks with the best of Alpine literature. There is one point, however, which is open to criticism. In his endeavour to avoid using "words of terror," which alarm general readers and break the music of sentences, Mr. Freshfield has not followed any definite system of transliterating place-names. Accordingly, to discover Mr. Freshfield's localities on the recent French map of Fournier, or on any Russian map, is a puzzle that requires ingenuity and patience; while to find his names in a Russian index is sometimes almost impossible. Thus ч is sometimes transliterated *ch*, and at other times *tsh*; ж is rendered as *j* or *dj*; *k* may stand either for the Russian к or х, while *kh* also represents both these letters. The letter *z* comes from either з or ц; *b* or *v* from в; *u*, *y* and *i* from ы; and *a* from а or я; and *e* from е or э. Sometimes the Russian о is given its phonetic equivalent of *a*, but at other times, when it has the same pronunciation, it is rendered by *o*. Hence in retransliterating some of the author's place-names into Russian, there are so many available alternatives that certainty is impossible.

The spelling of place-names, however, is a detail with which the general reader has no concern; but Mr. Freshfield's compromises form pitfalls for the students who may use the volume. With the difficulties of the "scientist" the author has scant sympathy. A current of delightful and subtle sarcasm runs all through the book; and the unlucky "scientist" comes in for all the author's hardest hits and most racy banter. At first sight it appears that the three main sins of the man of science are his narrow specialism, his pernicious habit of publishing "scattered communications" in scientific serials, and his delusion that a climber is not necessarily a geologist. The author, however, fortunately defines the sense in which he uses the word "scientist": he means thereby "a man who bears the same relation to a 'man of science' as a poetaster does to a poet." Perhaps it is a pity that Mr. Freshfield did not make use of the pejorative *-aster*, and then classify writers on Caucasian natural history into "scientists" or men of science, and scientasters. Häckel once grouped into one section of a bibliography, all the works which he regarded as quite valueless. He never repeated this experiment; and Mr. Freshfield might have found the publication of a list of scientasters a more dangerous feat than any of his first ascents in the Caucasus. When we come to definite cases, we find that the man of science is blamed for the sins of those who are not men of science, and are hardly scientasters. Mr. Freshfield is severe on the man of science for the mistakes made in underrating the area of the Caucasian glaciers. He promises, on the principle of *corruptio optimi pessima*, that he will only quote from "writers of authority." Then he proceeds to quote from Keith Johnston and Reclus. But they are compilers and not original authorities; and judging from some of the extracts given, we should think the introduction of the word compilaster is urgently required. The quotations from the "Géographie Universelle" afford an illustration of a devotion to obsolete authorities not unusual among anarchists. If a man of science wanted accurate information about Caucasian glaciers, he would not go to books where the information is given second-hand and often third-hand, but to the series of papers by Zhukov in *Zemlevyedyenie*, or the elaborate monograph by Dinnik in the *Zap. Kavkaz. Otd. Russ. Gheoghr. Obshch.* But we cannot find any reference to either author in the volumes, although we have searched for the latter as Dinnik, Djinnikh, Jinnik, Schinnik, and Finik. So we presume he is either a "scientist" or a quasi-scientist or a scientaster, and that his elaborate monograph only "darkens with vain words" the 130 pages of the serial on which it is printed. The complaint is made that men of science have not always given his climbing colleagues fair credit for the results they have obtained. If climbers had always worked as carefully, and observed as thoroughly as Mr. Freshfield, and if they had possessed the critical geographical instinct shown on every page he has contributed to these volumes, the criticisms in question would probably never have been made. The latest scientific work on the Caucasus expresses full acknowledgment of the work of "les hardis alpinistes anglais." And with the present work before him, no one can doubt the value of the contributions which climbers have made to scientific geography. J. W. G.

THE EXTRACTION OF AN ALCOHOL-PRODUCING FERMENT FROM YEAST.

It has long been currently taught that the alcoholic fermentation of sugar by yeast differs from the more common hydrolytic processes of the ordinary enzymes, inasmuch as it is intimately associated with, and directly dependent on, the living action of the yeast cell. But some investigators have believed that, notwithstanding the apparent impossibility of separating an alcoholic ferment from the organism, such a body nevertheless exists, and that alcoholic fermentation is thus, after all, only a special case of ordinary enzyme action, although, no doubt, one of peculiar complexity.

These views have just received a remarkable confirmation at the hands of Dr. E. Buchner, who has communicated the results of his researches on this problem in a short but important paper, entitled "Alcoholische Gährung ohne Hefezellen," which will be found in the first number of the *Ber. d. deutsch. Chem. Gesellsch.* for the present year. The author, by pounding up pure yeast with quartz sand, and adding a certain amount of water, was able to squeeze out, under a pressure of 4–500 atmospheres, a liquid which, after thorough filtering, was of an opalescent appearance, and possessed an agreeable yeast-like odour. All care was taken to exclude any organism from the liquid, and it was found that under these conditions it was able to excite alcoholic fermentation in solutions of suitable sugars. Thus, on adding a quantity to an equal volume of cane-sugar, bubbles of carbon dioxide appeared after the lapse of an interval varying from fifteen minutes to an hour. Grape-sugar is similarly fermented, but milk-sugar undergoes no change, just as is the case when living yeast is employed.

One observation is of especial interest, namely, that the addition of chloroform, even up to the saturation point, does not inhibit the fermentative process, although it causes a rapid precipitation of albuminous substances from the liquid. This seems to prove conclusively that we are not here dealing with a body which is still living, in the ordinary acceptation of the term.

If the expressed liquid be heated to a temperature of about 50° C. coagulation occurs, and the power of exciting fermentation is lost both by the coagulum and by the remaining liquid. It was also found that in the active liquid the ferment itself diffuses very slowly, if at all, through parchment-paper (*pergament-papier*).

On the whole, the evidence at present before us seems to indicate that the ferment, which its discoverer has called Zymase, is possibly of a proteid nature. Dr. Buchner believes that this is certainly the case, though until it has been separated from the rest of the heterogeneous substances, some at least of which are proteids, the question as to its real constitution can hardly be regarded as decided.

Buchner, whilst believing that the process of normal fermentation can go on within the body of the yeast cell itself, considers it as yet more probable that the Zymase is actually excreted into the sugar solution by the living organism. At any rate, it would seem that proteids can pass out of the cells into the surrounding liquid, for if the yeast be sown in a slightly alkaline solution of cane-sugar, and some of the fermenting fluid be examined after some hours have elapsed, it is found to contain a considerable quantity of a substance which coagulates on heating, and which is stated to be of an albuminous nature.

This brief sketch of Buchner's work will suffice to indicate not only its great theoretical interest, but also its practical importance in connection with those industries which are more directly concerned with fermentative processes. J. B. F.

KARL WEIERSTRASS.

THE death of Prof. Karl Weierstrass, on February 19 in the present year, has taken from science one of the greatest pure mathematicians of the century. It is now some considerable time since he ceased to deliver lectures as professor in the University of Berlin; the last few years of his life were troubled by broken health. As is indicated by a pathetic reference in the preface to the first volume of his Collected Works, he was obliged to obtain assistance, partly in preparing them for publication, and partly to secure that his intentions with regard to them might be carried out in case of his death. This help was loyally given by friends and former pupils during his life; it may be expected that the same loyalty will now be devoted to completing the series, which will be a fitting monument to his genius. And the appearance of the successive volumes will be eagerly expected and cordially welcomed by pure mathematicians all the world over.

Weierstrass was born at Osterfelde, near Münster, on October 31, 1815; so that at the time of his death he was in his eighty-second year. His first professorship was at Deutsch Krone, the appointment dating as far back as 1842; from that chair he passed, in 1848, to Braunsberg; and thence to Berlin. He was made professor extraordinarius at that University in 1856, and full professor in 1864; after which date the rest of his life was spent in connection with the University.

The long range of his life finds a parallel in the long range of his scientific activity; a couple of facts may suffice in illustration of its now distant beginning. As long ago as 1840, he prepared a memoir on elliptic functions, then called modular functions (it constitutes that portion of his now classical memoir "Theorie der Abelschen Functionen," which relates to elliptic functions): in 1840, Cayley was an undergraduate at Cambridge. Weierstrass's first paper on the higher Abelian transcendental functions was published in 1848; the contributions, which he then made to the theory, and the analytical method, which he then was perfecting, have been of significant import in the algebraical development of the theory of these functions. In 1848, Riemann was a student in Berlin; to the younger generation of mathematicians Riemann seems to belong to the past, for he died more than thirty years ago.

This is not the occasion to write of Weierstrass's work in detail, or to sketch the magnitude of his influence upon science and upon mathematicians. Its appreciation in England was marked by the Royal Society in 1881, when he was elected a foreign member of that body, and again in 1895, when he was awarded the Copley medal—the highest honour which the President and Council have the power to bestow in recognition of scientific worth. It would be idle to surmise what Weierstrass's precise place in the history of his subject may prove to be, and its consideration may fairly be left to the future: any contemporary estimate would make it high and honourable. He has been described as the parent of modern mathematical analysis; his years and his knowledge had made him a Nestor among mathematicians; and those who knew his writings, even though they may not have known the man, will learn of his death with a sense of personal regret.

A. R. F.

NOTES

M. G. DARBOUX, the distinguished professor of higher geometry in the University of Paris, has been elected a corresponding member of the Berlin Academy of Sciences.

THE fifth "James Forrest" lecture of the Institution of Civil Engineers will be delivered by Dr. G. Sims Woodhead on Thursday, March 18, on "Bacteriology."

A SPECIAL meeting of the Chemical Society is announced for Thursday, March 25, at eight o'clock, when Prof. Percy Frankland, F.R.S., will deliver the Pasteur Memorial lecture.

THE contributions so far sent by members of the General Committee of the British Section of the Pasteur International Memorial, amount to 425*l.* (10,625 francs). This sum has been forwarded to the Central Fund in Paris.

MR. EDGAR THURSTON, Superintendent of the Madras Museum, has just arrived in England on a year's leave of absence.

MR. W. HARCOURT-BATH, who contributes to the March number of *The Entomologist* a suggestive note on the causes of the decadence of the British Rhopalocera, is about to leave England upon an entomological expedition to the Himalayas.

WE regret to announce the deaths of Prof. Georges Ville, professor of botanical physics in the Paris Natural History Museum, and Geheimrath Wilhelm Döllen, formerly assistant in the Observatories of Dorpat and Pulkova, and the author of a number of important papers in geodesy and astronomy.

THE Council of the Society of Arts will proceed to consider the award of the Albert Medal for 1897 early in May next, and they, therefore, invite members of the Society to forward to the Secretary, on or before the 10th of April, the names of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit for promoting Arts, Manufactures, or Commerce," and was last awarded to Prof. D. E. Hughes, F.R.S.

THE Victorian Era Exhibition, to be held this year at Earl's Court, London, S.W., will comprise scientific and economic sections. The object of the exhibition is to show the advances which have been made during the sixty years of the reign of Her Majesty the Queen. In the scientific section it is intended to devote particular attention to the discoveries and inventions made in the United Kingdom during the Victorian era, and their development and application to purposes of general public utility. The chairman of the sub-committee of this section is Major-General Sir John Donnelly, R.E., K.C.B., and the vice-chairman, Mr. W. H. Preece, C.B., F.R.S. There are fifteen other members of the committee, most of them being Fellows of the Royal Society, and all of them known in the scientific world.

THE Mathematical and Physical Section of the Royal Society of Naples announces that the mathematical prize of 1896 is unawarded, and the competition will be postponed till March 31, 1898. The theme for the prize is as follows:—To expound, discuss, and coordinate, possibly in a compendious form, all researches concerning the totality of prime numbers, introducing some noteworthy contribution to the laws according to which these numbers are distributed among integers The essays may be written in Italian, French, or Latin.

H.S.H. PRINCE ALBERT OF MONACO has just published, in the *Comptes rendus*, the usual summary of his work in the Atlantic and Mediterranean. The third season's cruise includes 82 soundings, with 19 sets of temperature observations; samples of air and water were collected and examined, the former in the open sea and at high altitudes on the Azores. The most interesting result obtained is the discovery of a new bank, christened the Princess Alice Bank, near the Azores, between 31° 28′ and 31° 41′ N. lat. and 37° 50′ and 38° W. long. This bank lies N.W. to S.E., bottom rock and volcanic sand, at a mean depth of 252 metres, and has a rich and abundant fauna. On June 4 to 6, between Monaco and Corsica, hundreds of swallows alighted on the vessel and showed themselves remarkably tame, making their way into the engine-room and stoke-hold, and feeding from the sailors' hands.

M. JULES RICHARD, zoologist on board the Prince of Monaco's vessel, describes in the *Comptes rendus* an apparatus devised by him with the view of ascertaining whether the amount of gases dissolved in sea water is independent of pressure at great depths, or not. A steel bottle filled with mercury, and ingeniously arranged to remain vertically inverted over a beaker, was allowed to slide down the sounding line till, at the required depth, a catch previously attached to the line actuated an arrangement for lowering the beaker slightly, allowing mercury to escape from the bottle and to be replaced by water. A messenger, sent down later, "set off" the reversing thermometer, and at the same time lowered the steel bottle again into the mercury of the beaker. On drawing the whole up, any gases not in solution must have been set free, either by change of temperature or of pressure. The result of two satisfactory experiments at depths of 1000 and 2700 metres is to confirm previous experience that the quantity of gas dissolved is independent of the pressure. M. Richard applies a similar mechanical arrangement to a modification of Giesbrecht's tow-net, which he describes in the *Bulletin de la Société Zoologique de France*. The tow-net is placed on the sounding-line *after* the latter has been lowered to the desired depth, and allowed to slide down closed, until a stop on the line arrests and opens it. Before hauling up, the mouth of the net is again closed by a messenger let down from the surface. In a series of notes, M. Richard contributes to the same publication observations on a *Limnicythera* of the lakes in the Bois de Boulogne, on the fresh-water fauna of the Azores, and on the fauna of some high lakes in the Caucasus, the last from collections by M. Kavraisky.

ABUNDANT stores of cleveite, alvite, monazite, and other rare minerals, have been found in a mine recently discovered at Ryfylke, Norway. A specimen of the cleveite has been sent to us, and it proves to be very rich in helium. Many investigators will be glad to know that the minerals can be purchased at a comparatively low price, particulars of which will be found in our advertisement columns.

FROM a careful study of James Glaisher's aerostatical observations, Signor F. Siacci has propounded two new formulæ representing the law of decrease of atmospheric temperature and aqueous vapour with the altitude. From these he has deduced a new barometric formula for the measurement of altitudes, as simple as Laplace's formula, and which, when tested on Monviso and Mount Etna, has given almost perfect results.

AN investigation of certain new series for the Gamma Function has been given by Herr G. Landsberg, of Heidelberg, who has discovered some remarkable generalisations of Stirling's and Kummer's series. The two new series, of which these are particular cases, are shown to be closely connected together, a result the more remarkable in view of the fact that Kummer's series is convergent for certain values of the variable, while Stirling's series is always semi-convergent, being ultimately divergent, though the convergent portion can be used for practical approximations. Herr Landsberg's paper is to be published by the Royal Academy of Belgium among their foreign memoirs.

THE brilliantly iridescent colours of the scales on the Brazilian diamond beetle (*Entimus imperialis*) have been examined by Dr. Garbasso, who finds that, unlike the corresponding colours in Lepidoptera, these are entirely due to interference, and are of the nature of colours of thin plates. With transmitted and reflected light the colours seen are complementary; moreover, the colours can be altered by subjecting the scale to pressure; again, on moistening and subsequently drying the scale, changes of colour are observed not unlike those produced in M. Lippmann's colour-photographs when the gelatine film has been moistened and allowed to dry. All these phenomena accord with the view that the scales consist of two layers separated by a thin interspace. Dr. Garbasso's paper is published in the *Memorie della R. Accademia delle Scienze di Torino.*

PROF. F. PLATEAU, of the University of Ghent, has for many years carried on a series of observations on the mode in which insects are attracted to flowers, the results of which are published in the *Bulletin* of the Royal Academy of Sciences of Belgium. His conclusions are not in accord with that of Darwin, that the bright colour of the corolla acts as a beacon to attract insects. He believes that they are attracted chiefly by some other sense than that of sight, probably that of smell. In the case of the dahlia (single) and other species of Compositæ, the removal of the conspicuous ray-florets had but little effect on the visits of insects; nor had the removal of the conspicuous part of the corolla in other flowers, as long as the nectary remained. On the other hand, the artificial placing of honey on otherwise scentless flowers resulted in their being immediately visited by numbers of insects. Where the same species varies in the colour of the flower, as between blue and white, or red and white, insects visit quite indifferently flowers of different colours belonging to the same species.

AN interesting paper by Prof. F. Omori, on the intensity and amplitude of the motion in the great Japanese earthquake of 1891, appears in the latest *Bollettino* (vol. ii. N. 6) of the Italian Seismological Society. At Osaka, distant 140 km. from the place where the shock was most severe, the maximum horizontal displacement (or double amplitude) was 30 mm., and the maximum acceleration, which measures the intensity, 600 mm. per sec. per. sec. At Tōkiō, distant 270 km., the displacement was about 45 mm., and the maximum acceleration 230 mm. per sec. per sec. These values were obtained from seismographic records. Nearer the epicentre, the maximum acceleration can only be determined by observations on the overturning or fracturing of various bodies. At two places in the province of Owari, it exceeded 4300 mm. per sec. per sec.; while at Nagoya, in the same province, it was found to be 2600 mm. per second, and the greatest displacement 220 mm.

IN the January number of *Natur und Offenbarung* (Münster), Dr. J. W. van Bebber gives an interesting account of the methods employed and the success attained in the telegraphic weather service of the Deutsche Seewarte at Hamburg, and traces the history of this branch of meteorological science since the invention of the optical telegraph in 1793. The question of the actual results attained is not so easy to decide as might at first sight appear, owing to the various methods employed in checking them, and the different purposes for which the forecasts are used. Seamen are mostly concerned with the direction and force of wind, while agriculturists are chiefly interested with temperature, and fine or wet weather. In the present state of the science, the former conditions are much easier to predict than the latter. So far as storm warnings are concerned, the author has investigated the cases in which shipping casualties have occurred on the German coasts for a considerable number of years, and finds that in nearly all cases successful warnings were issued. The methods employed are nearly similar to those followed in this country; telegrams are received at various hours showing, according to the international code, the actual conditions, and the changes since the previous reports. In the morning five weather charts are simultaneously prepared, showing respectively the barometric pressure, wind direction and force, state of the sky, temperature, and rainfall, &c. In the afternoon two charts are drawn, showing the air-pressure, temperature, and the variations since the morning, and during the unsettled season (September to April) further charts are constructed, showing the conditions in the evening.

THE current number of the *Revue de l'Université de Bruxelles* contains an interesting memoir by Dr. Funck, entitled "Les vaccinations contre le choléra aux Indes." It will be remembered that the first attempts at anti-cholera vaccination originated with and were carried out by a Spanish medical man, Dr. Ferran, some twelve years ago, and we can but admire the splendid audacity which in those early days led him to practise inoculations with living cholera bacilli. His vaccine consisted of eight drops of a cholera culture mixed with bile, and the misfortunes which followed his inoculations were, probably, largely attributable to his cholera cultures not being pure. That considerable faith was in the first instance placed in Ferran's process, is shown by the fact that some 25,000 persons underwent the treatment. Haffkine's vaccinations against cholera are a direct outcome of the pioneering work published by Ferran on this subject in 1885. In the inoculations which have proved so successful in India, Haffkine employs first, attenuated cholera bacilli, and then, a few days later, virulent cholera cultures; but recently Kolle has obtained equally good results by using dead cholera bacilli, which have been destroyed either by heat or chloroform. In the latter process rather larger doses have to be employed to produce the same effect. The blood of persons vaccinated against cholera has been tested as to its protective potency, and it has been found to be two hundred times more active against cholera infection than that of a non-vaccinated individual. That improved sanitation and enlightened hygienic measures are capable of combating cholera to a most important extent, is shown by the fact that, since the year 1892, whilst in Russia 800,000 individuals have fallen victims to cholera; in Germany, including the Hamburg cholera epidemic, only 9000 cholera deaths have been recorded.

A DESCRIPTIVE list of all published observations of the Aurora Australis is given by Dr. Wilhelm Boller in Gerland's "Beiträge zur Geophysik" (vol. iii.). From this catalogue it appears that the greatest number of observations were made in March and October, and the least in June and November. As with the Aurora Borealis, the frequency of the phenomena seems to vary in consonance with the eleven-year period of solar activity. The line which embraces all the observations is a circle around the south magnetic pole, this result being similar to that obtained by Nordenskiöld from the observations of the Aurora Borealis. Dr. Boller intends to amplify and continue his catalogue, and for that purpose he will be glad to know of any records overlooked by him, or of any observations which may be made in the future. Letters will find him at the Geographical Seminary of the University of Strasburg.

EVIDENCE of the former extension of glacial action on the west coast of Greenland, and in Labrador and Baffin Land, is given by Mr. George H. Barton in the *American Geologist* (December 1896), an excerpt from which has just been sent to us. Mr. Barton went to northern Greenland with the sixth Peary expedition in the summer of last year, and he proposes to continue his observations during the coming summer, when Lieut. Peary will take another expedition to Greenland for the purpose of obtaining the large meteorite which could not be shipped last year. The coast of Greenland offers exceptional facilities for the study of glacial phenomena. It is hoped, therefore, that, as Cornell University and the Massachusetts Institute of Technology sent parties with the Peary expedition last year, other universities, colleges, and scientific organisations will send parties to accompany the forthcoming expedition.

AN interesting contribution to the question "How do igneous rocks intrude?" has been made by Prof. I. C. Russell, in two papers to the *Journal of Geology*, and one to the *Popular Science Monthly* (December 1896). Besides bringing together a number of suggestions already made, he introduces some new ideas based on his study of the Black Hills of Dakota. In that region a number of structures are found (of which striking photographs are given), resembling the famous laccolites of the Henry Mountains, but, in part, differing from them in the absence of any lateral extension. These Prof. Russell calls *plutonic plugs*. A study of these leads him to the suggestion that the whole of the Black Hills uplift, and other mountain uplifts in which direct elevation and stretching take the place of compression and crumpling, may be due to enormous laccolite-like intrusions of molten rock at a great depth. Such an intrusion he terms a *subtuberant mountain*, and suggests that crystalline areas, commonly said to show "regional metamorphism," may be such subtuberant mountains laid bare.

OUR congratulations to the Leicester Literary and Philosophical Society. Stimulated into action by a paper on the disappearances of certain species of insects, by Mr. Frank Bouskell, a Committee was formed to formulate regulations for the protection of local species. As a result of their deliberations, a list of insects has been drawn up, and the number of each allowed to be taken by members of the Society in one season has been specified. When a collector now sees *Leucophasia sinapsis* (the Wood White butterfly), he must hold his hand and crush his sporting instinct, for none of this insect are to be taken. Of *Macroglossa fuciformis* only one specimen must be taken by each member in a single season, and only one specimen of *Sesia apiformis*. The penalty for breaking these regulations are drastic. If a member of the Society, the transgressor is liable to be expelled by a bare majority of the members present at any meeting, and if a member of any other Society, the transgression will be reported to that Society. Landowners will also be asked to refuse to permit offenders to pass through their grounds. The over-zealous collector will, indeed, be ostracised, and will find that no one will buy from him, exchange with him, or have anything to do with him entomologically. There may be a difficulty in carrying out the regulations, and one result will probably be that collectors will prefer to go out alone in the future. But it is hoped that entomologists will remember that they are not supposed merely to fulfil the functions of a fly-paper, but also to work for the advancement of their science.

LECTURERS upon geography will be glad to know that lantern slides of the illustrations in Dr. Nansen's "Farthest North" are now published by Messrs. Newton and Co., who made the slides which Dr. Nansen uses at his own lectures.

AN elaborate descriptive catalogue of chemical apparatus, containing more than five hundred pages, has been issued by Messrs. A. Gallenkamp and Co. The list contains quotations for apparatus and accessories used in every branch of chemistry, and the prices are given both for Germany and the United Kingdom.

The *Rendiconti del R. Istituto Lombardo* (xxx. iii.) contains papers, by G. Melzi, "On Certain Rocks from the Island of Ceylon," and an account, by Prof. C. Somigliana, of some determinations of the specific heat of sea and lake water, undertaken by the late Prof. Adolfo Bartoli, of Pavia, shortly before his death, and forming his last contributions to science.

THE March number of the *Geographical Journal* contains a fine portrait of Dr. Nansen, reproduced by the Swan Electric Engraving Company, and an illustration of the special medal presented to him by the Royal Geographical Society. The address delivered in the Albert Hall, on February 8, is not printed in the *Journal*, because Dr. Nansen is delivering it in different parts of the United Kingdom during the present month.

Two parts recently issued complete the ninth volume of that useful publication, *The Essex Naturalist.* A more than local interest attaches to the reports on the borings for coal at Stutton and Weeley, on the latter of which more details are promised in the next number. Both borings have been unsuccessful in their primary object, high-dipping unfossiliferous rocks, of at least Lower Carboniferous age, coming immediately under the Gault in both cases. Among the numerous papers and notes on Essex matters, we note a contour-shaded map of South Essex, prepared by Mr. T. V. Holmes, which may be regarded as an example of how accurate small-scale maps can be produced: it is reduced by photography from a shaded six-inch map.

THE well-known work on "Metals; their properties and treatment," published in Messrs. Longmans' series of Text-Books of Science, has been considerably enlarged by Prof. A. K. Huntington and Mr. W. G. McMillan. The work originally appeared in 1872, and occupied 312 pages; but, in order to include the great developments which have taken place in the practice of metallurgy in recent years, it has had to be extended to 562 pages, and even now Prof. Huntington regrets that he has not been able to deal with each branch of the subject fully enough to satisfy himself. Notwithstanding this statute of limitations, the new edition of "Metals" has been brought up to date so satisfactorily that it will certainly meet with a hearty reception. The object of the book is to "make clear the principles which have guided the evolution of the metallurgical arts and industries, avoiding multiplicity of detail, which tends to obscure main issues." The present edition of the book shows that this object has been borne in mind throughout, the result being a readable and instructive volume.

THE report drawn up by Prof. W. A. Herdman and Mr. Andrew Scott, on the investigations carried on, in 1896, in connection with the Lancashire Sea-Fisheries Laboratory at University College, Liverpool, contains many noteworthy matters. Particular attention is given to the description of work on oysters and their possible connection with disease in man. Prof. Herdman urges moderation on the part of those sanitary reformers who expect the conditions in which oysters are kept to be perfect. "After all," he says, "we do not want—even if we could get it—an aseptic oyster. The rest of our food—our milk, our bread and cheese, our ham sandwiches, and so on—are teeming with germs, most of them harmless so far as we know; but some of them may be just as bad as any that can be in shellfish. If we were to insist on breathing filtered air, and eating nothing but sterile food, washed down with antiseptic drinks, we should probably die of starvation, or something worse, if we did not go mad first with the constant anxiety." It is held that the object should be to get our oyster-beds as healthy as possible, but not to insist upon conditions which will make it impossible to rear any oysters at all. As the result of work carried out with Prof. Boyce, Prof. Herdman recommends that all grounds upon which shellfish are grown or bedded should be inspected, so as to ensure their practical freedom from sewage, and also that oysters should be kept alive for a short time in running water; for experiments show that the living animal soon gets rid of any disease germs with which it may be infected, if it is kept in clean water. A catalogue of the Fisheries Collection in the Zoological Department of the University College, Liverpool, is appended to Prof. Herdman's report.

TWO papers, extracted from the thirteenth annual report of the ureau of Ethnology, have come to us from Mr. Cosmos Mindeleff. One is on the "Casa Grande Ruin," situated near Gila River, in Southern Arizona, and the best-known specimen of aboriginal architecture in the United States. The accurate plans and careful descriptions contained in this paper should be very valuable to students of American antiquities. It is concluded that the Casa Grande was undoubtedly built and occupied by a branch of the Pueblo race, or by an allied people. These people were probably the ancestors of the present Pima Indians, now found in the vicinity, and known to be a pueblo-building tribe. The subject of Mr. Cosmos Mindeleff's second memoir is "Aboriginal Remains in Verde Valley, Arizona." It is concluded that these ruins represent a comparatively late period in the history of the Pueblo tribes. There is no essential difference, other than those due to immediate environment, between the architecture of the lower Verde region and that of the more primitive types—Tusayan, for example—found in other regions. The Verde architecture is, however, of a more purely aboriginal type than that of any modern pueblo, and the absence of introduced or foreign ideas is its chief characteristic. The remains suggest that cavate lodges and cliff-dwellings are simple varieties of the same phase of life, and that life was an agricultural one. Mr. Mindeleff's paper is a very valuable contribution to the knowledge concerning the interesting archæological remains of the Rio Verde valley, and their position among types of house structure.

THE fourth Annual Report of the Shanghai Meteorological Society contains an interesting essay on the variations of the atmospheric pressure over Siberia and Eastern Asia during the months of January and February 1890, by the Rev. S. Chevalier, S.J., Director of the Zi-ka-wei Observatory, and President of the Society. The investigation was undertaken to elucidate some of the more doubtful points relating to winter storms in the Eastern seas, and for this purpose synoptic charts have been drawn twice daily for the period in question, showing the distribution of barometric pressure over Siberia and Eastern Asia, based chiefly upon the reports issued by the Russian, Chinese and Japanese services. The conclusions arrived at show that while some of the cyclonic storms may make a tour of the globe, most of them experience great difficulty in crossing Western Siberia, and are generally deflected towards the North Pole by the high pressure prevailing over Central Siberia. The depressions over Siberia, though far distant from the coasts of China, affect, at least indirectly, the weather of those parts; and the author finds that the winter storms of China are very generally preceded by the passage of extra-tropical cyclones. The violence of the gales not only depends upon the depth of the disturbance, but also upon the character of the high-pressure areas in the rear of the depression.

THE additions to the Zoological Society's Gardens during the past week include a Yellow-bellied Liothrix (*Liothrix luteus*) from India, presented by Madame Caté; a Viperine Snake (*Tropidonotus viperinus*), Europe, presented by Mr. J. H. M. Furse; eleven Scorpion Mud Terrapins (*Cinosternon scorpoides*) from North Brazil, presented by Dr. Émil A. Goeldi; a Yellow-cheeked Amazon (*Chrysotis autumnalis*) from Honduras, presented by Mrs. Annie Kattengell; two Chipping Squirrels (*Tamias striatus*) from North America, deposited; a Common Otter (*Lutra vulgaris*) from Berkshire, a Salle's Amazon (*Chrysotis ventralis*) from St. Domingo, purchased; two Egyptian Jerboas (*Dipus ægyptius*), nine Egyptian Cobras (*Naia haje*), two Cerastes Vipers (*Cerastes cornutus*), twelve Egyptian Eryx (*Eryx jaculus*), a Clifford's Snake (*Zamenis diadema*), two Hissing Sand Snakes (*Psammophis sibilans*), two —— Snakes (*Zamensis florulentus*) from Egypt, received in exchange.

OUR ASTRONOMICAL COLUMN.

DRAWINGS OF MERCURY.—Mr. Percival Lowell, writing (*Astr. Nach.*, No. 3407) of the planet Mercury, says that the markings of the planet are distinct and dark. They are generally of the nature of lines. Both poles, he says, are shaded, and there is a conspicuous dark band cutting off the southern one from the rest of the planet. This band is stated to be continuous for several degrees of longitude, and may possibly girdle the zone completely. The period of rotation of the planet was found to be synchronous with the orbital revolution, thus endorsing Schiaparelli's previously determined period of eighty-eight days. Even from the drawings, several of which are reproduced, a slow period of rotation seems the more probable, while observations made since they were completed confirm this still more.

PROMINENCE PHOTOGRAPHY.—During the last twelve months many attempts have been made to obtain impressions on a photographic plate, showing various solar phenomena, and all of them have had for their basis the well-known action of electrical radiation on a sensitive film. The method consists in wrapping a plate in some opaque material, velvet, tinfoil, paper, &c., and then exposing it to the sun, using either the general diffused light, or the image formed by an object-glass or in a pin-hole camera. In several cases results have been obtained more or less consistent, but in general the impressions have been dissimilar at each trial, thus suggesting accidental causes for the effect. In the *Photogram* for July 1896, Mr. D. Packer gave several photographs of impressions he had obtained on plates exposed in this way, which were supposed to show the details of the solar corona. Results exactly similar to those given have been obtained by the writer, but in every case the effect could be traced to imperfections in the wrapping of the plate, and the consequent spreading of the light thus admitted direct to the film.

Now in the current *Comptes rendus* (p. 459), M. P. de Heen describes the appearance he gets on exposing a covered plate at the focus of a small object-glass. He finds that a ring is produced on the plate, corresponding to the solar atmosphere in size, and thinks that the chromosphere is the seat of electric radiations, while the photosphere is simply the source of luminous radiation, thus suggesting that, if true, this may furnish a method of examining the spots and prominences.

OXYGEN IN THE SUN.—Some time ago (NATURE, vol. lv. p. 303) we pointed out in this column that Herren Runge and Paschen had reason to believe that the three lines of oxygen—7772·26, 7774·30, and 7775·97—in the solar spectrum were probably not atmospheric, and we further mentioned that a crucial test could be made by examining the solar spectrum for motion in the line of sight. Mr. Lewis Jewell has taken up this problem, and contributes the result of his inquiry to the *Astrophysical Journal* (February 1897, p. 99). He found that using a grating, 15,000 lines to the inch, the spectrum was so exceedingly weak to the eye when the slit of the spectroscope was placed near the edge of the sun's disc, that no satisfactory observations of the three lines mentioned above could be made.

Mr. Jewell then turned his attention to investigating whether a high or low sun caused any appreciable difference in intensity of these lines. In this he was more fortunate, and is now able to state that his observations "prove conclusively that the three lines supposed to be due to oxygen in the sun are produced by water vapour in the earth's atmosphere."

THE TOTAL SOLAR ECLIPSE OF AUGUST 8, 1896.—In the January number of the *Bulletin* of the St. Petersburg Imperial Academy of Sciences (5th series, vol. vi. No. 1) appear three accounts of the observations made at Novaya Zemlya. The first is the report of Prof. O. Backlund, whose station was situated at Malya Karmakouly, and whose programme consisted in observing the contacts and sketching the corona. The weather seemed to have been all that could be desired, and all four contacts were obtained The second report is made by M. S. Kostinsky and A. Hansky, who observed from the same station. This is accompanied by some excellent reproductions taken direct from the enlarged negatives, showing an amount of detail in the streamers that is seldom obtained. One photograph was taken about third contact, and shows that interesting phenomenon known as "Baily's beads," which interferes so much with the estimation of the exact observed time of contact. There is also a plate showing the corona and a large region of the sky around it: conspicuous on this are Jupiter and several stars. An excellent drawing of the details, as gathered from a minute examination of all the photographs taken, is further added. Lieut. Bouchteeff, who was carrying on some hydrographic operations at Novaya Zemlya, observed the eclipse from the Bay of Belougia Gouba. He noted the times of all four contacts, and made a rough sketch of the corona, which are all given in his report published in this *Bulletin*.

THE CHEMISTRY OF THE STARS.—The rapid strides that have been made in the development of spectrum analysis since the time of Wollaston, and the important step taken by Prof. Pickering in the adoption of the prismatic-camera form of instrument, have led many to investigate the spectra of the stars in our universe. Such a survey, although slow to accomplish, is of great importance, since we are able to pass at a bound from terrestrial temperatures, and observe the behaviour of our elements at temperatures far beyond our ken. The chemist is thus left far behind, and is restricted to a very limited range of temperature, while the astronomer has at his disposal temperatures the magnitude of which cannot be even conceived. That the celestial bodies about us vary enormously in their degrees of temperature is now admitted by every one, and some idea of the different kinds of spectra emitted by these bodies may be gathered from Mr. Fowler's interesting article in *Knowledge* (March), which deals in the main with the important work that is being carried on at Kensington under the direction of Mr. Norman Lockyer. That the stars are now being successfully classified in a closed curve—*i.e.* some are increasing and some decreasing their temperatures—is only one of many important advances of the last few years. The recent discovery of the new form of hydrogen, by Prof. Pickering, is another rundle in the ladder of temperature, which seems to indicate that even in those stars within our sphere of the cosmos we may not have examples of the *highest* attainable temperature.

ON ELECTRIC EQUILIBRIUM BETWEEN URANIUM AND AN INSULATED METAL IN ITS NEIGHBOURHOOD.[1]

THE wonderful fact that uranium held in the neighbourhood of an electrified body diselectrifies it, was first discovered by H. Becquerel. Through the kindness of M. Moissan we have had a disc of this metal, about five centimetres in diameter and a half-centimetre in thickness, placed at our disposal.

We made a few preliminary observations on its diselectrifying property. We observed first the rate of discharge when a body was charged to different potentials. We found that the quantity lost per half-minute was very far from increasing in simple proportion to the voltage, from 5 volts up to 2100 volts; the electrified body being at a distance of about 2 cms. from the uranium discs. [*Added March* 9.—We have to-day seen Prof. Becquerel's paper in *Comptes rendus* for March 1. It gives us great pleasure to find that the results we have obtained on discharge by uranium at different voltages have been obtained in another way by the discoverer of the effect. A very interesting account will be found in the paper above cited, which was read to the French Academy of Sciences on the same evening, curiously enough, as ours was read before the Royal Society of Edinburgh.]

These first experiments were made with no screen placed between the uranium and the charged body. We afterwards found that there was also a discharging effect, though much slower, when the uranium was wrapped in tinfoil. The effect was still observable when an aluminium screen was placed between the uranium, wrapped in tinfoil, and the charged body.

To make experiments on the electric equilibrium between uranium and a metal in its neighbourhood, we connected an insulated horizontal metal disc to the insulated pair of quadrants of an electrometer. We placed the uranium opposite this disc, and connected it and the other pair of quadrants of the electrometer to sheaths. The surface of the uranium was parallel to that of the insulated metal disc, and at a distance of about 1 cm. from it. It was so arranged as to allow of its easy removal.

With a polished aluminium disc as the insulated metal, and with a similar piece of aluminium placed opposite it, in place of the uranium, no deviation from the metallic zero was found when the pairs of quadrants were insulated from one another. With

[1] By Lord Kelvin, Dr. J. Carruthers Beattie, Dr. M. Smoluchowski de Smolan. Read before the Royal Society of Edinburgh, March 1.

the uranium opposite the insulated polished aluminium, a deviation of -84 sc. divs. from the metallic zero was found in about half a minute. After that the electrometer reading remained steady at this point, which we may call the uranium rays-zero for the two metals separated by air which was traversed by uranium rays. If, instead of having the uranium opposite to the aluminium, with only air between them, the uranium was wrapped in a piece taken from the same aluminium sheet, and then placed opposite to the insulated polished aluminium disc, no deviation was produced. Thus in this case the rays-zero agreed with the metallic zero.

With polished copper as the insulated metal, and the uranium separated only by air from this copper, there was a deviation of about $+10$ sc. divs. With the uranium wrapped in thin sheet aluminium and placed in position opposite the insulated copper disc, a deviation from the metallic zero of $+43$ sc. divs. was produced in two minutes, and at the end of that time a steady state had not been reached.

With oxidised copper as the insulated metal, opposed to the uranium with only air between them, a deviation from the metallic zero of about $+25$ sc. divs. was produced.

When the uranium, instead of being placed at a distance of one centimetre from the insulated metal disc, was placed at a distance of two or three millimetres, the deviation from the metallic zero was the same.

These experiments show that two polished metallic surfaces connected to the sheath and the insulated electrode of an electrometer, when the air between them is influenced by the uranium rays, give a deflection from the metallic zero, the same in direction, and of about the same amount, as when the two metals are connected by a drop of water.

THE EXTRACTION OF GOLD BY CHEMICAL METHODS.

EXCLUDING mechanical, smelting, and amalgamation processes, the methods of extracting gold from its ores may conveniently be grouped together under the heading of wet or chemical methods. In these, the gold is dissolved by some suitable solvent, and is then separated from the unaltered ore by washing, and recovered by precipitation. The processes owe their origin to the rapid advance in the science of chemistry which has been made during the present century, and, although they are now of vast importance, and give results which would astonish our grandfathers, it is, perhaps, somewhat surprising that chemistry has not done more for the gold-mining industry. At the present day, the wet methods produce little more than a tenth of the total output of gold, while mechanical improvements in the old processes, made during the last half-century, are probably answerable for four or five times as much.

Gold exists in nature practically only in one form, the metallic state, and the differences in treatment of the ores are necessitated by the variations in the physical condition of the metal, and by changes in the other constituents of the rock. Where the particles of gold are large enough to be seen by unassisted vision, they can usually be collected by means of mercury, and, on the other hand, are not dissolved in a reasonable time by any of the solvents of gold yet applied in practice. In these cases, therefore, chemical methods are not advantageous. Nevertheless, it usually happens that some, if not all, of the gold in an ore is in an extremely fine state of division. It has recently been shown by Edman that a great proportion of the gold in American ores consists of particles less than $\frac{1}{1000}$ inch in diameter, and that some of these are less than $\frac{1}{12000}$ inch. Sometimes, gold in an ore is not visible even under the microscope, though readily detected by chemical means. Metal in such a condition is far more readily dissolved by a mobile liquid than by a viscous one like mercury, which does not wet the grains of sand between which the gold is hidden. Moreover, mercury may be prevented from doing its work by the presence of substances on which it exerts chemical action, such as the sulphides of antimony, or arsenic, or which protect the gold from its action by coating the particles with insoluble films.

From such causes as these, it has long been recognised that the treatment of gold ores by mercury is very imperfect in a great many cases. The method is, speaking generally, unsatisfactory in extracting gold contained in pyrites or other sulphides, and it is in the treatment of these substances that the chlorination process, now nearly fifty years old, has its main value. Chlorine is a somewhat slow solvent for gold, but the time occupied by it in dissolving the fine flakes existing in pyrites is not excessive. Unfortunately, chlorine has a strongly preferential action on sulphides, and, to avoid the enormous waste of the gas which is entailed in the oxidation of a small percentage of these substances, it is necessary to precede chlorination by careful and complete roasting. Even in the rare cases, such as that of the Mount Morgan ore, in which the use of chlorine on completely oxidised ores is found to be desirable, the preliminary roasting is not omitted, as the percolation of liquids through the roasted mass is far easier than through the raw ore.

After roasting, there is little difficulty in the process. Oxides of the metals, except the alkaline earths, are very slowly attacked by chlorine; and when the alkaline earths are present salt is added in the roasting furnace. Here one of the sources of loss in the process is encountered, chloride of gold being formed and volatilised at all temperatures above 200°, when common salt is mixed with the ore. In long-bedded furnaces, however, this loss is reduced to a minimum; chloride of gold is prevented from formation by the presence of large quantities of unoxidised pyrites, and when formed, in the oxidised product in the hottest part of the furnace, it is in great part decomposed and re-absorbed during its passage over the bed of comparatively cool ore, which has just been charged into the furnace.

It was formerly the universal practice to apply the chlorine to the slightly-damped roasted ore in the form of gas, and this method has never been entirely abandoned. Subsequently, after Dr. Mears had discovered that compressed chlorine was more rapid in its action than the same agent under ordinary atmospheric pressure, strong aqueous solutions were used, the ore being agitated with the solvent in revolving barrels. This practice is still adhered to in several works in the United States. Elsewhere, however, it has been completely set aside. For example, at Mount Morgan, in Queensland, the largest chlorination mill in the world, stationary vats have been reverted to, aqueous solutions of chlorine being, however, still used. At this mill about 1,500 tons of ore are treated every week at a cost of about 18*s.* per ton, or little more than one-sixth of the value of the yield in gold.

After the ore has been treated with chlorine for a period varying in different mills from an hour to one or two days, the liquid is filtered off and the gold precipitated by ferrous sulphate, sulphuretted hydrogen, or charcoal. As regards the relative advantages of these methods, it may be noted that charcoal only acts well with boiling solutions, and that sulphuretted hydrogen is now recommended by its advocates even when copper is present in the ore, Rothwell having recently pointed out that in acid solutions there is partial precipitation, all the gold being removed from solution before the copper begins to come down.

The chlorination process, though perhaps unrivalled in the percentage of extraction which can usually be attained, labours under two serious disadvantages. Roasting the ore is often so expensive as to be impracticable, and the silver is, in any case, all lost. Both of these disadvantages are avoided by the use of the cyanide process. This was introduced by MacArthur and the Forrests after prolonged researches, having for their object the discovery of some chemical process which would not require a preliminary roasting of the ore.

The action of cyanide solutions on the precious metals had long been known. Elsner had stated, in 1846, that the presence of air was necessary for the dissolution of gold or silver by potassium cyanide, and, subsequently, it was suggested that the action was represented by the equation

$$4Au + 8KCy + O_2 + 2H_2O = 4KAuCy_2 + 4KHO.$$

This equation has recently been established by Maclaurin (*Jour. Chem. Soc.* vol. lxiii. (1893) p. 724; vol. lxvii. (1895) p. 199), who also showed that the dissolution of gold and silver becomes slower in proportion as free oxygen is more and more carefully excluded from the system. Thus, when a plate of gold was treated with a solution containing 1 per cent. of cyanide of potassium in a stoppered bottle filled with oxygen, the loss of weight was 0·24 gramme in 96 hours; in a shallow vessel exposed to the air, the loss was 0·00835 gramme in 24 hours, and in a flask, freed from air as completely as possible, the loss was only 0·0002 gramme in the same time. In addition, Maclaurin prepared the curves of solubility of gold and silver in cyanide solutions, and showed that the maximum rate of dissolution of both metals is reached at 0·25 per cent. of KCy, and diminishes slowly as the concentration is increased, and rapidly if it is decreased.

These results are in perfect accord with the experience gained in practice on a large scale. Before Maclaurin's papers were published, the favourite stock solution in South Africa had for some time been one containing from 0·25 to 0·30 per cent. of cyanide, although weaker solutions are also used with excellent effect. Moreover, the difficulties introduced by a lack of free oxygen in the ore have long been severely felt. In particular, when concentrates containing much pyrites are treated, the absorption of oxygen by the sulphides is so rapid that the dissolution of gold is soon checked and becomes extremely slow. Thus, while gold-leaf floating on cyanide solutions is dissolved in a few minutes, and, if submerged, in a few hours, the films of gold in pyrites, which are probably similar in thickness to gold-leaf, often take two or three weeks in going into solution.

This is so far from satisfactory that many efforts have been made to increase the speed of action of cyanide in some way. An artificial supply of oxygen, or air forced through the charge of ore and solution, was found to shorten the time required but to increase the waste of cyanide, and similar results follow from the use of various oxidising agents, such as manganese dioxide, hydrogen peroxide, and bleaching powder.

Greater interest attaches to the proposal made by Sulman and Teed to add bromide of cyanogen to ordinary cyanide solutions (Trans. of the *Inst. of Mining and Metallurgy*, vol. iii. (1895), p. 202). They put forward the equation

$$CyBr + 3KCy + 2Au = 2KAuCy_2 + KBr$$

as expressing the action which takes place, but no direct proof has yet been afforded of the validity of this equation. These experimenters are, however, convinced that oxygen plays no part in the action, and, consequently, that except for the fact that the edges only of the films of gold in pyrites are presented for attack, solution of the gold in concentrates is as rapid as that in quartzose ores. This view is borne out by a number of trials on half-ton lots of ore, although no results of actual working have yet been published. Even when there is full access of air, however, as in the case of gold-leaf floating on the solution, the addition of cyanogen bromide greatly increases the rate of action of potassium cyanide, and if air and bromine are together passed through a solution of cyanide, the rate is increased about 100 times.

Slowness of action in dissolving gold is of more importance than may at first sight appear, for it must be remembered that alkaline cyanides attack many of the constituents of gold ores at varying rates, and, therefore, that the longer the solution is left in contact with the ore, the greater will be the decomposition of the cyanide, and, consequently, the greater the total cost of the process. Decomposing pyrites (especially if sulphide of copper is present) are, when not in perfect contact with gold, particularly active in destroying cyanide, and, in order to partially prevent their effect, it is customary to neutralise ores which have been rendered acid by the formation of sulphates by "weathering." The neutralisation is effected by the addition of a solution of caustic soda, or, more usually, of lime to the ore before it is treated with cyanide. The destruction of cyanide, however, still goes on to a limited extent in such cases, and treatment is rendered practicable only by the preferential or more rapid action of very dilute solutions of cyanide on gold as compared with their action on the sulphides.

The relative rates of action of cyanogen bromide on gold, and on the various sulphides and oxides met with in ores, remain undetermined, or at any rate unpublished, and until more light is thrown on these, either by laboratory experiments or by practical work on a large scale, it is impossible to judge what may be the future of the process. From some experiments, already made, it would appear that cyanogen bromide suffers considerable decomposition when placed in contact with some of the minerals met with in gold ores, and so it may happen that in many cases the haloid compound will be destroyed before it has time to get fairly to work in dissolving the gold.

The gold is recovered from solution either by its precipitation and replacement in solution by a metal positive to it in cyanide solutions, or by electro-deposition. The only metal largely used in practice is zinc, the action being one of direct replacement, expressed by the equation

$$2KAuCy_2 + Zn = 2Au + K_2ZnCy_4.$$

It has been found necessary to use the zinc in a fine state of division, and the filaments, prepared by turning zinc in a lathe, are certainly more efficient than other forms. The shavings are no more than 0·1 m.m. in thickness, and 0·5 m.m. in width. When packed in spongy form they weigh about six or seven lbs. per cubic foot and can be ignited by a lucifer match, burning readily to zinc oxide. They must be freshly turned, as in practice the cyanide solutions are too dilute to clean dirty surfaces by dissolving hydrates or carbonates of zinc.

The action of the zinc is undoubtedly aided by the presence of lead, which exists as an impurity in commercial zinc to the extent of about 1 per cent., and by the iron gratings on which the filaments rest. Galvanic couples are thus formed, which assist in starting the action. Nevertheless, precipitation of the gold is at first slow, especially in very dilute solutions, and it is only after some gold has been thrown down, and the gold-zinc couple formed, that the action becomes fairly vigorous. When the amount of gold in solution has fallen to about 0·0003 per cent., or from 1½ to 2 dwts. per ton of liquid, the action again becomes slow, and this amount is left unprecipitated in practice, but, as the solutions are used again on fresh charges of ore, no loss of gold occurs.

The black slimy deposit of gold, or alloy of gold and zinc thus formed, is washed and sieved off from the undecomposed zinc as far as possible, and is dried, roasted, and melted down with borax, carbonate of soda, and other fluxes, with or without a previous treatment with dilute sulphuric acid. The bullion thus obtained is very base, containing about 700 of gold per 1000, and variable quantities of zinc, lead, copper, and other metals. It is subject to the disadvantage that assay pieces, taken in the ordinary way, frequently differ in composition from the ingot taken as a whole.

The recovery of the gold from cyanide solutions by electro-deposition is the basis of the Siemens-Halske process. In this process the kathodes are of iron, and the anodes of lead foil. A very large surface is given to the electrodes, 12,000 square feet of surface of lead being exposed in the treatment of 70 tons of solution per day at the Worcester Mine in the Transvaal. At stated intervals, the lead anodes, containing from 2 to 12 per cent. of gold, are removed, melted down, and cupelled. The bullion produced is very fine, but the cost of precipitation appears to be greater than that by the zinc process, the main items being the lead and iron consumed. The current needed is only about 0·06 ampere per square foot, the power required being about 5 h.p. in the treatment of 70 tons of solution per day. The process makes but slow progress, only a small proportion of the gold produced by cyanide on the Rand being obtained in this way.

T. K. ROSE.

AGRICULTURAL TEACHING AT OXFORD.[1]

THE present Professor of Rural Economy at Oxford has made use of the opportunity, afforded by the occurrence of the centenary of the foundation of his professorship, to discuss the general question of agricultural teaching in our Universities. After an interesting description of the life and work of Sibthorp, formerly Professor of Botany at Oxford, who literally gave up his life for the study of natural history on the shores of Greece, Prof. Warington proceeds, in the first place, to consider the important developments, both in the subject and in the means of teaching, which have taken place during the past century. He says:—

"The point on which I want to fix attention is the wholly different position in which agriculture stands at the present day from that which it held a hundred years ago. A hundred years ago agriculture was an art, having few points of contact with natural science. At the present time, both the materials and the operations of agriculture have been so far examined and elucidated by patient scientific investigation, that we may now fearlessly give the title of 'Agricultural Science' to the edifice of true theory which has been constructed. We need not shrink from making this claim because the theoretical edifice is still incomplete, for this incompleteness of theory is the normal condition of the natural sciences; what we assert is, that the whole field of agriculture is now occupied by the

1 "Agricultural Science: its place in a University Education." A lecture delivered before the University of Oxford, on November 5, 1896, on the occasion of the centenary of the foundation by Dr. John Sibthorp of the chair of Rural Economy, by Robert Warington, M.A., F.R.S., Sibthorpian Professor of Rural Economy. (London: Henry Frowde, 1896.)

scientific investigator, and that it is only a question of time when the problems still awaiting solution will cease to puzzle us."

This important change in the character of the subject is made the foundation of a claim for its fuller recognition by the University.

"In considering what should be the place of agriculture in University teaching, it is of primary importance that we should grasp the fact of the existence of this great body of agricultural science which has grown up during the last century. If agriculture is still merely an art, it has no proper place in University teaching, and those who wish to learn it must resort to some technical school for the purpose. If, on the other hand, agriculture is now as much a department of science as geology or medicine, it has an undoubted claim to be recognised, and its claim becomes urgent when we consider the vast importance of the subject."

The most important steps which have been taken in the development of agricultural teaching are then noticed, especial emphasis being laid on the great extension of such teaching during the last ten years, chiefly through the exertions of the County Councils and the Board of Agriculture. Not only have the means of instruction been greatly increased, there has also been a remarkable growth of opinion among the higher class of agriculturists as to the value of a thoroughly scientific training in the department of agriculture. Thus, in February 1893, the Council of the Royal Agricultural Society passed the following resolution:—"That, in the opinion of the Royal Agricultural Society of England, it is desirable that provision be made in all Universities for the granting of a degree in Science for students of agriculture." The same Society gave evidence before the Royal Commission on the proposed Gresham University for London, and urged that a degree for students in Agriculture should be given by the new University.

Prof. Warington next proceeds to mention what is being at present done in the way of agricultural teaching by British Universities and University Colleges. It appears that the Universities of Edinburgh, Glasgow, Aberdeen, Durham, and Wales, all grant the degree of B.Sc. in Agriculture to students who have successfully passed examinations in agriculture and in the sciences connected therewith. The scheme for agricultural instruction at Cambridge did not succeed in passing the Senate; this University now grants a diploma in Agriculture, the examination for which is open to all-comers. About one half of the University Colleges in England give a complete course of agricultural teaching. Besides these, there are the purely agricultural colleges, to which many additions have recently been made by the County Councils.

The question is then asked, Does this great extension of agricultural teaching in recent years meet all our requirements? The answer is that it does not.

"A real effort is being made to instruct and elevate the farmer and the more intelligent of the labouring class, while the landowner, who finds his education at Oxford or Cambridge, is left without the opportunity of fitting himself for his subsequent duties, and consequently cannot be expected to act the part of a wise leader in the march of improvement which has become so necessary. In the Universities of Oxford and Cambridge there are, I suppose, about 5000 undergraduates, of whom a considerable proportion will in after life have the management of land. A proper provision for the teaching of agriculture in these Universities would, I believe, do far more to improve the condition of agriculture in this country than is effected by all the Government grants distributed by the Board of Agriculture."

Prof. Warington considers, in conclusion, what may be usefully done at Oxford in the direction just indicated. The twelve annual lectures required by statute from the Sibthorpian Professor, unconnected as they are with any examination or degree, are productive of little good. He does not ask that the University should institute a degree in Agriculture, or even that they should at present deal with the subject in any large or comprehensive way. The proposal is that Agricultural Science should be placed among the science subjects, of which two may be selected as part of the final examination for a Pass degree. This plan would merely require the provision of additional lectures, so that agricultural science might be taught throughout the whole academic year. If this modest scheme were adopted the agricultural teaching would become effective, being tested by examination, and leading to that goal of all University men—a degree.

We do not wish to express an opinion on the details of a University scheme; but we heartily wish success to Prof. Warington's proposal. The function of a University is the education of the mind, and the propagation of knowledge; and such an important branch of knowledge as agricultural science should certainly find a place in our schemes of University education.

DR. KOCH'S REPORTS ON RINDERPEST.

THREE reports have now been published by Dr. Koch on Rinderpest. The Cape of Good Hope *Agricultural Journal* for January 14, reprints the first two, whilst the third has appeared in the weekly edition of the *Cape Times* of February 10. The first is dated December 9, four days after Dr. Koch arrived at Kimberley, and the second and third, January 3 and 31 respectively. All hail from Kimberley, which city Dr. Koch has made his headquarters for the present. The scientific experiment station, which has been arranged and fitted up for him, is situated about two miles out. Dr. Edington's research station is at Taungs, where it is stated that the inhabitants have lost as many as 20,000 head of cattle from the pest. It will be remembered that Dr. Edington has discovered and cultivated certain micro-organisms which he believes to be the virus of cattle plague, and Dr. Koch is carrying out some experiments with cultures, placed at his disposal by Dr. Edington, to ascertain what, if any, part is played by them in the disease. Elaborate precautions have had to be taken at the Victorian Compound, Dr. Koch's station, to avoid accidental infection of the animals under observation, which would entirely vitiate the inquiry. Dr. Koch provided himself with blood and other materials obtained from plague-stricken animals, and with these he has already carried out a large number of inoculation experiments. In the first instance an efficient method had to be discovered of infecting animals artificially with the disease, for the methods hitherto employed were not attended with the desired success. Koch, instead of using the secretions of infected animals, has employed hypodermic injections of blood taken from rinderpest victims, and this method has proved extremely successful. All efforts so far to find, whether by cultivation, or microscopical examination, a specific micro-organism in the blood have proved fruitless; neither has any specific microbe been discovered among those abundantly present in the mucus from the nose, the secretions, and other mucous membranes. Dr. Koch has no intention of abandoning the search, but at present his efforts are concentrated upon finding a process which may attenuate the virus of rinderpest, so as to transform it into an antidote. The first steps in this direction were made by inoculating animals, such as sheep and goats, less susceptible to the disease than other cattle, with rinderpest blood. The symptoms, consequent upon these inoculations, resembled those of a mitigated attack of rinderpest; the blood of these animals inoculated into other sheep and goats also induced symptoms of mild rinderpest, and the hope was raised that after these inoculations had been continued through further generations, the blood of these animals might induce a modified attack of the disease in cattle. This hope proved, however, illusory, for cattle succumbed rapidly to rinderpest after such inoculations. Dr. Koch has also been endeavouring to produce an attenuated virus by chemical and physical means. Rinderpest blood mixed with glycerine appears to suffer some abatement of its virulence, whilst even better results followed the addition of phenol to the virus. Cows inoculated with rinderpest blood and phenol did not contract the disease; moreover, when subsequently inoculated with virulent blood, they remained healthy. These experiments are being continued. A most noteworthy experiment was, however, the dessication of rinderpest blood at a temperature of 31° C. during a period of four days. A head of cattle inoculated with this blood dissolved in water remained perfectly healthy. Unfortunately, however, although the inoculation produced no effect upon the animal, it also afforded it no protection from subsequent infection with fresh rinderpest blood. Of all the animals which have been infected with rinderpest blood at the experimental station, only four have recovered, and Dr. Koch has used them for ascertaining whether the blood of immune animals, for they did not contract the disease when reinoculated, possesses any protective power. The results were encouraging, for this blood certainly did exert a distinct immunising action; but it remains to be seen how long this immunity lasts in animals thus vaccinated against rinderpest. It has been ascertained that neither birds, such as fowls, doves, pigeons, guinea-fowls, and cranes are susceptible to the pest. An eagle and a secretary-bird were fed for weeks on intestines taken from rinderpest animals, but absolutely no ill-effect followed. Dogs and donkeys are also immune, as are likewise mice, guinea-pigs, and rabbits; to pigs only, so far, does it appear possible to transmit the infection. In conclusion, Dr. Koch's investigations with Dr. Edington's plague microbe have proved that the latter is not the cause of rinderpest.

NOCTURNAL AND DIURNAL CHANGES IN THE COLOURS OF CERTAIN FISHES AND OF THE SQUID (LOLIGO), WITH NOTES ON THEIR SLEEPING HABITS.[1]

WHILE investigating the nocturnal habits and colours of some of our native marine fishes, in 1885 to 1887, at Wood's Holl, Mass., in the laboratory of the U.S. Fish Commission, of which I had charge at that time, I made the unexpected discovery that a number of species had the peculiar habit of assuming, while sleeping, a style of colouration quite unlike that seen in the daytime. Numerous other duties prevented me from making as many observations of this kind as I wished, at that time, nor have I since had opportunities to continue them. Therefore I have decided to publish these incomplete observations, with the hope of inducing other naturalists to continue such studies in some of the various zoological stations that are now established.

Most of my observations were made late at night, between midnight and 2 o'clock a.m., when everybody else had retired. The gas jets near the aquaria were turned down so low as to give barely light enough to distinguish the forms and colours of the fishes. Under these conditions, by using great care not to cause any jar of the floor, nor sudden movements of any kind, I succeeded in observing many species asleep. Most fishes sleep very lightly, and are aroused by almost imperceptible vibrations of the air or water. Some of these fishes took unexpected attitudes while asleep.

In many cases the change of colour from that seen while awake, or in the daytime, consisted in a simple increase in the depth or intensity of the colours, the pattern of colours remaining the same. This was the case with several species of flounders. Those that are spotted or mottled with dark pigment showed their markings much more strongly, or in greater contrast with the ground-colour, than by day. Several species of minnows (*Fundulus*), which are marked either with longitudinal or transverse dark bands, have these markings more decidedly black and better defined than by day. The same is true of the king-fish (*Menticirrus nebulosus*), in which there are obliquely transverse dark stripes that come out more strongly at night than by day.

The black sea-bass (*Serranus furvus*) and the sea-robins (*Prionotus palmipes* and *P. evolans*) presented the same phenomena. Several species of trout (*Salvelinus fontinalis*, &c.) were observed to become much darker at night than in the daytime, but I was not sure that any of those observed were asleep at the time.

It is well known that trout, flounders, and some other fishes are able to change their colours, even in the daytime, according to the colour of their surroundings. Therefore a darkening of the colours at night is to be expected, even if not asleep. But in all the cases mentioned above the nocturnal change of colour is of a protective character.

Other fishes, however, show much more remarkable changes. Among these the scup or porgy (*Stenotomus chrysops*) is one of the best examples. This fish, when active in the daytime, usually has a bright silvery colour with iridescent tints. But at night, when asleep, it has a dull bronzy ground-colour, and the body is crossed by about six transverse black bands. When one of these fishes, with this colouration, was awakenedby suddenly turning up the gas, it immediately assumed the bright silvery colours belonging to its daytime dress. This experiment was repeated many times, on different individuals, with the same result. As this fish naturally rests among eel-grass and sea-weeds, the protective character of its nocturnal colours is obvious.

A common file-fish (*Monacanthus*, sp.) was observed that presents a very decided change in colour pattern. This species, in the daytime, is mottled with brown and dark olive-green, and the fins and tail are a little darker than the body, but when asleep, at night, its body becomes pallid grey or nearly white, while the fins and tail become decidedly black. These colours are decidedly protective at night, or in a feeble light, among rocks and weeds, where it lives. This and other species of file-fishes, when sleeping, would usually rest on the bottom with the back leaning against the glass of the aquarium, or against a stone at a considerable angle.

The common tautog or black fish (*Tautoga onitis*) has the curious habit of resting upon one side, half-buried among gravel, or partly under stones, and is often curved in strange positions. It is easy to imagine that the flounders originated from some symmetrical ancestral form that acquired, like the tautog, the habit of resting upon one side, at first only when sleeping, but afterwards continually, owing to the greater protection that this habit and its imitative colouration afforded. The one-sided colouration and the changes in the position of the eyes, &c., would gradually follow in accordance with well-known laws of evolution.

The common squid (*Loligo Pealei*) was observed sleeping on several occasions. At such times it rests in an inclined position, on the tip of its tail and on the basal parts of the arms, which are bunched together and extended forward, so that the head and anterior part of the body are raised from the bottom, so as to give room for breathing. The siphon tube is then turned to one side. Under these circumstances the colour is darker and the spots more distinct than when it is active, owing to the expansion of the brown and purple chromatophores. A. E. VERRILL.

[1] Abstract of a paper read before the American Morphological Society, December 30, 1896. These observations were also communicated to the Connecticut Academy of Sciences, in 1888, but were not published. (Reprinted from the *American Journal of Science* for February.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Junior Scientific Club met on Wednesday, March 3, Mr. A. W. Brown (Ch. Ch.), President, in the chair. Prof. Ray Lankester exhibited and described a specimen of Cladoslache and a cast of a restoration of the skull of Thylacoleo. Both specimens have recently been added to the museum. Dr. J. S. Haldane read a paper on "The Causes of Absorption of Oxygen by the Lungs," which was followed by a lengthy and animated discussion.

CAMBRIDGE.—Dr. S. H. Vines, F.R.S., has been appointed by the Council of the Senate a Governor of the Oxford High School for boys.

The valuable collection of Pyrenean and Alpine plants, numbering about 4000, made by the late Mr. Charles Packe, of Christ Church, Oxford, has been presented by his widow to the University Herbarium.

MR. WILLIAM LAMPSON, who died recently at Le Roy, near Rochester, in the State of New York, left the bulk of his estate, valued at about one million dollars, to Yale University, from which he graduated in 1862.

THE Norwegian Parliament has unanimously decided to appoint Dr. Nansen to a Chair of Zoology in the University of Christiania. It is understood that the duties of the Chair will not interfere with any further explorations of the Arctic or Antarctic regions which Dr. Nansen may be disposed to undertake.

To city and county authorities seeking a means of commemorating the sixtieth year of the Queen's reign, we commend the example of the Royal Reception Committee at Sheffield. This Committee was entrusted with the duty of preparing for the Queen's visit to that city on May 21, and at the same time of arranging a suitable mode of commemorating the Diamond Jubilee, and they have decided that the endowment of the Sheffield University College is the best object. For this end the sum of 30,000*l*. is still required, and the Committee have resolved to invite subscriptions through the Mayor, the Duke of Norfolk.

THE Technical Education Board of the London County Council invite applications for a scholarship in sanitary science of the value ot £150 a year, tenable in the pathological laboratory of Claybury Asylum. Candidates must be ordinarily resident within the administrative county of London. In making the selection, preference will be given to a candidate who is a qualified and registered practitioner, and has completed his academic course. The scholar must make such arrangements as to residence as will enable him to devote his whole time to the study of the working and effects of preventable, social and industrial causes of insanity.

DR. M. W. NENCKI, director of the chemical department of the Institute for Experimental Medicine, has, states the *British Medical Journal*, recently celebrated the twenty-fifth anniversary of his appointment as Professor of Pathological Chemistry in the University of St. Petersburg. He was presented by his friends and former pupils with a *Festschrift*, which contains, amongst others, papers by Prof. Thomas Arthus, of Freiburg, and Dr. Kostanecky, of Bern. The Council of the University of Kasan, with which Prof. Nencki was connected at the commencement of his professional career, has elected him honorary member, a distinction which is considered a very high compliment in Russia.

THE following are among recent announcements:—Dr. Pompecki to be curator of the State palæontological collection at Munich; Dr. Noll to be professor of botany at Bonn; Prof. E. Wernicke has been invited to the chair of hygiene at Marburg; Dr. Franz Lafar has been invited to the chair of bacteriology and fermentation-physiology in the Technical High School at Vienna; Mr. Charles D. Walcott to be acting assistant secretary in charge of the U.S. National Museum; Mr. Richard Rathbun to be assistant secretary in charge of the office and exchanges of the Smithsonian Institution; Dr. Julius Aparicio to be director of the meteorological and astronomical observatory at San Salvador; Prof. J. Franz to be director of the observatory at Breslau, and professor of astronomy in the University there.

MAY the many instances of large benefactions to research and education in America, recorded by Mr. George Iles in *The Century* for March, act persuasively upon millionaires, and stimulate a desire to emulate the example. Mr. Iles points out that the first large gift for original research in the United States is that of 500,000 dols. received in 1838 as a bequest from James Smithson, an Englishman, who, strange to say, never set his foot in America; in 1891, another Englishman, Thomas Hodgkins, gave the Smithsonian Institution 200,000 dols. more. In bringing the results of research to the service of the public on the lines of an industrial university, the Pratt Institute in Brooklyn is instanced as doing notable work. With its endowment of 3,500,000 dols. it represents a total gift of about 4,000,000 dols. On a plane of yet higher educational activity stands the Johns Hopkins University in Baltimore, to which Johns Hopkins gave 3,500,000 dols. The University of Chicago, opened but five years ago, has already received about 12,000,000 dols. as gifts, more than half of it being from Mr. John D. Rockefeller. In 1895 Mr. Rockefeller offered this University 2,000,000 dols. in addition to his previous gifts, on condition that an equal sum should be given to it by 1900. His offer has already resulted in a gift of 1,025,000 dols. from Miss Helen Culver. Mr. Ezra Cornell gave 670,000 dols. to the University which bears his name, and the Hon. Henry W. Sage 1,171,000 dols. The cash gifts to the University aggregate 2,738,000 dols. Columbia University, New York, asked for 4,000,000 dols. to erect new buildings when removing to a new site. It received 350,000 dols. from Mr. W. C. Schermerhorn for a natural science building; 1,000,000 dols. from President Seth Low for a library; and 400,000 dols. from members of the Havemeyer family for the erection of a memorial hall. Before the new wants of the university had been declared, its medical departments received 1,970,000 dols. from the Vanderbilt family. Mr. Anthony J. Drexel gave more than 3,000,000 dols. for the foundation of the Drexel College of art, science, and industry; Mr. Marshall Field gave 1,000,000 dols. for the foundation of the Field Columbian Museum; Clark University was established by a gift of 1,500,000 dols. from Mr. Jonas G. Clark; and many other instances of generosity are mentioned by Mr. Iles. It is pointed out, however, that American science still awaits its adequate physical and chemical laboratory for pure research. Judging from the generous spirit shown by past gifts, the waiting time should not be long.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 18.—"On the Significance of Bravais' Formulæ for Regression, &c., in the case of Skew Correlation." By G. Udny Yule. Received December 14, 1896.

If two variables, x and y, be normally correlated, the means of arrays of x's associated with successive types of y's lie on a straight line, called the line of regression. In the general case of skew correlation, this straight line becomes a curve. If, however, a straight line be fitted to the curve by the method of least squares, the equation to this straight line is identical with the equation to the "line of regression" of normal correlation. Hence the formulæ given by Bravais still remain significant whatever the form of the correlation. If the regression of x on y be positive, large values of x correspond, on the whole, to large values of y, and *vice versâ*. The expression for the standard deviation of the array in normal correlation is, in the general case, interpretable as the standard deviation of the whole series of observations from the line of regression.

Similar interpretations hold good for the cases of correlation between three, four, or more variables.

"On the Iron Lines present in the Hottest Stars. Preliminary Note." By J. Norman Lockyer, C.B., F.R.S. Received January 25.

In continuation of investigations communicated to the Royal Society in 1879 (*Roy. Soc. Proc.* 1879, vol. xxx. p. 22), and 1881 (*ibid.*, 1881, vol. xxxii. p. 204), on the effect of high-tension electricity on the line spectra of metals, I have recently used a more powerful current and larger jar surface than that I formerly employed.

The former work consisted in noting (1) the lines brightened in passing a spark in a flame charged with metallic vapours, and (2) the lines brightened on passing from the arc to the spark. It was found, in the case of iron, that two lines in the visible spectrum at 4924·1 and 5018·6, on Rowland's scale, were greatly enhanced in brightness, and were very important in solar phenomena.

The recent work carries these results into the photographic region. The result is interesting and important, since seven additional lines have been found to have their brightness enhanced at the highest temperature. These, as well as the two previously observed, are shown in the following table, which also indicates the behaviour of the lines under different conditions, as observed by Kayser and Runge (K. and R.) and myself (L.) in the arc, and by Thalèn (T.) and myself in sparks:—

Lines of Iron which are enhanced in Spark.

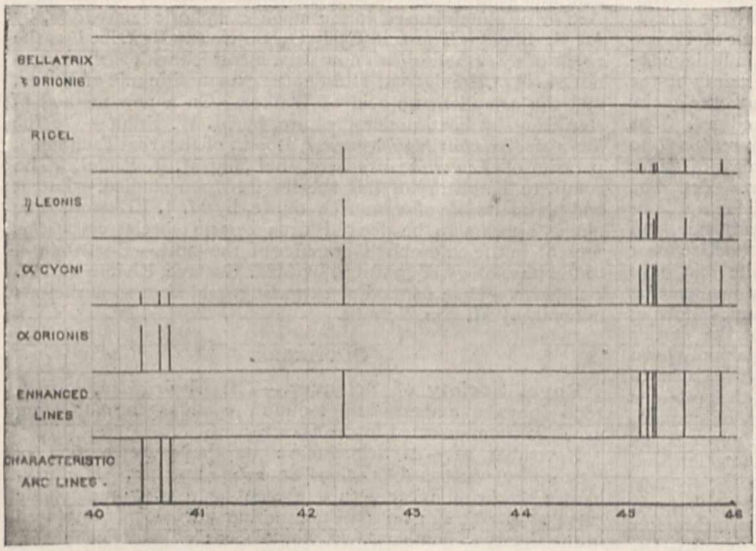
Wave-length.	Intensity in flame.	Intensity in arc (K and R). Max.=10.	Length in arc (L). Max.=10.	Intensity in spark (T). Max.=10.	Intensity in hot spark (L). Max.=10.
4233·3	—	1	—	—	4
4508·5	—	1	—	—	4
4515·5	—	1	—	—	4
4520·4	—	1	—	—	2
4522·8	—	1	3	—	4
4549·6	—	4	5	—	6
4584·0	—	2	4	—	7
4924·1	—	1	3	6	6
5018·6	—	4	—	—	6

Combining this with former results, we seem justified in concluding that, in a space heated to the temperature of the hottest spark, and shielded from a lower temperature, these lines would constitute the spectrum of iron.

Defining the hottest stars as those in which the ultra-violet spectrum is most extended, it is known that absorption is indicated by few lines only. In these stars iron is practically represented by the enhanced lines alone; those which build up, for the most part, the arc spectrum are almost or entirely absent.

The intensities of the enhanced lines in some of the hottest stars are shown in the appended diagram, and for the sake of comparison, the behaviour of a group of three lines which are among the most marked at lower temperatures, is also indicated. In addition, the diagram shows the inversion in intensities of the spark and arc lines in the spectrum of a relatively cool star—such as α-Orionis.

The facts illustrated by the diagram indicate that the enhanced lines may be absent from the spectrum of a star, either on account of too low or too high a temperature. In the case of low temperature, however, iron is represented among the lines in the spectrum, but at the highest temperature all visible indications of its presence seem to have vanished.



This result affords a valuable confirmation of my view, that the arc spectrum of the metallic elements is produced by molecules of different complexities, and it also indicates that the temperature of the hottest stars is sufficient to produce simplifications beyond those which have so far been produced in our laboratories.

CAMBRIDGE.

Philosophical Society, February 8.—Mr. F. Darwin, President, in the chair.—On the kathode rays, by Prof. J. J. Thomson. The experiments described in this paper were of two kinds: the first set were on the electric charges carried along the rays, the second on the deflection produced in these rays when they traversed a uniform magnetic field. In the experiments on the electrical effects produced by the rays, the kathode, a plane disc, was placed in a small side tube fused on to a large bulb; between this tube and the bulb there was a thick earth-connected metal disc with a slit in it; a pencil of kathode rays shot through this slit into the bulb. In the bulb on the side opposite to the slit there was an arrangement similar to that used by Perrin in his experiments on the charges carried by the kathode rays; it consisted of two cylinders, one inside the other; the outer cylinder was connected with the earth, and the inner cylinder (which was insulated from the outer) was connected with one pair of quadrants of an electrometer. Slits were cut in the cylinder so that the kathode rays could pass through the slits into the inside of the inner cylinder. The cylinders were placed at a considerable distance from the direct line of the rays, so that unless the rays were deflected by a magnet they did not enter the cylinder. The charge in the cylinder produced by each make and break of the coil was investigated. A slight charge was found to pass into the cylinder even when it was not in the direct line of the rays, due probably to a diffused charge sent out from the tube through the slit into the bulb at each discharge of the coil; this charge was small; it was generally negative, but at high exhaustions was frequently positive. When the rays were deflected by a magnet so as to pass inside the cylinder, the cylinder received a strong negative charge; the charge was large as long as the phosphorescent patch was stopped by the cylinder, small when by the motion of the magnet the patch was removed to one side or another of the cylinder. This experiment seems conclusively to show that there is a flow of negative electricity along the kathode rays. The following experiments show, however, that there must be something besides a stream of negatively electrified particles along the kathode rays. If the coil is kept running the negative charge in the cylinder does not increase indefinitely, it reaches a certain limit and then remains constant, though the kathode rays keep pouring into the cylinder; and further, if the inner cylinder be charged negatively to begin with, then if this charge exceeds a certain amount, though the insulation is perfect when the rays are not playing upon the cylinder, yet as soon as the rays fall upon it some of the *negative* charge escapes. In the experiments on the magnetic deflection of the rays, the rays were produced in a side tube and sent into a large bell jar through a slit in a metallic plate. The bell jar was placed between two coils arranged as in a Helmholtz galvanometer so as to produce a uniform magnetic field. The rays in their course through the bell passed in front of a glass plate ruled into squares. A large number of photographs of the rays were taken in different gases and at various degrees of exhaustion. The following were some of the results obtained. The magnetic deflection of the kathode rays in air, hydrogen, carbonic acid gas and methyl iodide is the same provided the mean potential difference between the kathode and the anode is the same. Coming through the slit there are certain "rays" which are not deflected by a magnet: these have little if any power of producing phosphorescence. The path of the rays for the first part of their course was very approximately circular.—On electricity in gases and the formation of clouds in charged gases, by J. S. Townsend. In the paper on this subject it is shown that the gases, given off when certain chemical actions are going on, have sometimes a very large electrostatic charge. The oxygen and hydrogen given off when a current is sent through a sulphuric acid electrolyte carry with them a positive charge, and when these gases are prepared in a similar manner from a caustic potash cell they carry with them negative electricity. The gases have the property of retaining their electricity in a very striking manner, the fraction of the charge lost when the gas is bubbled through a liquid being very small. When put into vessels and shaken up with sulphuric acid, a large proportion of the electricity still remains in the gas. If a charged gas be left in a flask it loses its charge slowly, for after the space of two hours it is found that $\frac{1}{6}$th of the original charge remains. These gases have the property of condensing a cloud when they get into a moist atmosphere, which can be completely removed by sulphuric acid. The whole process of bubbling through water and forming a cloud and again bubbling through sulphuric acid and removing it can be gone through without losing more than 21 per cent. of the original charge on the gas. The dry gas when it gets into the air of the room will form a perfectly stable cloud in the unsaturated atmosphere. These clouds are very heavy and are easily weighed, and it was found that the weight of the cloud is proportional to the charge; but the proportionality changes with the sign of the charge, the cloud being much heavier in negative oxygen than in positive oxygen, the quantity of electricity being the same in each case.

DUBLIN.

Royal Dublin Society, January 20.—Dr. J. Joly, F.R.S., in the chair.—The Committee, consisting of Prof. W. J. Sollas, F.R.S., Mr. R. Lloyd Praeger, Dr. A. F. Dixon, and Mr. Alfred Delap, appointed by the Royal Dublin Society to investigate the recent bog-flow in Kerry, presented their report, which was communicated by Prof. W. J. Sollas. The report was illustrated by photographs taken on the spot by Dr. A. F. Dixon.—Mr. T. Preston made two communications: (*a*) The parallelogram of forces and the laws of motion; (*b*) Applications of a fundamental method in kinematics and dynamics.—Prof. Hartley, F.R.S., and Mr. Hugh Ramage exhibited specimens of photographs of spectra which illustrate the use of the spectrograph in the minute and accurate analysis of minerals and metallurgical products.

February 17.—Prof. G. F. Fitzgerald, F.R.S., in the chair.—The following paper was read:—On the geology of Slieve

Gallion, in the County of Londonderry, by Prof. Grenville A. J. Cole. The author arrives at the following conclusions: (1) The series of hornblendic and pyroxenic rocks on Slieve Gallion, hitherto described as of metamorphic origin, include a volcanic series of andesite-tuffs and vesicular and compact andesites, together with their deep-seated representatives. The age of this series is "Dalradian," using that term in its widest sense. (2) The granite, also once held to be of metamorphic origin, is an intrusive mass, which has absorbed some of the basic rocks, and has produced quartz-diorites by a process of intermingling. The period of its intrusion was pre-Carboniferous, and probably Middle Devonian, as stated by the officers of the Geological Survey. (3) The basic series west of Cookstown, including the volcanic tuffs of Beaghbeg, is indistinguishable from that of Slieve Gallion, and is almost certainly of the same geological age. The relations of this series to the gneiss that underlies it, have yet to be satisfactorily worked out. The suggestion of Mr. Nolan, that the gneiss became remelted to provide the granite veins above it and the granite mass of Slieve Gallion, deserves the most careful consideration. (4) The occurrence of aplitic granites and eurites on Slieve Gallion, associated with varieties rich in biotite and in hornblende, and the discovery of intrusive veins of pure soda-orthoclase near Oritor, suggest that even the biotite in the granite may have resulted from the absorption of the basic series by a magma that would have otherwise crystallised as an aplite; and, following on this, it is urged that the underlying magmas of the earth's crust may be of far simpler character than has commonly been supposed. Prof. Sollas's investigations at Barnavave, seem to point to the same conclusion. It is then suggested that plutonic rocks, as we ordinarily know them, are phenomena of contact, produced in what are, comparatively speaking, the upper layers of the earth's crust. (5) By a combination of absorption and concomitant or subsequent differentiation, an invading igneous rock may come to occupy the place of a pre-existing rock, and may, in fact, represent it as a pseudomorph, the absorbed matter being drawn off through the molten mass to lower levels.—Dr. F. T. Trouton exhibited photographs taken by Becquerel's new radiation.

PARIS.

Academy of Sciences, March 1.—M. A. Chatin in the chair.—The election of M. Violle, in the Section of Physics, was confirmed by the President of the Republic.—The Perpetual Secretary announced to the Academy the loss it had sustained by the death of M. Weierstrass, Foreign Associate.—Notice on M. Weierstrass, by M. Hermite.—On the residues of some double integrals of rational functions, by M. Émile Picard.—Researches on the uranic rays, by M. Henri Becquerel. Uranium has the property of discharging electrified bodies in air at a distance, the time of discharge being the same for both positive and negative charges. The potential of the charged body was varied between one volt and three thousand volts. For potentials under fifteen volts, the velocity of discharge by the uranium appears to be proportional to the potential, analogous to the law of cooling; but this law is not followed even approximately for very high potentials. Thus, for values between 1500 and 2000 volts, the velocity of discharge is practically constant.—On the histological mechanism of cicatrisation, and on some new fibres, "synaptic fibres," by M. L. Ranvier. The name, "synaptic fibres" is given to fibres special to a cicatrix. These are always firmly attached to the bundles of conjunctive tissue, whatever their origin may have been, have a very variable diameter, and possess the singular property of retraction. Three organic elements appear to be concerned in the formation of synaptic fibres, fibrin, the endothelial cells, and the lymphatic cells. A new theory of cicatrisation is based on these observations.—Remarks by M. Guyon on his work on the therapeutics of urinary diseases.—Observations on the sun, made at the Observatory of Lyons with the Brunner equatorial, during the fourth quarter of 1896, by M. J. Guillaume. The results are summarised in three tables, of which the first two deal with sun-spots, and the other with the distribution of faculæ.—On the theory of surfaces, by M. A. Pellet.—Discharge by the Röntgen rays, by M. Jean Perrin. The effect produced upon a charged conductor by the Röntgen rays is shown to consist of two effects, one depending upon the nature of the gas alone, the other upon the nature of the metal.—Existence of anode rays, analogous to the kathode rays of Lénard and Crookes, by M. P. de Heen.—Photography of the electric radiations of the sun and of its atmosphere, by M. P. de Heen (see p. 447).—Estimation of atmospheric ozone on Mount Blanc, by M. Maurice de Thierry. The air at the summit of Mount Blanc having, on several occasions, showed presence of ozone by qualitative reactions, an attempt was made to estimate the amount quantitatively. The estimation was carried out at Chamonix and at the Grands-Mulets by means of the oxidising action upon an alkaline arsenite in presence of potassium iodide. The amounts found were from two to four times greater than at Montsouris.—Action of dilute nitric acid upon certain metallic nitrates in presence of ether, by M. Tanret.—The commercial transformation of oleic acid into stearolactone and monoxystearic acid, by M. David.—Action of aluminium chloride upon camphoric anhydride, by M. G. Blanc. The acid $C_9H_{14}O_2$, previously described as the result of this reaction, has now been identified with the isolauronolic acid of Kœnigs and Hœrlin, the campholitic acid of Noyes, and the camphothetic acid of Walker.—On a new method of sterilising by heat, under pressure, by M. W. Kühn.—On the larva of *Thrixion Halidayanum*, Rond., of the tribe Tachininæ, parasite of *Leptynia hispanica*, Bol., by M. J. Pautel. The complete life-history of this species has been studied.—Latent and plasmatic life of certain Uredineæ, by M. J. Eriksson. The fungus appears to be derived from certain special corpuscles present in the chlorophyll granules of the host.—Contribution to the physiology of grafting, by MM. Gustave Rivière and G. Bailhache.—On a method of extracting gold from an auriferous mineral, by M. Ém. Serrant.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten*, Part 4, 1896 (physico-mathematical section), contains the following memoirs communicated to the Society.

November 21.—A. Schoenflies: on the representation of "cubes" of various dimensions upon one another. H. Burkhardt: theory of linear groups of point-aggregates on algebraic curves. H. Weber: on a theorem in integral calculus employed in the theory of numbers. E. von Weber: on linear connexes. W. F. Osgood: on non-uniform convergence and the integration of series term by term. W. Voigt: kinetic considerations relating to the theory of evaporation, &c.

December 5.—P. Stäckel: on Goldbach's empirical theorem that every even number may be presented as the sum of two primes.

December 19.—P. Bachmetjew: results of an inquiry on the dependence of electrical earth-currents on the fluctuations in the level of the ground-water in Bulgaria. O. Wallach: researches made in the Göttingen University Chemical Laboratory; (1) on the absorption of violet rays by certain non-saturated ketones; (2) on new compounds of the fenchon-series; (3) on certain condensation-products of cyclic ketones; (4) synthesis of a partially-hydrated methyl-fluorine. A. Hurwitz: on the quaternionic theory of numbers. Vice-Admiral de Jonquières: two errata in vol. ii. of Gauss's Works.

ST. LOUIS.

Academy of Science, January 4.—Dr. Amand Ravold gave a microscopic demonstration of Widal's test for typhoid fever, demonstrating that after the disease has existed for four days or more the blood of typhoid patients, probably because of some contained antitoxine, possesses the power of inhibiting the motion of typhoid bacilli from a pure culture introduced into it within a period of one hour or less, whereas in normal blood similar bacilli retain their power of locomotion for an indefinite length of time. It was stated that typhoid blood possesses this property, even after having been dried for a period of four weeks or more, so that a few drops obtained from a person suspected of having the disease may be sent to suitable places for applying the test, thus rendering comparatively easy the early diagnosis of a disease which in its early stages presents many clinical difficulties.—Prof. F. E. Nipher gave preliminary results of partially completed experiments, made through the courtesy of the Burlington and Illinois Central Railroads, to determine the frictional effect of trains of cars on the air near them. His apparatus consists of a cup collector supported on a bar capable of sliding in guides on a clamp attached to the window-sill of the car. The bar is thrust out to varying distances up to 30 inches. The mouth of the collector is turned in the direction of motion of the train. The pressure due to the motion is conveyed through a rubber tube attached to the rear of the collector, and passing lengthwise through the bar to a water manometer. The manometer has a tube with a rise of 4 or 5 in 100, and is provided with a pivotal mounting and a level. The pressure near the train is comparatively small, and increases as the collector is thrust further out. It approaches a limit corresponding to the train velocity at the instant. Prof. Nipher finds the relation between the limiting pressure and velocity to agree exactly with the formula

$$P = \frac{\delta}{2}v^2$$

where v is the train velocity in centimetres per second, P is the pressure in dynes to the square centimetre, and δ is the density of air in C.G. units at the temperature and pressure of the observations. He finds the pressure a maximum when the axis of the collector is parallel to the direction of motion with the mouth to the wind. Turning the collector until its axis makes an angle of about 60° with this position, the pressure reduces to zero. At greater angles the pressure becomes less than atmospheric pressure by an amount which reaches a maximum at an angle of 90°, and passes through a minimum at an angle of 180°, when the collector is in a trailing position. The sum of the coefficients for the two positions of maximum compression and minimum exhaust is almost exactly the same as Langley obtained with a pressure board when exposed normally to the wind. The result shows that a large amount of air is dragged along with the train, the motion being communicated to air many feet away. This air is a source of danger to one standing too near the train when at full speed. One is likely to be toppled over, and the blow of the air communicates a motion of rotation which may cause one to roll under the train if the nature of the ground does not prevent such a result. It was remarked, however, that where trains have a right to run at any speed, no prudent person would stand so near to a train as is necessary in order to be in danger from this source.—The following officers were declared elected for the year 1897:—President: M. L. Gray. First Vice-President: E. A. Engler. Second Vice-President: Charles R. Sanger. Recording Secretary: William Trelease. Corresponding Secretary, E. C. Runge. Treasurer: Enno Sander. Librarian: G. Hambach. Curators: Julius Hurter, J. H. Kinealy, E. Evers. Directors: M. H. Post, Joseph Grindon. (Signed) William Trelease, Recording Secretary.

AMSTERDAM.

Royal Academy of Sciences, January 2.—Prof. Stokvis in the chair.—Mr. Jan de Vries on accelerations of plane motion.—Mr. Jan de Vries read a second paper on geometrical proofs of arithmetical theorems.—On behalf of Mr. Gegenbauer, of Vienna, on the resultant of two consecutive denominators of a certain regular continuous fraction.—Prof. J. A. C. Oudemans made a communication concerning the contents of the fifth section of his report on the triangulation of Java. Of all the sides, both the primary and the secondary ones, it contains the azimuths and the distances. According to the author's calculations, the latter ought to be increased by about two-millionths, to be reduced to mètres des Archives, but by about four-millionth, to reduce them to mètres Internationaux. It is true that the "Comité International," trusting to measurements executed by the "Commission mixte," assumes the above-mentioned standards to be equal in length (though this equality has not been controlled by direct comparison), but the measurements carried out by the Netherlands Committee for the mètre led to the result that the mètre International is shorter than the mètre des Archives by more than 2 μ. At the close of the work the wish is uttered "that the Comité mixte may as yet decide to execute a series of direct comparisons at 0° C. and at high temperatures, between the mètre International and the mètre des Archives.—Prof. Lorentz, on behalf of (*a*) Mr. A. Smits: Measurements with the micromanometer. This instrument, with which differences of pressure as small as 1/4000 mm. of mercury can be observed, consists of a U-shaped tube, the upper parts of whose legs are widened. It contains two fluids, viz. aniline in the lower and narrower part, and upon it, on either side, a quantity of water, whose surface is in the wider part of the tube; the position of the plane separating the two fluids is read with a kathetometer. The object of the research (conducted in the Utrecht Physical Laboratory) was to determine the difference between the vapour pressure at 0° C. of pure water and that of very dilute solutions. For this purpose it was necessary to exhaust the manometer with a mercurial air-pump, some oil being poured on the water on both sides, and to arrange suitable connections either between the two legs or between them and bulbs containing water and a solution. For all these connections mercury joints were employed. Bulbs containing P_2O_5 and H_2SO_4 served for drying, the latter substance at the same time for the absorption of aniline vapour. The measurements were made with solutions of NaCl, KOH, and cane-sugar, the number of gramme molecules in 1000 gr. of water varying in the first case from 1·83 to 0·020, in the second case from 2·64 to 0·013, and in the last case from 1·88 to 0·021. The coefficient i in Van 't Hoff's well-known formula was found to be constant, by 1 for the sugar solutions, but the two other substances yielded values diminishing with decreasing concentration. The extreme numbers were 1·77 and 1·40 for NaCl and 2·17 and 1·5 for KOH. (*b*) Prof. V. A. Julius (Utrecht) on the question: Is the maximum vapour pressure solely a function of temperature? After having discovered the causes of the irregularities presented by the micromanometer in the first stage of Mr. Smit's experiments (a trace of aniline vapour sufficed to prevent the regular condensation of the vapour of water), the author could put to a very severe test the opinion expressed by Wüllner and Grotrian (*Wied. Ann.*, vol. xi. p. 545), according to which a vapour can be compressed above what is commonly called its maximum tension, even though a certain quantity of the liquid be present. Experiments with water and a solution of NaCl at 0° C. did not confirm this view. A space containing a sufficient amount of the liquid and filled for the remainder with saturated vapour, could be diminished by $\frac{1}{4}$ of its original volume. In this way a temporary elevation of pressure was produced, but in a short time the original pressure was re-established by condensation. A change of pressure as small as 1/18000 of its value could have been detected.—Prof. Van der Waals presented for publication in the Academy's *Proceedings*: (1) On behalf of Prof. Kamerlingh Onnes a paper, by Mr. L. H. Siertsema, on an investigation carried out in the Leyden Physical Laboratory, concerning the influence of pressure upon the natural rotation of the plane of polarisation in solutions of cane-sugar. (2) On behalf of Prof. C. A. Lobry de Bruyn and Mr. W. Alberda van Ekenstein, a communication to the effect that the chitosamine from chitin (hitherto wrongly called glucosamine) can be obtained in the free and the crystallised state from the hydrochloric salt and methylalcoholic sodium. It easily changes into another crystalline body, which can be prepared direct from fructose (levulose) and methylalcoholic ammonia. Consequently there is a relation between the last-mentioned sugar and that from which chitosamine is obtained. With silver carbonate HCl chitosamine yields through oxidation a substance, which with phenyl-hydrazine directly gives abundant glucosazon at about 70°, and so it may be glucoson (which is a keton-aldehyde). (3) On behalf of Mr. D. F. Tollenaar, a paper on some experiments with two kathodes, square aluminium plates, the distance of which could be varied. The phosphorescence figures on the wall of the globular screen consisted of a zone of very intense green, bordered on either side by two rings. By changing the intensity of the current towards one of the kathodes, the motion of one of the rings was found to obey the rules of deflexion figures given by Goldstein, but the other ring behaved quite differently. When a triangular or square plate was used, and a metal globe as screen, remarkable shadows were obtained, viz. a triangle and a square respectively, which looked as if turned through angles of 60° and 45° with respect to the kathode. (4) On behalf of Mr. S. Krüger, S.J., a paper on the ellipsoidal forms of equilibrium of a revolving homogeneous liquid body. Prof. G. H. Darwin (*Proc.* Roy. Soc., xli.) does not sufficiently account for the method of disregarding errors, which he proposed in the case of very elongate ellipsoids. The kinetic energy of the revolving motion in the case of Jacobi's ellipsoid does not become a maximum "when the length of the ellipsoid is about five times its diameter" (*l.c.*, p. 334), but when the ratio of the longest to the shortest axis is about $9\frac{1}{2}$. When the halves of the axes of Jacobi's ellipsoid are represented by a, b, and c, and this series of forms of equilibrium is continuous, so that $a^2 - b^2/a^2 - c^2$ increases from 0 to 1, then an infinitely great number of bifurcation forms (Poincaré, *Acta mathem.*, vii.) are met with, but *not any one of these figures is found as long as* $a^2 - b^2/a^2 - c^2 \leqq \frac{2}{3}$. The limit form of the ellipsoids of revolution is at the same time a bifurcation form, with a series of non-ellipsoidal forms of equilibrium.

DIARY OF SOCIETIES.

THURSDAY, MARCH 11.

ROYAL SOCIETY, at 4.30.—The Comparative Physiology of the Suprarenal Capsules: Swale Vincent.—The Origin and Destination of certain Afferent and Efferent Tracts in the Medulla Oblongata: Dr. J. S. Risien Russell.—On the Orientation of certain Greek Temples and the Dates of their Foundation derived from Astronomical Considerations: F. C. Penrose, F.R.S.—Some Experiments with Cathode Rays: A. A. C. Swinton.—A Study of the Phenomena and Causation of Heat-contraction of Skeletal Muscle: Dr. T. G. Brodie and S. W. F. Richardson.

ROYAL INSTITUTION, at 3.—Greek History and Extant Monuments: Prof. Percy Gardner.

SOCIETY OF ARTS, at 4.30.—Prevention of Famine in India: Sir Charles Alfred Elliott, K.C.S.I.

MATHEMATICAL SOCIETY, at 8.—On a Law of Combination of Operators bearing on the Theory of Continuous Transformation Groups: J. E. Campbell.—A System of Circles associated with a Triangle: Prof. Steggall.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—On some Repairs to the South American Company's Cable off Cape Verde, 1893 and 1895: H. Benest.

CAMERA CLUB, at 8.15.—Forty Years of Mountaineering: Hon. Justice Wills.

FRIDAY, MARCH 12.

ROYAL INSTITUTION, at 9.—The Source of Light in Flames: Prof. A. Smithells.

PHYSICAL SOCIETY, at 5.—A Mechanical Cause of Homogeneity of Structure and Symmetry Geometrically investigated, with special application to Crystals and to Chemical Combination (illustrated by Models): William Barlow.

ROYAL ASTRONOMICAL SOCIETY, at 8.—On the Mean Motions of the Lunar Perigee and Node: Prof. E. W. Brown.—On the Theoretical Values of the Secular Accelerations in the Lunar Theory: Prof. E. W. Brown.—New Double Stars found in 1896: Royal Observatory, Cape of Good Hope.—Observations of Comets and Planets.: Royal Observatory, Edinburgh.—Micrometrical Measures of Double Stars: W. Coleman.—The Nuclei of a Sun-spot: T. R. Mellor.—On a New Binary of Short Period in Dorado: T. J. J. See.—Observations taken at Vadsö during the Total Solar Eclipse, 1896, August 9, by Passengers of the ss. *Neptun*: communicated by Rev. T. C. Porter.—The Orbit of δ Cygni: S. W. Burnham.—On the curve $y = \left\{ \frac{1}{x^2 + \sin^2\psi} \right\}^{\frac{3}{2}}$, and its connection with an Astronomical Problem: Mrs. W. H. Young (Miss G. Chisholm).—Discordances of Index Errors of the Madras Mural Circle, 1834–42: A. M. W. Downing.—On a Photographic Transit Circle: H. H. Turner.—Further Proof of the Rotation Period of Venus: Percival Lowell.—The Spectrum of β Lyræ as observed at Stonyhurst College Observatory in 1895: Rev. W. Sidgreaves.

MALACOLOGICAL SOCIETY, at 8.

ANATOMICAL SOCIETY (University College), at 4.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Inverness Section of the Inverness and Aviemore Railway: H. F. Brand.

SATURDAY, MARCH 13.

ROYAL INSTITUTION, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh.

ROYAL BOTANIC SOCIETY, at 4.

MONDAY, MARCH 15.

IMPERIAL INSTITUTE, at 8.30.—Some Indian Dye-Stuffs: Prof. J. J. Hummel.

SOCIETY OF ARTS, at 4.30.—Alloys: Prof. W. Chandler Roberts-Austen, C.B., F.R.S.

SANITARY INSTITUTE, at 8.—Diseases of Animals in relation to Food Supply: Dr. Alfred Hill.

VICTORIA INSTITUTE, at 4.30.—Creation or Evolution: Dr. W. Kidd.

TUESDAY, MARCH 16.

ROYAL INSTITUTION, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.

SOCIETY OF ARTS, at 8.—The Progress of the British Colonies of Australasia during the Sixty Years of her Majesty's Reign: James Bonwick.

ZOOLOGICAL SOCIETY, at 8.30.—On the Malagasy Rodent-genus *Brachyuromys* and its Affinities: Dr. C. I. Forsyth Major.—On a Collection of Mammals from North and North-west Australia (received February 10): Dr. R. Collett, F.M.Z.S.—Vertebrate Palæontology in South America: Notes of a Recent Tour: A. Smith Woodward.—On the Distribution of Marine Mammals: P. L. Sclater, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Discussion upon "The Main Drainage of London" and "The Purification of the Thames" to be continued and concluded.—Also Paper to be read with a view to Discussion: The Mond Gas-Producer Plant and its Application: H. A. Humphrey.

ROYAL STATISTICAL SOCIETY, at 5.30.

ROYAL VICTORIA HALL, at 8.30.—The Valley of Kashmir: Walter R. Lawrence.

WEDNESDAY, MARCH 17.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Meteorological Observations in 1837 and 1897: G. J. Symons, F.R.S.

SOCIETY OF ARTS, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, MARCH 18.

ROYAL SOCIETY, at 4.30.—*Probable* Papers: On the Conditions which render Absolute the Readings of the Mercurial Thermometer: S. A. Sworn.—Experiments on the Flame Spectrum of Carbon Monoxide: Prof. Hartley, F.R.S.

ROYAL INSTITUTION, at 3.—Greek History and Extant Monuments: Prof. Percy Gardner.

LINNEAN SOCIETY, at 8.—Further Observations on Stipules: Right Hon. Sir John Lubbock, Bart., M.P., F.R.S.—On the Origin of Transfusion-tissue in the Leaves of Gymnospermous Plants: W. C. Worsdell.

CHEMICAL SOCIETY, at 8.—On the Atomic Weight of Carbon: Dr. Alexander Scott.—On a New Series of Miacosulphates of the Vitriol Group: Dr. Alexander Scott.—The Action of Alkylhaloids on Aldoximes and Ketoximes: Wyndham R. Dunstan, F.R.S., and Ernest Goulding.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Fifth "James Forrest" Lecture—Bacteriology: Dr. G. Sims Woodhead.

SANITARY INSTITUTE, at 8.—Infectious Diseases and Methods of Disinfection: Dr. H. R. Kenwood.

CAMERA CLUB, at 8.15.—Geographical Pictures: Dr. H. R. Mill.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Larvæ of the British Butterflies and Moths: W. Buckler, edited by G. T. Porritt, Vol. vii. (Ray Society).—A Contribution to the History of the Respiration of Man: Dr. W. Marcet (Churchill).—Further Contributions to the Geology of the Sierra Nevada: H. W. Turner (Washington).—Vita Medica: Chapters of Medical Life and Work: Sir B. W. Richardson (Longmans).—Experimental Morphology: Dr. C. B. Davenport, Part 1 (Macmillan).—A Recalculation of the Atomic Weights: F. W. Clarke, new edition (Washington).—Appearance and Reality: Dr. F. H. Bradley, 2nd Edition (Sonnenschein).—L'Éclairage a l'Acétylène: G. Pelissier (Paris, Carré).—La Plague Photographique: R. Colson (Paris, Carré).—Seventeenth Report of the U.S. Geological Survey, Part 3, 2 Vols. (Washington).—Chapters on the Aims and Practice of Teaching: edited by Prof. F. Spencer (Cambridge University Press).

PAMPHLETS.—Moods, their Mental and Physical Character: F. Phillips (Churchill).—Insects affecting Domestic Animals: Prof. H. Osborn (Washington).—Zür Zoogeographie der Landbewohnenden Wirbellosen: Dr. O. Stoll (Berlin, Friedländer).—Grasses and Forage Plants of the Dakotas: T. A. Williams (Washington).—Virginia Cartography: P. L. Phillips (Washington).—Atmospheric Actinometry and the Actinic Constitution of the Atmosphere: Prof. E. Duclaux (Washington).

SERIALS.—Humanitarian, March (Hutchinson).—National Review, March (Arnold).—Fortnightly Review, March (Chapman).—Journal of the Chemical Society, January (Gurney).—Bulletin of the New York Mathematical Society, February (New York, Macmillan).—Das Tierreich, 1 Liefg.: Aves (Berlin, Friedländer).—Geographical Journal, March (Stanford).—Atlantic Monthly, March (Gay).—American Journal of Science, March (New Haven).

CONTENTS.