THURSDAY, MARCH 1, 1894.

THE REPORT OF THE GRESHAM UNIVERSITY COMMISSION.

THE "Report of the Commissioners appointed to consider the Draft Charter for the proposed Gresham University in London, together with Dissentient and other Notes," is a document of sixty-three pages full of important matter from beginning to end. It bears evidence of very careful thought, and is worth attentive study.

The Commissioners accept at once two principles, both of which were included in, and one of which was peculiar to, the scheme of the Association for promoting a Professorial University in London.[1] They lay it down that there should be one University only in the metropolis, and that the changes which they recommend should be effected not by Charter, but by legislative authority, and by the appointment of a Statutory Commission. They thus adopt the only satisfactory theoretical solution of the problem, and the only possible way of putting theory into practice. Every one is tired of the game in which the shuttlecock is tossed backwards and forwards from the University to the Colleges, from the Senate to Convocation. London and learning cannot wait indefinitely. The time has come when Parliament must arbitrate between conflicting views and interests.

The Commissioners also decide that the same University is capable of carrying on simultaneously systems of internal and external examinations, though Prof. Sidgwick has thought it right to express his disapproval of this conclusion.

They further propose that the scope of the University shall be enlarged in respect both of the subject-matter and the method of its teaching, so as to include six Faculties, viz. Arts, Science, Medicine, Law, Theology, and Music.

The first two of these are, of course, fundamental, and we hope that even if difficulties should arise with regard to the others, the foundation of a Teaching University in London, with the Faculties of Arts and Science only, will not thereby be prevented. If the existing University and the institutions of University rank which are chiefly interested in Arts and Science can be united, a most important result will have been achieved. The law of gravitation will in time do the rest.

We shall, therefore, confine ourselves chiefly to the proposals of the Commissioners with respect to Arts and Science, but a mere recapitulation of their recommendations would be of little interest unless the points of agreement with or divergence from previous schemes were indicated.

We propose, then, in the first instance to institute a comparison between the scheme of the Commissioners and three of the more important proposals which have been made in the course of the long discussion as to the best constitution for a Teaching University in the metropolis. The abortive Gresham Scheme may at once be put on one side. Its authors aimed at founding a second University in London. Everyone now agrees that there should be one only. The schemes which we select for our purpose are (1) the so-called Revised Scheme, which was approved by the Senate but rejected by the Convocation of the University of London; (2) the scheme approved in 1893 by Convocation; and (3) the Association Scheme.

The "Revised Scheme" and that of Convocation differ from the others in that their authors contemplate the possibility of the University having direct relations with educational institutions outside the metropolitan area. As it is probable that the teaching operations of the new University will be confined to London, we shall pass over this point without further reference.

The Association and Convocation agree in fashioning the University out of materials which closely correspond to the "Chancellor, Masters, and Scholars" of our older seats of learning. On the other hand, the Revised Scheme and that of the Commissioners make a beginning with such bodies as the Senate, Convocation, &c. The matter is not of fundamental importance, but it is necessary to refer to it as the phrase "*the University shall consist of*" is applied in different ways.

Putting this difference aside, the government of the University is distributed among various bodies named as follows:—

Revised Scheme	Convocation	Association	Commissioners
Senate	Senate	Court	Senate
Convocation	Convocation	Convocation	Convocation
Constituent Colleges	Professoriate	Professoriate	Academic Council
Faculties	Faculties		Faculties
Board of Studies	Board of Studies		Board of Studies

In what follows we shall use the word Senate to designate the Supreme Governing Body of the University. Its constitution under the different schemes is as follows:—

Nominated or Elected by	Revised Scheme	Convocation	Association	Commissioners
Crown	10	8	15	3
Ministers	—	—	—	5
Convocation	10	12	3	9
Institutions representing:				
(α) Medicine	4	2	—	5
(β) Law	2	2	—	6
(γ) Applied Science	—	—	—	4
(δ) Pure Science	—	—	—	2
(ε) Education	10	2	—	5
Corporation, County Council, &c.	—	4	4	4
Teachers in University or Colleges	16	10	25	22
Nominated by Senate itself	—	—	4	—
Total	52	40	51	65

It will be observed that while but slightly reducing the absolute number of members claimed by Convocation

[1] This will be hereafter referred to as the Association Scheme.

and the Association for the interests with which they are specially connected, the relative importance of the representation of the graduates and the Professors has been reduced by the Commissioners.

The reduction has been about in the proportion of one-third to one-seventh in the case of Convocation, and one-half to one-third in the case of the Teachers.

We are inclined to think that Convocation is still over-represented, and should have been glad to see the principle admitted that half the entire Senate should consist of Teachers in the University. As far as these numbers are concerned, however, we accept the decision of the Commissioners as that of a body of men who have weighed most carefully the evidence submitted to them, and have evidently tried to do impartial justice.

A mere numerical comparison, such as the foregoing, does not, however, show all the points of difference between the schemes. The most fundamental divergence is in the proposed relations between the University and the chief Educational Institutions which already exist in London.

The Revised Scheme contemplated the establishment of Constituent Colleges, that is, institutions which the University recognised as giving teaching of University rank in some or all branches of learning. The Teachers in the Constituent Colleges who were thus recognised by the University were grouped into Faculties, to which bodies certain powers and privileges were given.

Over and above this the Senate was to have the power of entering into arrangements with any Constituent College by which it approved certain courses of study given in the College, accepted certificates of attendance at such courses, recognised special examinations conducted in the College by a College Professor and an *adjoint* Examiner appointed by the Senate, and gave Degrees to candidates who attended the specified courses and passed the special examinations. A Standing Committee of the Senate was to co-operate with the Constituent Colleges in the organisation and improvement of University Teaching in and for London, "including the establishment of Professorships." Inasmuch, however, as the Faculties were to consist of Teachers of the Constituent Colleges only, and no provision was made for the admission to them of University Professors who were not connected with a Constituent College, it would appear that the University itself was not to be a Teaching Body.

As far as the Colleges are concerned, this was in effect the plan which has worked successfully in the Victoria University. The Colleges were to be independent, to appoint their own Professors, to find their own funds. If they succeeded they were to be recognised, and to share in the government of the University. Success would depend in part on the number of their students. Hence they were to be rivals, but the University would neither help nor hinder them. Equal privileges could be won by all. They would be impartially withdrawn from those who failed. The idea of recognising special examinations to suit special needs was an advance, and a very important advance, on the scheme of the Victoria University. A fundamental difference between the two Universities would, however, have been that, whereas the Victoria University can only give Degrees to candidates who have passed through a College of the University, the University of London would have been able to give Degrees to all-comers, as well as to make special arrangements for students in Constituent Colleges.

The scheme of Convocation went a step further. It contemplated the possession by the University of independent laboratories, and therefore of a teaching staff of its own. It also proposed that Professorial Chairs in other Institutions should be endowed by the University on condition "that the appointment to such Chairs whenever a vacancy occurs should pass to the University." It was not stated whether the Professor so appointed should be subject to the University only, or whether he should be under the partial or exclusive control of the Governing Body of the College in which he worked. The Professorial Scheme was very similar. Every Professor of the University was to be appointed and paid by the University, and a Statutory Commission was to make arrangements with existing Institutions for complete or partial incorporation.

The Commissioners propose that certain Institutions, or departments in Institutions, shall be recognised as Schools of the University. The teachers in these Schools must be individually approved to secure a University *status*. The principle laid down by the Professorial Association, that Teaching Institutions as such are not to be represented on the Senate, is accepted, and thus the Constitution of the University is not in theory federal. On the other hand, places on the Senate are allotted to University College, King's College, the Royal College of Science, and the City and Guilds of London Institute, "regarded as important and wealthy public Corporations, or Societies, having and exercising wide educational aims and powers in connection with University education in London." The distinction is rather a fine one, but we gather that in the Commissioners' opinion King's College ought to have two representatives on the Governing Body, even if some theological difficulty led to its refusing to accept the position of a School of the University. The Commissioners decline to accept the idea either of immediate or of ultimate absorption of Educational Institutions as the basis of the University. But even if this is so, we think that they have gone too far in allotting a definite number of representatives to certain Teaching Institutions which happen at the moment to be the most important in London. The very existence of the Royal College of Science depends on the will of a Minister. We suppose that the City and Guilds Institute would collapse if the subventions it receives from the City Companies were withdrawn. The Commissioners themselves would surely be unwilling to throw any obstacles in the way of the complete absorption of University College by the University if in twenty years time it should itself desire it. Yet as matters stand any such change would involve a change in the Charter. It would surely be better to allot six representatives to the Governing Bodies of important Educational Institutions to be distributed in the first instance as the Commissioners propose, with the condition that the Senate may from time to time revise the list, subject to an appeal to the Privy Council. This at all events would secure greater flexibility. It is also possible that the Senate might

delegate the government of institutions founded by the University to committees like the Kew Committee of the Royal Society, and, subject always to the approval of the Privy Council, there seems no reason why, if the number of independent Teaching Colleges were diminished, the places of their representatives should not be occupied by experts chosen from among the members of such Committees.

Among the Institutions which the Commissioners think should be at once admitted in whole or in part as Schools of the University, those which would be chiefly concerned with the Faculties of Arts and Science are the following:

University College.
King's College.
The Royal College of Science.
The City and Guilds of London Institute.
Bedford College.
And six Theological Colleges.

The University is to be able to appoint Professors and to found Teaching Institutions of its own, and it is also to have the power "to allocate funds for the enlargement and assistance of the teaching staff of recognised institutions, the extension of their buildings, the improvement of their equipment for teaching and research, and the endowment of University Professors, Readers, Lecturers, Demonstrators, or assistants, or for other purposes in connection with such institutions." It is to be "understood that in these cases the University will impose such terms and conditions as will secure to it a reasonable and proper amount of control over the educational resources thus provided, and will have the power of determining the duties of the University Chairs which it establishes or subsidises in any institution, and of regulating the fees payable for attendance on the lectures." "But," the Commissioners continue, "we do not think it necessary to lay down any rules which would fetter the discretion of the University in this matter. We take it for granted that it will be the endeavour of the University and of the institutions to organise a homogeneous system of University education, to utilise, to combine, and to economise existing resources to their fullest extent, and to supplement them in such a mode as will best serve the progress of knowledge."

In spite of this optimistic view of the future, it may be feared that the financial relations between the Colleges and the University will be difficult to adjust. Indeed, there are several points on which the Government will have to decide before putting the scheme into operation.

The University will have to be endowed by State or Municipal funds, if it is to be able either to subsidise or to add to the number of Colleges. If no such funds are provided, the state of things contemplated in the Revised Scheme will, in effect, be realised. The Colleges will be pecuniarily independent of the University, and since the University is to have no power of control except in return for subsidies, it will only be able to influence the "Schools" indirectly by visitation and by prescribing courses of study for the Degrees.

The Commissioners, however, evidently contemplate the large endowment of the University by the State. In this case it may have a more important part to play; but unless the control it claims in return for subsidies is sufficiently great to act as a deterrent, there will certainly be an undignified scramble for funds among the Colleges. It will be a miserable ending to the long controversy if the University is to be merely the guardian of a Government Grant fund, doling out one paltry sum here to build a second-rate laboratory, and forthwith bound to match it by another grant there, just to show that, like Justice, it is blind.

If the University establishes on a German scale a laboratory of its own, chiefly intended for post-graduate study, there will be an outcry against divorcing teaching from research. If it selects one existing Institution as that with which the laboratory is to be connected, it will be held to be neutralising the public-spirited efforts of the promoters of the others. If it tries to level up all round, it will achieve nothing really great. We do not say that such results must necessarily follow from the realisation of the scheme of the Commissioners, but the Commissioners themselves appear to have thought that the only way out of the difficulty was to appeal to the good feeling and good sense of all concerned. It is evident that the future of the University largely depends upon whether their appeal is successful, and upon the action of the Statutory Commissioners when appointed.

It might be possible to establish "spheres of influence" in the territory of Knowledge as well as in the Dark Continent. But whatever device be adopted, it cannot be made too clear that the Commissioners leave to the Statutory Commission and to the University itself the solution of the most difficult problems connected with its establishment. The character of the University will largely depend upon its relations with the Colleges, and their relations have yet to be defined.

We do not point to this "lacuna" in a spirit of adverse criticism. As nothing is known about the funds and resources the University will possess, it would probably have been useless for the Commissioners to have made detailed suggestions. But it is all-important that those who have most knowledge and experience in educational matters should agree upon some scheme more subtle than the suggestion that Colleges, like savages, should adhere to the good old rule—

> "That he should take who has the power,
> And he should keep who can."

The relations of the Colleges and of the Teachers to the University are so intertwined that it is difficult to separate them. In what has been said, however, stress has chiefly been laid upon the former. We now turn to the position of the Teachers in the University.

The Association Scheme insisted that every Professor of the University should be "appointed and paid by the University." The Commissioners state that this "restricts within a narrower area than any other scheme which has been proposed to us the class of teachers who are permitted to share in the Government of the University." It is doubtful whether this was the intention of those who framed the Association Scheme. They undoubtedly desired that the University should be a Teaching University, and not merely a body with funds to be exploited by Teaching Colleges. Their proposal, therefore, was that all Professors teaching in the name and on behalf of the University should be directly responsible to it, and should therefore be paid by the

University, whether the ultimate sources of their emoluments were provided by it or by a College. The regulation was probably intended to indicate a *status*, and not to restrict the number of those who attained it, and we hope it will be incorporated in the final scheme. But if this is so, it must be admitted that the Association's proposal is open to the second criticism which the Commissioners pass upon it. It created, they say, a single and undivided assembly of Teachers, on which, though in subordination to the Court, it conferred not only deliberative and consultative, but executive powers in matters which must necessarily involve much detailed and constant supervision.

In opposition to this the Commissioners group the Teachers into Faculties, and allow them to elect a very important body to be called the Academic Council. It is to consist, in addition to the Vice-Chancellor, of fifteen members, chosen as follows: Arts 4, Science 4, Medicine 3, Law 2, Theology 1, Music 1. The term of service is to be four years. Six to be a quorum. To this body will be entrusted the duty of regulating, subject to the Ordinances of the University, the teaching, examinations, and discipline of the University, and of determining what Teachers in any school of the University shall be recognised as University Teachers, and to what Faculties they shall be assigned.

In addition to these executive functions, it will be its duty to advise the Senate upon the affairs of the University, and particularly upon the assignment of funds for the erection or extension of buildings and the provision of teaching or equipment in connection with admitted Institutions or otherwise, and upon a number of similar points.

It is evident that by the establishment of this Council the Commissioners are prepared to give power to the Teachers of the University with no ungrudging hand. They assume that seats on the Academic Council will be held only by men of unquestioned reputation and experience, whose views will command the respect of the Senate. The Council is given very wide executive powers and the right to advise on matters of the utmost delicacy and importance. The only difficulty that we see is the possible intervention of College jealousy. It will be all-important that the men who are chosen shall be not only eminent in their own lines of work, but fair-minded and possessed of administrative powers. If once the easy expedient of taking turns is adopted, or if Professors working in University institutions are boycotted in favour of those connected with Colleges, or *vice versâ*, the Academic Council will be a failure. These considerations will probably suffice to prevent such evils arising; and if so, we think it possible that the Academic Council of the future University of London may develop into a body of the utmost importance, and that its views may acquire an authority which would never be attained by the decisions of a large assembly, many of the members of which would necessarily be comparatively unknown men. It will thus be seen that the Teachers of the University are to share in its government in two different ways. First, they are in their Faculties to elect one-third of the members of the Supreme Body or Senate; secondly, they are to elect fifteen of their number to form an Academic Council with wide executive and advisory powers. It only remains to add that machinery is also provided by which this Council is to be kept in touch with the main body of the Teachers. For this purpose Boards of Studies are to be appointed, the number and composition of which are to be determined by the Academic Council, with the proviso that not less than three-fourths of any Board are to be elected by the Faculty to which it belongs, and the remainder (if any) appointed by the Academic Council. These Boards are to have advisory powers, and it is laid down that no rule should be made with regard to or change effected in the curricula unless it has either been recommended by the Board or Boards of Studies of the Faculty concerned, or has been submitted to them by the Academic Council for consideration. It is also provided that in dealing with the courses of study to be pursued at any Institution it is reasonable that the Academic Council should first consult the authorities of the Institution. In neither case, however, is the Academic Council bound to conform itself to the view expressed by the bodies which it consults.

Such then, in general outline, is the scheme for the government of the new University proposed by the Commissioners.

It is in many respects bold and drastic. The existing Senate of the University of London is swept away. Thus, and in our opinion very rightly, it is made clear that the carrying into effect of the scheme of the Commissioners would be an absolutely new departure. It would be preceded by the complete dissolution of the Governing Body of the present University, no single member of which might find a place in the new order of things.

The Association, or some members of it, no doubt desired that a similar act of renunciation should precede the admission of a College to the University. Had this desire been fulfilled the whole problem would have been simplified, and the chances of success enormously increased. It is still possible for the Government to set the example in the case of the Royal College of Science. University and King's Colleges are, however, the results of private effort. It would have been sheer confiscation to compel their Governing Bodies to resign their functions, though we believe that if they had sufficient confidence in the scheme proposed by the Commissioners to do so, their last service to learning and to education would surpass all the good work they have done in the past. Assuming, however, that they continue to exist as independent organisations, the most that can reasonably be urged is that the scheme shall throw no impediment in the way of absorption if all concerned should ultimately desire it. The Commissioners have evidently been anxious to leave the University as free as possible to develop in this as in any other direction. In one point only—and in that probably from inadvertence—have they imposed an unnecessary restriction. Representation on the Senate should not be allotted to particular Colleges, but to a class of Institutions, the list of which is capable of being revised with the approval of the Privy Council without a change in the Charter.

On the other hand, it must be admitted that the Commissioners, like the advocates of the Association Scheme,

leave so much to be settled by the Statutory Commission that the ultimate character of the University is still very doubtful. Though non-federal in theory, it may be practically federal in fact, and it behoves those who are interested in the matter to do all in their power to protect it from the grave dangers which will beset the earliest stages of its career. The position assigned to Teachers, though not exactly that claimed by the Association, is so strong and so dignified that on this point we hope there will be no further controversy.

To sum up. Putting aside the relations of the University to Theology, Medicine, Law, and Music, the scheme of the Commissioners is the Revised Scheme, improved and modified so as to be much more closely in accord with the ideas of the Association. The question as to whether the University is, as far as Arts and Science are concerned, practically a federation of Colleges, is left to a Statutory Commission to decide. The main danger with which the University is threatened is jealousy between semi-independent Colleges. The only safeguard against this which the Commissioners suggest is that they take it for granted that everybody concerned will do his best "for the progress of knowledge." To which we heartily say "Amen."

STEREOCHEMISTRY.

Handbuch der Stereochemie. Unter Mitwirkung von Dr. Paul Walden herausgegeben von Dr. C. A. Bischoff. I. Band. (Frankfurt: H. Bechhold, 1893.)

STEREOCHEMISTRY grows apace. The birth of this youngest scion of the chemical family, which occurred about twenty years ago, when Van't Hoff and Le Bel published almost simultaneously their now famous memoirs, was not greeted with universal acclamation. The event excited at the time but little interest among English chemists, and when the young science was introduced, through F. Hermann's *Lagerung der Atome im Raume*, to the acquaintance of our German colleagues, it was regarded not without suspicion in some quarters. There was one chemist of high rank who denounced the *Chimie dans l'Espace* as "fanciful nonsense," as the outcome of "a miserable speculative philosophy, whose treatment of scientific subjects is not many degrees removed from a belief in witches and spirit-rapping." Stereochemistry, however, soon found a congenial home in the German laboratories, and flourished marvellously. About four years ago the young stripling was duly christened by Victor Meyer on the occasion of an address to the German Chemical Society, and thus received formal recognition as a legitimate member of the chemical family. Since then three general treatises have been called for in order to chronicle the progress of this latest development of chemical science—the "Chemistry in Space" of Van't Hoff, translated into English and re-edited by J. E. Marsh; Meyerhoffer's "Stereochemie," a later translation into German of the same work with much additional matter, and the admirable "Grundriss der Stereochemie," by A. Hantzsch. Following quickly in the wake of these, we have, in the "Handbuch der Stereochemie," a much more elaborate and complete treatise, chiefly from the pen of Dr. C. A. Bischoff, whose well-known indefatigable labours in the new field of research eminently qualify him for the serious task he has undertaken.

As explained in the publishers' announcement, stereochemistry has extended with such rapidity in recent years, and the numerous theoretical and experimental researches in this department are dispersed throughout so many different periodicals and pamphlets, that it is not easy for anyone who has not closely followed the subject from the outset, to obtain a general view of the development and present stand-point of the science. The object of the work before us is to remove this difficulty, and to attract more adherents to the new study. The book is further intended to exhibit the present position of all the problems which have been touched by stereochemistry, and to furnish a brief record of all the compounds which have any relation to optical and geometrical isomerism, so that it may serve as a convenient and reliable work of reference to the investigator.

The first volume of the treatise, extending to about 450 closely printed pages, comprises a general part, entitled "Die historische Entwickelung der Principien der Stereochemie," and the first subdivision of a special part, dealing with the relations of stereochemical theory to the phenomena of optical activity in organic compounds. The second volume, which is to appear shortly, will contain the remaining two subdivisions of the special part, which are to treat respectively of geometrical isomerism, and of the influence of intra-molecular space relations on chemical reactions.

The book has two distinct aims, which it is not easy to combine. As a work of reference the "Handbuch," we believe, fulfils all its claims, and will supply a much-felt want. The matter throughout is well up to date, the references to literature are copious, and the systematic account of all the known optically active organic compounds, which occupies more than half the volume, is the only complete collection of the kind we have at the present time. The organic chemist will understand the force of the commendation when we describe the book, from this point of view, as a *stereochemical Beilstein*, which will be indispensable in every laboratory where stereochemical research is being conducted. With respect, however, to the other purpose of the book, that of presenting a general picture of the development and present position of the science, the result is less satisfactory. The general part, which, judging from its title, was written with this end more particularly in view, is somewhat disappointing. The history of stereochemistry is an extremely fascinating subject; it contains all the elements of a good sensational scientific story, mysterious facts, wild speculations, ingenious hypotheses, beautifully verified predictions; but the subject as here presented is, to our mind, rather dry. The title of the chapter indicates that the development of the principles of stereochemistry is to be brought prominently into view; but we shall be surprised if the student, unless he is already pretty familiar with the literature of the subject, does not rise from its perusal, so bewildered in a maze of subtle speculation and conflicting hypothesis, as to conclude that stereochemistry has really no principles to develop. The introduction into a work of this kind of the speculation and hypothesis, to which stereochemical

discovery has given such a wonderful impulse, is of course not only justifiable, but highly necessary at the present stage. It is not to this, nor to the matter of the book generally, which indeed is admirably selected, that we venture to take objection, but rather to the method of treatment. The method adopted in the general part is not calculated in our opinion to present a history of the development of the subject in a striking and lucid manner. The chapter really consists of a series of abstracts of memoirs, ranging over the whole field of stereochemistry, placed in chronological order of publication, to which the author seldom adds expository or critical remarks. The paucity of experimental facts in illustration of the theories described, adds still further to the unattractiveness of the picture. The author, it is true, expressly states in the preface that details have been intentionally omitted, but the unavoidable result is that the abstracts are in many cases so bald as to be shorn of much of their interest, and the often repeated reference to the special part for application of the theories described becomes tantalising. Stereochemistry has already in the short period of its existence pushed its way in so many different directions, that to present an effective picture of its growth, it would be necessary to trace its development along a number of more or less independent lines. The opening chapter of the special part, we ought to state, supplies this want to a great extent with respect to optical isomerism, and similar sketches will, no doubt, be given in the other subdivisions.

The idea that the relative position of atoms in space within the molecule, must be an important factor in determining the properties of compounds, was, no doubt, present to the minds of many of the founders of the atomic theory, and it is interesting to learn from a correspondent in these columns (vol. xlix. p. 173) that Wollaston had a very clear conception of this fact. The history of stereochemistry, however, begins with Pasteur, and we are glad to see that the importance of his experimental discoveries and far-seeing predictions receive ample recognition. A portrait of the veteran chemist is placed opposite the title-page, with that of his younger colleagues, Van't Hoff and Le Bel.

As is generally known, these two distinguished chemists arrived at their fruitful theory of the asymmetric carbon atom by two entirely different paths, and their positions with respect to it are by no means identical; indeed, Le Bel has entered a protest on several occasions against his views being confounded with those of Van't Hoff. The disadvantage of the chronological method, to which we have alluded, is very apparent here, for to form any adequate idea of Le Bel's present stand-point, the reader has to hunt up the summaries of various papers which are scattered throughout the general and special parts. The views held by Le Bel are particularly interesting, as they lead him to sundry fundamental conclusions, which must seem very heretical to those who have adopted the doctrine of Van't Hoff without qualification into their chemical creed. Thus he has recently concluded that even a molecule of the type CR_4 does not necessarily possess a configuration which can be symbolised by a regular tetrahedron, and that the usually accepted argument for the symmetrical distribution of the four hydrogen atoms in the molecule of marsh gas, based on the existence of only one monoderivative, is unsound. The experimental ground of his conclusion is the more interesting, as it furnishes one of the few instances in which the obvious property of the crystalline form of a compound has been used for the purpose of determining its molecular configuration. He finds in fact, contrary to Wislicenus' prediction with respect to compounds of the type indicated, that carbon tetrabromide does not crystallise in the regular system. Again, Le Bel's views do not exclude the possibility of optical isomerism in unsaturated bodies, and he finds indeed that solutions of citraconic acid become strongly active when mould is grown in them; should this discovery prove to be due to the production of an active isomeride of this acid, the discovery would revolutionise an important branch of stereochemical theory. Such considerations remind us that the prevailing stereochemical theories, fruitful as they have been, are nevertheless only a first approximation to the truth, and will have to undergo important modifications with the progress of discovery.

The reader of Dr. Bischoff's book will find abundant food for reflection in the numerous monographs, of which very good abstracts are given. Many of them, dealing with such fundamental subjects as the nature of chemical affinity, valency, the significance of double and treble linkage, the influence of the form and motion of atoms on chemical action, are highly interesting and suggestive; some of these papers will be already familiar to the readers of the *Berichte* and *Annalen*, but others which have been published in separate form are not readily accessible to the English chemist. The perusal of the opening chapter will convince the reader that stereochemical conceptions are already initiating a searching revision of the very foundations of the chemical edifice, and that they are destined in the near future to play an important, perhaps a predominant, part in the progress of chemical theory.

We may add that the book is abundantly illustrated with geometrical figures, and that a detailed index is promised with the second volume.

We have observed the following misprints: "symmetrischen" instead of "unsymmetrischen" in the last paragraph, p. 24; "+" instead of "×," p. 97; "Nachwirkung" instead of "Nahewirkung," p. 121.

T. P.

MARINE BOILERS.

Marine Boiler Management and Construction. By C. E. Stromeyer. (London: Longmans, 1893.)

THE difficulties attending the economic management of marine boilers have engaged the serious attention of engineers for many years, and Mr. Stromeyer's book will be welcomed as by far the most valuable addition which has been recently made to the subject.

The author treats in detail the generally accepted plans for the construction and methods of management of marine steam generators, and discusses, more or less fully, the causes of corrosion and other sources of wear and tear in boilers. Fuels and the conditions of heat transmission through plates are treated at length, whilst in the latter portion of the book, strength of materials

and details of boiler construction and design are discussed.

It is a matter for regret that from so good a book a certain number of errors could not have been eliminated. Thus, in speaking of the pitting of boiler plates below the surface of the water, the author states that in contact with the heated portion of the plate, the water gives up its dissolved air in contact with the surface of the metal, and that the bubbles there remain until large enough to rise, and he considers that during this period of rest the "nascent" oxygen which they contain will attack the iron. The idea that oxygen driven out of solution by the action of heat possesses the powers attributed to the nascent condition, will come as a surprise to his chemical readers. And again, on p. 61 it is stated that in the lungs the process of slow combustion is continually proceeding. In an age of specialism it is unlikely, and perhaps undesirable, that an author should speak with equal authority as engineer and physiologist. Reference to any modern text-book of physiology would have made clear the fact that diverse as may be the opinions as to the actual field of oxidation, the author appears solitary in selecting the lungs as the sphere of action.

The collection of formulæ put forward by various authorities for calculation of the calorific value of fuel from its chemical composition is very complete, but the author might have insisted more strongly than he has upon the errors inseparable from any such calculated heat values, which are due to our present ignorance of the molecular groupings in coal, and the thermal changes attending its formation.

An amazing confusion of idea is exhibited in the statement made on p. 69, "that gun-cotton ignites so readily that it could not be used for ammunition until it was discovered that the admixture of camphor or nitroglycerine raised this temperature." In the table of temperatures of ignition, on the same page, the ignition point of coal is given at 600° F.; this, on the evidence of recent experiments, is too low.

In the valuable chapter on heat transmission, no mention is made of one of the chief sources of loss in the passage of heat from the furnace to the water, namely, that the burning furnace gases are extinguished by contact with the comparatively cold surface of the plates, with the result that the flame never comes in contact with the metal, a layer of unburnt gas of very low conductivity existing between flame and plate; and this not only impedes the passage of heat to the water, but the gas creeping along the surface of the metal often escapes combustion, both in the furnace, combustion chambers, and tubes.

Coming to the engineering portion of the book, there is much which will excite comment from practical men. In the basic Bessemer steel process using phosphoric pig-iron, the purity of the blown metal is usually judged by the bath sample "fracture," which is quite as easy to gauge as a sample from the open-hearth working, and the procedure given in paragraph 6, p. 101, is at variance with every-day practice. Again, in describing the acid Siemens-Martin process, on p. 103, the author speaks of adding 25 per cent. scrap-iron, the ordinary practice being to charge steel scrap with the pig-iron before melting. In fact, scrap-iron could not be used in any quantity in this process, on account of the phosphorus and sulphur often contained in it; and it is the custom in most works to pick out all the iron found amongst the steel scrap for use in the Siemens-Martin furnace.

On p. 107 there is an excellent paragraph on cold bending, which contains valuable suggestions; but the remark that the bending of samples after annealing is valueless, may be objected to. The obvious reason of doing so is to bring the sample to the same condition as the finished article, and it is a common practice to specify that flange plates, or plates which have to be worked in any way, shall be annealed as a final process to bring them to a uniform condition; they may have been rolled at various temperatures, in which case the tensile and elongation tests would vary considerably. Nor will Mr. Stromeyer's remarks upon drift tests meet with the general approbation of railway engineers. Surely, also, the first paragraph on p. 122, when considered in conjunction with the remarks on annealing made on p. 107, are of a contradictory nature?

The opinions expressed in the first paragraph of p. 156 are not justified by results of recent experiments, and the percentage of failures on the weld is not nearly so high as one would be led to expect from the experimental figures given on p. 157.

The tools described as being in use in boiler shops, on p. 182, are of an old-fashioned type, for special machines with three or more spindles capable of drilling up to 120 tube holes per day of nine hours, without any preparation of the plates, such as punching or drilling small holes, have been in use in most shops for a considerable period. The statement made on p. 237, that fitting a sufficient number of stay tubes will overcome the trouble consequent upon forced draught, is open to criticism, as it is not borne out by facts, and has indeed been the cause of considerable trouble in boilers.

It would have been better on the whole, considering the large number of books which now exist on design, to have curtailed the space devoted to this branch of the subject, which, although no doubt useful to the young draughtsman, might with advantage have been omitted from Mr. Stromeyer's book.

These are minor and technical criticisms of an excellent work, exhibiting signs of much industry in compilation. The author is to be especially commended for his habit of reference on all occasions to the source of information.

OUR BOOK SHELF.

Chapters on Electricity. By Samuel Sheldon, Ph.D. (New York: Charles Collins, and the Baker and Taylor Co.)

IN the preface the author states that "these chapters on electricity, prepared for and included in the fourth revised edition of Olmsted's 'College Philosophy,' are here offered in a separate volume." The chapters deal in much the usual way with the stock work commonly found in elementary text-books on magnetism and electricity. The writing, however, appears to have been carefully done; the general style is clear and concise, but a little more explanation would, in many cases, have added to the clearness and, in a few cases, to the accuracy of the work.

In connection with Coulomb's law, the statement that $F = Q/r^2$ (Art. 581) is "strictly true only when the two bodies are in a vacuum," requires a little more elucidation than the author gives. Similarly the explanation of polarisation, the definition of specific resistance (in terms of the metre and square millimetre), the statement of Ohm's law, and the laws of thermo-electric phenomena require more detailed and accurate treatment.

The paragraphs on recent work, such as Hertz's experiments, theories of magnetism and electrolysis, and modern theories of the ether, are far too meagre to be of any service; they give no information even to the student who is able to read between the lines.

Apart from these points, the book appears to present a fairly reliable exposition of the elements of the subject, which may justify its issue as a separate volume.

Meteorology. By H. N. Dickson, F.R.S.E. (London: Methuen and Co., 1893.)

IN this little book the author has attempted to lay down "a certain amount of 'permanent way' specially adapted to practical purposes, but at the same time leading towards the more theoretical grounds of modern research." The fundamental facts and principles stated in the earlier chapters furnish the inquirer with much of the necessary stock-in-trade of information culled from other branches of science; as, for example, the behaviour of gases under varying conditions of temperature and pressure. Cyclones and anticyclones receive somewhat detailed consideration, but the account is very intelligible, and the mathematical expressions are of the simplest character. The present position of meteorology in regard to weather-forecasting is very clearly and impartially stated. In the chapter on instruments the author leaves a little to be desired in the shape of illustrations and descriptions, especially as he aims at producing a practical treatise. An excellent account of cloud classification is given. The relation of meteorology to agriculture is a subject of great practical importance, and this is carefully discussed in the final chapter.

The author has availed himself of all the most recent sources of information, both British and foreign, and the references to original papers form a valuable feature of the book. To all who desire to carry their meteorological observations beyond the mere hobby stage, we heartily commend this little book.

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.*]

Great Auk's Egg.

IMAGINATION has long had a large share in the accounts given of the Gare-fowl or Great Auk, notwithstanding the efforts of those who have tried to set forth nothing but the truth on the subject, yet I do not call to mind meeting with so "many inventions" regarding it as have appeared in the newspapers within the last week, on the occasion of the recent sale of a specimen of the egg of that bird. I should occupy too much space were I to dwell upon them; but I would ask for the admission of a few lines in which to state what is known exactly of the origin of that specimen, which I well remember in the collection of the late Mr. Yarrell. He told me, as he told others of his friends, that he bought it in Paris; and, to the best of my belief, not many years after the peace of 1815. In a little curiosity-shop of mean appearance, he saw a number of eggs hanging on a string; he recognised one of them as an egg of *Alca impennis*, and asking their price was told that they were one franc apiece, except the large one, which from its size was worth two francs. He paid the money and walked away with the egg in his hat. That is the whole story on which so imposing an edifice has been built, and the only "variant" of it deserving of consideration is to the effect that the price of the big egg was five instead of two francs. I may add that this simple story was published by the late owner of the egg, the Baron Louis d'Hamonville, in the *Bulletin* of the French Zoological Society for 1891 (tome xvi. p. 34).

ALFRED NEWTON.

Magdalene College, Cambridge, February 24.

Frost-Cracks and "Fossils."

SEVERAL letters appeared in NATURE last winter describing some of the more interesting plant-like forms due to frost acting on various surfaces, and both Prof. Meldola and myself drew attention to the possible deceptions which might arise from a preservation of such patterns as fossils. I yesterday met with a striking case illustrating this. It was at Cullercoats, on the Northumberland coast. There had been a slight frost the night before, and the surface of a talus of semi-liquid mud at the foot of a low cliff of boulder clay (actually on the line of the great Fault known as the "Ninety-Fathom Dyke") was found to be indented with cracks about ¼ to ½ an inch deep and ¼ of an inch in breadth. These cracks were disposed in beautifully branched patterns bearing a surprising resemblance, in outline, to some of the more subdivided sea-weed fronds. A sandy beach lay close by, and a high wind was blowing the sand on to the mud. It was obvious that the sand would soon fill in the frost-cracks under these conditions. The cracks would thus be preserved, and if at any future time the mud surface be again exposed it will be found covered with sand (or, after induration of the mud and pressure of overlying material, sandstone) casts of what it would be very difficult to believe were not vegetable organisms in an unusually perfect state of preservation.

Newcastle-on-Tyne, February 25. G. A. LEBOUR.

The Origin of Lake Basins.

I WISH to draw the attention of your correspondents, Messrs. Aitken and Tarr, to p. 94 of the *Geological Magazine*, vol. iv. 1876, in regard to the manner in which, in all probability, the greater number of the lakes in British North America were formed. There are, however, doubtless many other causes by which lake basins have been formed. The object of my notice was simply to point out that the ice need not be supposed to have exerted any extraordinary or abnormal influence in scooping out rock basins which have subsequently become lakes.

Ottawa, February 16. ALFRED R. C. SELWYN.

Note on the Habits of a Jamaican Spider.

OBSERVING in your issue of January 11, p. 253, an interesting note on the *Nephila madagascariensis*, I am prompted to send you some unpublished observations on the Jamaican species, *N. clavipes*. They are from the MSS. of the late Mr. William Jones (concerning whom see *Journ. Inst. Jamaica*, 1893, p. 301), and date from over fifty years ago. The record begins: "*Aranea clavipes*, or the great yellowish wood-spider. I fancy Sir Hans Sloane must have been misinformed when he states that this spider's web will not only stop small birds but even pigeons. I will venture to assert that its strength would not even endure the struggling of the smallest humming-bird." But below is another entry: "Dec. 25, 1839. I wronged the accuracy of Sir H. Sloane's statement; a little boy returning from an errand brought me a little black and yellow bird that he found entangled in a web of *A. clavipes*." After this he adds a more general statement concerning the spider: "St. Thos. ye East, on bushes and outhouses,—I found in the old cooper's shop at Slamans Valley Est. in Portland, many hundreds of these, some of a monstrous size. These spiders weave an almost large (*sic*) spiral web, yellow and strong, like silk, glutinous or viscid, and well adapted for arresting the flight of large insects. I have frequently seen some of their lines two or three yards long. Butterflies appear their favourite food. They form an oblong oval cocoon of a white substance like soft chamois leather, outside composed of little round-shaped compartments; the cocoon is covered over with a mesh of strong yellow thread or silk." Finally he gives a technical description of the spider, which need not be quoted. The spider's size is said to be 1 to 1½ inches in length, with the fore-legs 2½ inches long, the second pair 2 inches, the third pair 1 inch, and the fourth pair 2 inches.

Thus it appears that *N. clavipes* is not altogether unworthy of comparison with the great Madagascar species in regard to its web. It is one of the very commonest spiders of Jamaica, as I have myself observed, and has a wide distribution in the neotropical region. T. D. A. COCKERELL.

Las Cruces, New Mexico, U.S.A., February 8.

The Cloudy Condensation of Steam.

WITH reference to Prof. Barus's letter (p. 363), I have never suggested that condensation nuclei in smoke, &c. would "remain distinct indefinitely," but that, if there were no chemical action, they would hardly disappear in the course of a few seconds.

There is no mention in my lecture of "dissociated particles," or of the dissociation of platinum at red heat. What I said was that electrical discharges and incandescent substances probably caused dissociation of oxygen and nitrogen in the surrounding air (*ante*, p. 214). SHELFORD BIDWELL.

February 22.

Astronomy in Poetry.

WITH reference to the note in the Astronomical Column of NATURE, No. 1226 (p. 372), it is worth remark that the nebular theory of the universe is briefly and accurately set forth by Tennyson thus—

> "This world was once a fluid haze of light,
> Till toward the centre set the starry tides
> And eddied into suns, that whirling cast
> The Planets." [*The Princess.*]

A little knowledge of astronomy would have led Coleridge's Ancient Mariner to know that he could never have seen

> "The horned moon, with one bright star within the nether tip."

Tennyson is always accurate in his descriptions of natural phenomena. EDWARD GEOGHEGAN.

Bardsea, February 19.

A Plausible Paradox in Chances.

WITH reference to the paradox in chances mentioned by Mr. Francis Galton in NATURE of February 15 last, I think the following remarks will show very simply where the fallacy lies.

If I assert that at least two out of three coins must turn up alike, I am saying what is evidently true; but if I go on to say that it is an even chance whether a third coin is head or tail, I am assuming that only two coins have been tossed, and that the fate of the third is still uncertain; but this is directly counter to my first assertion, which requires the tossing of three coins.

If this method of reasoning is to be used at all, I must say first that the chance of two coins turning up alike on being tossed is $\frac{1}{2}$, and then that the chance of a third coin being the same as the other two is also $\frac{1}{2}$, and that therefore the required chance of all three being alike is $\frac{1}{2} \times \frac{1}{2}$ or $\frac{1}{4}$.

LEWIS R. SHORTER.

THE PLANET VENUS.

FROM time immemorial the planet Venus has attracted the attention of mankind. Before the days when the "optic tube" began to be turned towards her disc, Venus, we might say, was still in myth, and she was hailed as Hesperus and Phosphorus, according as she was an evening or a morning star, the fact that the same object was in question being then unknown.

Shining as she does at times with a brilliancy surpassing any other body except the moon, it is only natural that she should have been so often sung about by poets in all lands, liking her unto

> "the fair star
> That gems the glittering coronet of morn."

And she is highly honoured by Homer, in that she is the only planet to which he refers:

> Ἔσπερος ὃς κάλλιστος ἐν οὐρανῷ ἵσταται ἀστήρ.
> Hesperus quæ pulcherrima in cœlo posita est stella.

To Galileo belongs the honour of first having viewed the planet through a telescope, but it is curious to remark the lapse of time that he allowed to pass before he made his first observation. The discovery that Venus exhibited phases did not take place until the end of September 1610, though Galileo first observed the satellites of Jupiter on January 7 of that year.

That Galileo should veil this important discovery of the phases of Venus under a Latin anagram,[1] does seem at first rather strange, but when one considers the vast importance of the discovery in that it supplied a simple proof of the planet's revolution round the sun, one can understand that he would first desire to be quite certain of his facts before giving the key to the anagram.

An historical fact of interest with reference to Father Castelli may be mentioned here. In Venturi's collection there is a letter from Father Castelli to the celebrated Florentian astronomer, dated November 5, 1610, in which he asks Galileo whether Venus and Mars show phases. Galileo evidently did not wish to give a direct answer, so evaded the question by saying that, although he was engaged in various investigations, he was better in bed than out in the open air in consequence of great infirmity. It was not until December 30, 1610, that he informed Castelli of his recognition of the cusps.

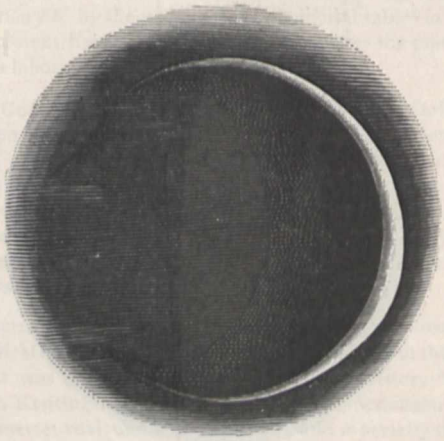


FIG. 1.—February 26, 1878 (Trouvelot).

With an ever-increasing number of telescopes at the disposal of astronomers, it is not astonishing that facts concerning surface markings, form, period of rotation, &c. should be rapidly forthcoming, and the sum total of what we now know about the planet has been gained at the expense of much labour and patience at the eye-piece end of the telescope.

During the past three months Venus has been a striking object in the south-western and western region of the sky, being in a position more than usually favourable for observation. Towards the end of November last her great southern declination began to decrease, while the planet became brighter and brighter, passing her greatest elongation east on December 6. On January 11 she attained her maximum brilliancy, the crescent form gradually increasing until on February 15, that is, at inferior conjunction, it was totally invisible. Gradually the crescent will become visible again, but in the inverse order, and we shall have another maximum on March 22, superior conjunction occurring on November 30. Thus we know that Venus is now lost in the sun's rays, and is, in consequence, invisible to us as an evening star for some time to come. The accompanying illustration (Fig. 1) gives a drawing of the planet as recorded by

[1] "Hæc immatura a me jam frustra leguntur," or with the letters properly arranged—"Cynthiæ figuras æmulatu Mater Amorum."

Trouvelot in 1878, at a time when only a very fine crescent was visible. (The bulging at the south-south-east portion of the crescent was observed, and is not a defect in the drawing.)

Of all the planets, Venus approaches us the nearest, her minimum distance amounting sometimes to approximately five million miles, that is, about five times nearer than when she is furthest from us. Unfortunately, at these times her illuminated disc is turned away from us, and all we can do is to direct our attention to the small crescent that remains before inferior conjunction is reached. This accounts for the uncertain knowledge that we possess with regard both to surface markings and the period of rotation. The latter question is still a moot point among astronomers, and it is interesting to note the historical sequence in which these investigations have been made. The first spots on the planet's disc were noted by Dominique Cassini in October and June of the years 1666 and 1667 respectively, and from them he deduced a period of 23h. 21m. Bianchini, about 60 years afterwards (1726–27), came to quite a different result, substituting 24 days 8 hours for that obtained above. Jacques Cassini, discussing his father's observations and those made by Bianchini, concluded that a period of 23h. 20m. satisfied both the old and new observations, but that Bianchini's value would not agree

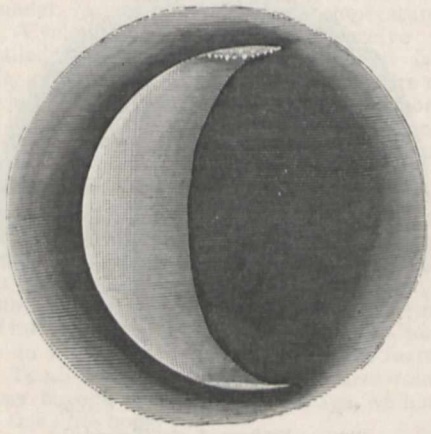
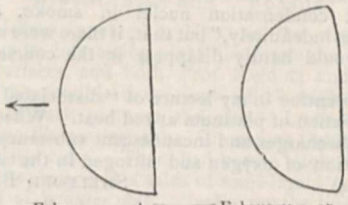


FIG. 2.—Details of snow-caps January 19, 1878 (Trouvelot).

with that of his father. This value seems for some time to have been accepted, and Schroeter's (1798–1799) and De Vico's (1840–42) observations practically confirmed it. Fig. 2 gives a view of the planet as seen on January 19, 1878, and shows the details in the polar spots sometimes available for "period of rotation" determinations.

Thus matters stood till that keen-eyed observer Schiaparelli took the field. After a most careful study, extending over many years, in which some single observations were made extending over eight consecutive hours, he was led to make the statement that the rotation of the planet is exceedingly slow, and probably takes place in a period of 224 days 7 hours, the duration of the revolution of Venus about the sun. At Nice, M. Perottin has come to a similar view, expressing his opinion in the following words: "Ne diffère pas de la durée de la revolution sidérale soit 225 jours environ, de plus de 30 jours." These two observers, especially the former, thus upset our whole belief in a short duration of the period, but we are still again brought to consider the question from observations emanating from another source. We refer to those made by Prof. Trouvelot (see NATURE, vol. xlvi. p. 470), whose opinion is of great weight. The importance of his work lies in the fact that it was carried on at the same time as that of Schiaparelli "souvent dans la même journée, sous un ciel également propice et précisément sur la même point de la planète." The value ultimately deduced was 23h. 49m. 28s., which again brings us back to a short period. In referring to Schiaparelli's observations he says: "La cause probable de l'erreur de M. Schiaparelli semble résulter de ce fait que les taches *h* et *k*, qui ont servi de base à ses conclusions, faisaient partie de la tache polaire méridionale qui, étant située centralement sur l'axe de rotation de la planète, semble rester stationnaire, comme cela se voit sur la



February 5, 2h. February 5, 5h. 43m.

FIG. 3.

tache polaire de Mars, quand elle se trouve réduite à de faibles dimensions." He also refers to the general features visible on the planet's surface as indications of a rapid rotation, especially that of the rapid deformations of the terminator and hours.

Thus we are left with the choice of two periods, one long and consisting of 224 days, the other short, of 24 hours nearly. We leave our readers to adopt that which they think best, the balance of favour falling, in our opinion, slightly towards the 24-hour side of the scale. But just as Schiaparelli's observation of the doubling of the canals of Mars was finally observed and universally accepted, so perhaps time may prove his case as regards this period of rotation.

Some of the most recent work on the planet Venus relates to the measurement of her diameter. Among a few of the reduced measures the following may be given:—Hartwig, with the Breslau heliometer, from forty-three observations obtained a diameter of 17″·67. The same observer, from a reduction of the Oxford observations, and also from Kaiser's observations with Airy's double-image micrometer, obtained 17″·582 and 17″·409 from

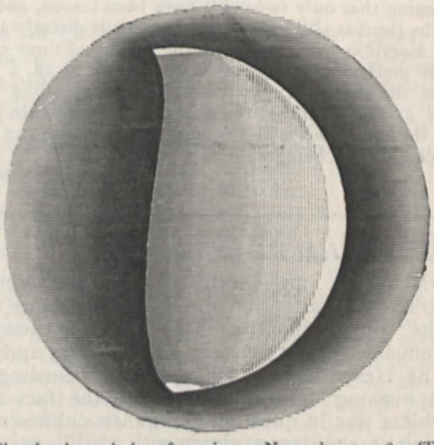


FIG. 4.—Showing irregularity of terminator November 23, 1877 (Trouvelot).

thirty-three and thirty-four observations respectively. Auwers from the transit of Venus measures deduced the value 16″·801, while Ambronn [1], from thirty-four observations, measured the diameter as 17″·711.

Among other interesting points to which we might refer, are the planet's visibility in full daylight, the snow-caps, the secondary light, the planet's form, &c. Each of

[1] See *Astr. Nachr.* No. 3204, p. 190.

these have raised a host of questions at various times, which even yet are not fully answered. The question as to the form of the planet itself is also one full of interest, and observers, from Beer and Mädler down to Trouvelot, have made numerous drawings of the different appearances. Observations have shown that the surface, or whatever it is that we look at, is by no means level, but extremely uneven or irregular. Such irregularities can be best detected naturally at the terminator and limb. Fig. 1 indicates a bulging at the limb, while Fig. 3 shows a similar phenomenon at the terminator at two different times—February 5, 2h. and 5h. 43m. (Perhaps this is one of the best proofs of a "short duration" period for rotation).

Fig. 4, which we also owe to Prof. Trouvelot, shows a more decided case of irregularity, and on perhaps a much larger scale.

Much remains, however, to be done before we are on anything like a footing with this planet as we are with Mars. With this latter we can observe directly the land and water markings, time to a second the period of rotation, observe local storms, and many other details; but with the former the case is different. Here the planet is for the most part lost in the rays of the sun, or at other times not very easy for observation.

That Venus has an atmosphere is a fact which has long been known, and that this is denser than the earth's envelope is also very probable. The part this atmosphere plays in the determination of the period of rotation seems to be of great importance, and it is rather a question of whether we have been observing real rigid markings on the planet itself, or only what has been described as "a shell of clouds, the appearances interpreted to signify the existence of lofty mountains, snow-caps, vast chasms, and crater-like depressions, are really nothing but the varying features of cloud scenery."

Whichever the case may be, future observation has still to show; but it seems that with the rapid advance now taking place in large instrument-making, such a question as this could be settled, given a few fine evenings or mornings near a favourable time of observation, a clear and still air, and a large aperture. Such occasions, perhaps, may be rare, but the point at issue is important, and should be settled as soon as possible.

W. J. L.

NOTES.

ALL the arrangements have now been made for the eleventh International Medical Congress, shortly to be held in Rome. The inauguration of the congress will take place on March 29, in the presence of the King of Italy. On the following day will commence the work of the scientific sections, which will be continued till April 5.

A CONGRESS of chemistry and pharmacy will be held in Naples at the beginning of next September. The congress will be divided into two sections—the one scientific, the other professional.

M. EUGÈNE CATALAN, a member of the Sciences Mathematiques section of the Paris Academy of Sciences, died at Liège on February 14.

ON March 18, Prof. J. Bertrand, the popular perpetual Secretary of the Paris Academy of Sciences, will have spent fifty years in expounding science. In order to celebrate this jubilee in a fitting manner, a committee has been formed, consisting chiefly of his old students at the École Polytechnique, the Sorbonne, the College de France, and the University, and a circular has been issued asking for subscriptions towards a commemorative medal which it is proposed to have struck for the occasion. The committee appeal not only to the eminent professor's old pupils, but also to his colleagues and friends who desire to do him honour. Among the members of the committee are Profs. Cornu, Marcel Deprez, Jordan, Maurice Lévy, Mascart, Mercadier, Picard, Poincaré, and M. Tisserand, the Director of the Paris Observatory. Subscriptions may be sent to any of these names, or to M. le Trésorier, de l'École Polytechnique, 21 Rue Descartes, Paris.

AN offer made by Miss Marian Brockhurst, to build a museum in the public park of Macclesfield, and endow it with £100 a year, has been accepted by the park committee.

AMONG the bequests of the late Mr. Thomas Avery, of Birmingham, is the sum of £2000 to the Midland Institute, and £1000 to Mansfield College, Oxford.

THE Malte-Brun gold medal of the Paris Geographical Society is to be awarded to M. A. Delebecque, for his researches on the French lakes, of most of which he has constructed detailed bathymetrical maps.

WE learn from the *Chemist and Druggist* that the centenary of the birth of Friedlieb Ferdinand Runge, whose name is connected with the discovery of aniline, carbolic acid, and the paraffines of coal-tar, was celebrated at Oranienburg, near Berlin, on February 6, by the unveiling of a memorial tablet in the wall of the present Royal Seminary, which occupies the place where Runge's laboratory formerly stood.

THE Council of the Society of Arts attended at Marlborough House on Friday, when the Prince of Wales, President of the Society, presented to Sir John Bennet Lawes the Albert medal, and a like medal to Sir J. Henry Gilbert, awarded to them in 1893 "for their joint services to scientific agriculture, and notably for the researches which, throughout a period of fifty years, have been carried on by them at the Experimental Farm, Rothamsted."

WE learn that the collection of fossil plants, got together by Mr. James M'Murtrie, of Radstock, has passed away from the county where it was chiefly collected to the Natural History Museum at South Kensington, where it has found a permanent home. The Somerset coal measures generally, and especially the Radstock seams, have long been known for the richness and variety of their fossil flora, which is found in a state of preservation probably not equalled in any other coal-field in the country, and a residence of more than thirty years amidst such surroundings, with the aid of many willing assistants, had enabled Mr. M'Murtrie to accumulate one of the finest private collections in the country. The collection, consisting of more than 300 specimens, includes every variety of plant life of the Carboniferous age, from the smallest variety of fern to the largest tree ferns.

A FINE egg of the gare-fowl or Great Auk was put up for auction by Mr. Stevens, on Thursday, and, after a keen competition, was purchased by Sir Vauncey H. Crewe for 300 guineas. The egg originally belonged to the late Mr. William Yarrell, and the facts relating to its purchase are stated by Prof. Newton in another column. In 1856 the late Mr. Frederick Bond purchased the specimen for twenty guineas. It remained in this gentleman's possession until 1875, when it was sold to Baron Louis d'Hamonville. Of the sixty-eight true specimens of the Great Auk's eggs known to be in existence, Great Britain is said to possess forty-eight; France, ten; Germany, three; Holland, two; Denmark, Portugal, and Switzerland, one each; and the United States, two.

THE origin of gold nuggets is a question about which much controversy has arisen. Dr. A. R. Selwyn long ago suggested that the nuggets grow in alluvial deposits by the deposition of

gold upon their surface. His theory has been supported by other geologists and chemists. Prof. A. Liversidge has recently made a large number of experiments bearing upon this question, and his conclusion is that although large nuggets may be artificially produced, those found in alluvial deposits have been derived from gold-bearing rocks and reefs, and have obtained their rounded and mammillated surface by attrition; also, any small addition of gold which they may have received from meteoric water has been quite immaterial. (Roy. Soc. N.S. Wales, September 6, 1893.)

WE have received the annual report of the Geological Survey of Canada for 1890-91 (vol. v. new series). The volume consists of 1566 pages, bound in two parts, and containing thirteen separate reports, with maps and illustrations descriptive of the geology, mineralogy, and natural history of the various sections of the Dominion to which they relate. The region surveyed is so large, and the matters described are so numerous, that a bare mention of the results would take up many columns of this paper. One of the points of interest that attracted our attention while glancing through the pages of the report, relates to the discovery of a considerable deposit of infusorial earth on the right bank of the Bras, just at its junction with the Montmorency River. The deposit is about fifteen feet thick, and occurs in sand containing boulders, about forty feet above the river, and is overlaid by fifty feet of the same material. In colour the earth is partly yellowish and partly lead-grey, these tints being sometimes arranged in different layers, and sometimes irregularly intermixed in spots and patches. Another deposit of the same kind has been found on the east side of the north branch of the Ste. Anne River. This deposit is said to extend over an area of half an acre in the river valley, and in places is more than four feet in thickness. Dr. A. R. C. Selwyn, the Director of the Survey, has the thanks of all students of geology for the mass of material he has brought together in the report, and for the manner in which it is arranged and indexed.

ANOTHER Arctic expedition is announced by Reuter's agency as being prepared in the United States by a journalist named Wollman. The proposed route is by Spitzbergen, whence "a dash is to be made for the pole," and America regained by November of the current year. In this connection it is interesting to note that an expedition under the Norwegian Ekroll was stated in the newspapers to have started in June, 1893, from the north of Spitzbergen, but from private information we understand that this expedition never set out. The experiment of an Arctic journey from this side would be well worth making, if the expedition were properly equipped and adequately organised.

THE recent planimetric measurement of France by the Geographical Department of the Army, gives as the total area 536,891 square kilometres, or 206,381 square miles, which is 2000 square miles more than was formerly accepted as the area of the country. The problem of the exact area of a country is one of the most difficult in geography, involving as it does a survey of high accuracy and very laborious computation from large scale maps. The datum is of extreme importance, as it enters into all questions of quantitative distribution; in the case in point, it reduces the average density of population in France at the census of 1891 from 187·8 to 185·8 per square mile.

AT the last meeting of the Royal Geographical Society, a paper by Mr. Warington Smyth, on the Upper Mekong, was read in his absence. The journey which was described was carried out for the Siamese Government, with the primary object of investigating a reported deposit of rubies and sapphires opposite Chiang-kong. Mr. Smyth left Bangkok in December, 1892, ascended the Menam for some distance, and crossed the mountainous country inhabited by the kindly and hospitable Laos eastward to the Mekong, which was reached near Chiang-kong. Across the river a series of low hills of crystalline rock gave origin to the gem-bearing gravels carried down by the streams which flowed from them to the main river. These gravels were being actively worked by the Burmese, who tried to keep the place of occurrence of the gems secret. The survey finished, Mr. Smyth's party came down the Mekong, five days' journey amidst beautiful scenery, to Luang Prabang, a large unwalled town of teak houses and numerous picturesque, often ruinous, monasteries. A French store established there seemed to do little business, the people preferring their home-woven cottons to the product of European looms.

WE have received an excerpt paper from the *Beobachtungen der Meteorologischen Stationen im Königreich Bayern* for 1893, containing an account of two balloon ascents, made at night-time, under the auspices of the Munich Balloon Society. The ascents were made for the purpose of investigating the conditions of the atmosphere at a time when the disturbances arising from heated ground were not effective, and the observations have been discussed by Profs. L. Sohncke and Finsterwalder, who also took part in one of the ascents. The instruments recorded automatically, electric light being employed both for attending to them and for obtaining photographic traces from some of the apparatus. The first ascent was made at 1 a.m. on July 2, 1893, from Munich, there being a barometric maximum at the time, and the second ascent was made on the 8th of the same month, under similar conditions. We can only refer here to one or two of the results of the first ascent. The most important feature in this case was the observation of a maximum temperature at a height of about 1000 feet above the ground. At a height of 400 feet the temperature was 63°·5, or 5°·4 higher than at the place of starting. In a stratum of another 450 feet there was only an unimportant rise of temperature, after which a rapid fall occurred, so that at a height of a little over 1000 feet the maximum temperature of 65°·8 was recorded, being 7°·7 higher than at the place of starting. From this point the temperature steadily decreased, and at 2900 feet it had fallen to 56°·3. The relative humidity first decreased regularly with height from 85 to 49 per cent., and then from 1400 feet to the highest point attained (2900 feet), it steadily rose to 72 per cent.

A VALUABLE contribution to the study of thunderstorms, by R. De C. Ward, appears in vol. xxxi. part ii. of the *Annals* of the Harvard College Observatory, which has just been published. Full details are given of all the storms observed in New England during the years 1886 and 1887. June, July, and August were the months in which thunder was most frequently heard, and July had the greatest number of distinct thunderstorms. The hours of greatest frequency were 5 to 7 p.m. On about 40 per cent. of the days when thunder was reported there were storms with progressive movement, the average rate in both years being about 35 miles per hour, while the maximum and minimum velocities were 50 and 14 miles per hour respectively. The results of 1886 tend to show that the dependence of thunderstorms on the larger atmospheric disturbances or cyclonic storms is not so striking as many observations have shown it to be for Europe. While in 1886 over 60 per cent. of the thunderstorms occurred in the southern or south-western quadrant of cyclones central north of New England, in 1887 the majority of the storms occurred in the south-eastern quadrant under anti-cyclonic conditions. A meteorological summary for New England in 1891, by J. Warren Smith, of the U.S. Weather Bureau, appears in the same volume.

THE last number of the *Memoirs and Proceeding* of the Manchester Literary and Philosophical Society (vol. viii. No. 1)

contains a paper by Dr. G. H. Bailey, on some aspects of town air as contrasted with that of the country. He proves that as a means of discriminating between polluted and unpolluted air, and as a means of forming some estimate of the extent of pollution, the determination of the sulphurous compounds and of organic matter are much to be preferred to that usually adopted, viz. an estimation of the carbonic acid. It is also urged that however minute the quantities of polluting matter may be, they are sufficient to bring about serious disorganisation in plant life and in human beings. Dr. Bailey has prepared a number of tables showing considerable variations in the quantity of sulphur compounds present in different localities in Manchester and London on clear days and on slightly or densely foggy days. A remarkable result derived from one of the tables is that during the dense fogs of December, 1892, in Manchester and London, there was a much larger proportion of sulphur compounds present in the London than in the Manchester air, notwithstanding the fact that the coal consumed in Manchester is generally understood to be much more sulphurous than that burnt in London.

AN ingenious method of photographing the spectrum of lightning is proposed in the current number of *Wiedemann's Annalen* by G. Meyer. The difficulty of directing the slit of the spectroscope upon the flash is got over by substituting a diffraction grating for the prism. A grating ruled on glass is placed in front of the object-glass of the apparatus, the object-glass being focussed for infinite distances. Under these circumstances several images of the flash are obtained, a central image produced by the undiffracted rays, and images of the first and higher orders belonging to the diffraction spectra. The number of images of each order corresponds to the number of lines in the spectrum of the lightning. The arrangement was tested during a night thunderstorm. Two plates were exposed in a camera with a landscape lens of 10 cm. focal length, provided with a grating with 40 lines to the mm. One of the plates showed two flashes with their diffraction images of the first order, but representing one line only. The other showed a number of flashes, and one very strong one, passing apparently between two chimney-pots, with its diffraction images well marked. A calculation of the wave-length of the light producing these images gave 382 $\mu\mu$. The measurement was not sufficiently accurate to warrant an identification of this line with a known wave-length, but it is certain that a radiation of about this wave-length must be added to the lines determined by Schuster and Vogel. It is probable that with better apparatus the method may be made to considerably increase our knowledge of the ultra-violet spectrum of lightning.

THE current number of the *Electrician* contains an abstract of a paper, by J. Sahulka, on the measurement of the capacity of condensers under alternating currents. The author has found that condensers with a solid dielectric have a smaller capacity when used with alternating currents than is given by measurement by direct current methods. He considers that the reason for this phenomenon lies in the condition of the dielectric; for even if it has a very high electrical resistance it absorbs energy in the process of charging, which energy is partly returned to the circuit in the discharge, and partly converted into heat. Thus, if a measurement of charge or discharge is made, the galvanometer deflection is too high, for it is a measure not only of the quantity of electricity passing on to or out of the coatings, but also of that taken up or returned by the dielectric. Now it is well known that the dielectric takes an appreciable time to take up this quantity of electricity, and since in alternate-current working charge and discharge occur successively with great rapidity, it follows that the dielectric has not time at every charge to take up as much electrical energy as it would if it were charged by an electromotive force applied for a much longer time. It is thus necessary to define what is meant by the capacity of a condenser where alternating currents are concerned, and the author proposes the following definition:—"The capacity of a condenser on an alternating current circuit is equal to the reciprocal of the product of $2\pi n$ and its inductive resistance, the latter being equal to the quotient of the potential difference at the condenser terminals caused by the charge, divided by the strength of the current flowing into it." The author mentions an experiment on a condenser with paraffined paper as dielectric, having a capacity of about one microfarad when measured on direct currents, which was found on an average of several experiments with alternating currents to have a capacity about 14 per cent. lower. Steinmetz's law, according to which condensers having solid dielectrics should absorb, under alternating currents, an amount of energy proportional to the square of the potential difference, was found by the author to be very approximately true.

WE have received a copy of the seventh annual report of the Liverpool Marine Biology Committee and their Biological Station at Port Erin (Isle of Man), by Prof. W. A. Herdman, F.R.S. The report shows that progress has been made in the scientific exploration of the Irish Sea during 1893, and a number of important investigations have been carried out by the sixty naturalists who worked at the station. The protective colouration of *Vibrius varians* was under observation during last summer. The manner in which individuals of this small prawn resemble the green, red, or brown seaweeds with which they are associated, on even sandy and gravel bottoms, was discussed in the report for 1892, and the question was raised as to whether, or to what extent, the adult animal could change its colour. Prof. Herdman says that a number of specimens, of various colours, were kept under observation in the laboratory during the year, in jars with various colours of seaweed and of background, and in very different amounts of light. The results of these experiments show clearly that the adult animal can change its colouring very thoroughly, although not in a very short space of time. The change in colour is due to changes in size and arrangement of the pigment granules of the chromatophores. It is remarked that an interesting point to determine is whether in this case, as in some others of similar colour changes, the modification of the chromatophores is due to nerve action and is dependent upon sight, or is the result of the direct action of light upon the integument.

A FURTHER contribution to our knowledge concerning the action of sunshine on microbes is to be found in a recent number of the *Comptes Rendus* (vol. cxviii. p. 151). MM. d'Arsonval and Charrin find that if the *b. pyocyaneus* (an organism frequently found in the pus from wounds) is exposed to sunshine in culture liquid (presumably broth) for from three to six hours, it is deprived of its pigment-producing power; if, however, it is only subjected to the influence of the *red* rays in the spectrum, it exhibits subsequently the typical fluorescent green colour on cultivation in agar-agar at 37° C. Moreover, if the amount of sunshine it receives is extended, no growths at all subsequently make their appearance, showing that it has been destroyed; whilst it can tolerate a similar exposure to the red rays without exhibiting any signs of discomfort. This loss of pigment-producing power may also, these investigators state, be brought about by subjection to very low temperatures; thus at between −40° and −60° C. this bacillus loses its characteristic rod-like shape, frequently becoming ovoid; it multiplies very slowly, and exhibits only creamy white growths on agar-agar.

WE have received a volume containing statistics of the colony of Tasmania for the year 1892, compiled in the office of the Government Statistician from official records.

THE February *Journal* of the Royal Microscopical Society contains the address on "The Progress and Present State of our Knowledge of the Acari," delivered by the president, Mr. A. D. Mitchell, on January 17 of this year.

THE number just issued of the *Journal* of the Institution of Electrical Engineers contains Prof. G. Forbes's paper upon "The Electrical Transmission of Power from Niagara Falls," and the valuable discussion which it raised.

MESSRS. WITHERBY AND CO. will issue next month a volume of essays on zoological and geological subjects by Mr. Richard Lydekker. The volume is to be entitled "Life and Rock," and will be fully illustrated.

A FIFTH edition of Mr. W. Larden's "School Course in Heat" has been published by Messrs. Sampson Low, Marston, and Co. The book has been enlarged, and in places rewritten, and has gained in value by the refining process to which it has been subjected.

A FIFTH edition of the late Prof. Tyndall's biographical sketch of Faraday has been published by Messrs. Longmans, Green, and Co. The preface of this new edition possesses a melancholy interest, for, in a brief note appended to it, Mrs. Tyndall says it was only written a few days before her husband's death.

JUDGING from the twenty-fourth annual report just received, the Wellington College Natural Science Society is in a very satisfactory condition. The report contains abstracts of the papers read before the Society during the year, the results of meteorological readings, observations of plants and insects, and a statement of entomological occurrences and peculiarities. The Society is certainly a creditable part of the College to which it belongs.

THE 1894 *Annuaire* of the Municipal Observatory of Montsouris contains, in addition to the usual meteorological, physical, and chemical tables, an article by M. Albert Lévy on the chemical analysis of air and water, and a memoir by Dr. P. Miquel on the organic matter in air and water. The latter paper deals with the microscopic analysis of the air of Montsouris and that of the centre of Paris, the microscopic analysis of water, and statistics as to ammoniacal ferments in the air and water of different places.

THE Universal Electrical Directory (J. A. Berly's) for 1894 has been published by Messrs. H. Alabaster, Gatehouse, and Co. It contains the names of the members of the electrical and kindred fraternities throughout the world. For simplicity and facility of reference the work is divided into four groups, dealing respectively with British, Continental, American, and Colonial names, and these parts are again subdivided into alphabetical and classified sections. Several thousands of new names have been incorporated in the present issue, and 104 pages have been added, making a total of 888 pages.

IN March of last year we noticed the first report of the proceedings of the International Congress of Prehistoric Archæology and Anthropology held at Moscow in 1892. The second volume has now reached us. The memoirs included in it are arranged into three classes, referring respectively to prehistoric archæology, anthropology, and prehistoric ethnology. In addition to these memoirs, many of which are of great importance, the present volume contains the *Procès-verbaux* of the meetings. Another volume that has also been recently published contains descriptions of the places and institutions visited during the Congress, and reports on some of the questions discussed.

IT is announced that a new monthly review of current scientific investigation—*Science Progress*—will make its *début* to-day. The new journal will be published by the Scientific Press, and will be edited by Prof. J. Bretland Farmer, with the assistance of an editorial committee, consisting of Prof. H. E. Armstrong, F.R.S.; Prof. C. S. Sherrington, F.R.S.; Prof. J. W. Judd, F.R.S.; Prof. R. T. Weldon, F.R.S.; Prof. G. B. Howes, and Prof. H. Marshall Ward, F.R.S. The editors propose to include in *Science Progress* notices and reviews of all the effective work that is being accomplished in the various branches of science, and the articles will aim at providing a critical exposition of current work in the departments to which they refer. In this way it is hoped that the journal will be of use, not only in recording what has actually been done, but also as indicating the direction and general tendency of research.

THE first number of the new series of *Science Gossip* contains, among other articles, one by the editor, on science at the free libraries. A recent tour through the metropolitan libraries, and those in some of the larger midland counties' towns, has shown Mr. Carrington that in many cases the income of the library goes in the purchase of fiction or general expenses, and the librarian depends upon donations for the science section of his catalogue, and must accept whatever comes to hand. To remedy this, it is suggested that some authoritative body, such as the Education Department of the Imperial Government, or failing that, the Library Association, should invite the councils of various learned societies, like the Royal, Linnean, Zoological, Geological, Geographical, Astronomical, Botanical, Chemical, Anthropological and Meteorological, to draw up a list of works dealing with their especial subjects, so as to get a list of good text-books and authorities. This list might be revised from time to time, as changes became necessary through the progress of research.

THE atomic weight of palladium has been subjected to revision by Prof. Keiser and Miss Breed. A previous investigation of the value to be ascribed to this metal was carried out by Prof. Keiser in 1889, the salt palladium diammonium chloride, $Pd(NH_3Cl)_2$, which was considered for many reasons to be particularly suitable, being employed. The number derived from nineteen determinations was 106·27. Since that time three other determinations of the atomic weight of palladium have been carried out, by Bayley and Lamb, and by Keller and Smith in 1892, and by Joly and Leidié in 1893, the results of which are most discordant, differing by as much as a unit and a half. Dr. Keiser has therefore returned to the work, and has succeeded in discovering a compound of palladium which can be vapourised, and therefore subjected to fractional distillation, a method which Stas considered as the only one by which substances may be obtained in the highest state of purity. The compound in question is the dichloride $PdCl_2$, which can be distilled at a low red heat in a current of chlorine. The pure chloride thus obtained was converted into palladammonium chloride, and the latter compound analysed by reduction to metallic palladium in a current of pure hydrogen. The results of all the analyses afford as the final mean value for the atomic weight the number 106·25, which agrees remarkably closely with that previously obtained by Dr. Keiser. The most divergent of all the individual values are only 0·07 apart, so that it would appear that the atomic weight of palladium is now definitely determined.

A FURTHER communication upon the subject of the artificial preparation of the diamond is contributed to the *Comptes Rendus* by M. Moissan. It was shown in an earlier memoir that when carbon is dissolved in various fused metals at the temperature of the electric furnace and at the ordinary pressure,

it invariably crystallises out upon cooling in the form o graphite of density about 2; but that when the operation is performed under increased pressure the density and hardness of the carbon which eventually separates are augmented, and black diamonds are produced in considerable quantity. A modification of the original form of these pressure experiments is now described, which results in the production of small but perfectly transparent and colourless diamonds similar to those found naturally. The former experiments were made with iron and silver as solvents for the carbon, the mixture of metal and excess of charcoal being heated in the arc of the electric furnace under pressure until most of the charcoal was dissolved in the white-hot metal, after which the hot crucible was th rown into a tank of water to effect sudden cooling. Bismuth has since been tried as a solvent, but is not found suitable, as a violent explosion is caused when the fused mass is projected into water, probably owing to the sudden decomposition of a carbide of bismuth. Iron is therefore used, and the cooling is effected by pouring the contents of the crucible into a bath of just melted lead. The solution of carbon in molten iron, being lighter than liquid lead, rises to the surface in spherical globules; the smaller spheres solidify before reaching the su rface of the lead, but the larger ones are still liquid and are still so hot that they cause the lead at the surface to burn in contact with the air, incandescent particles of metal and oxide being projected out, and torrents of fumes of litharge produced. Upon removing the globules floating at the surface of the lead, dissolving their leaden coating in nitric acid, and subsequently removing the iron by suitable solvents, as previously described by M. Moissan, the transparent diamonds are readily isolated. They frequently exhibit well-defined crystal faces, which are usually curved and striated and etched with cubical markings exactly like those of natural diamonds. They possess the same wonderful limpi dity, high refractive power, hardness, and density (3·5) as native diamonds, and exhibit many of the properties, such as anomalous polarisation and occasional spontaneous disruption, owing to their state of strain resulting from their formation under high pressu re, which are characteristic of some Cape diamonds. The hemihedral forms of the cubic system appear to predominate in the crystals e xamined. They scratch rubies, and resist the action of a mixture of potassium chlorate and fuming nitric acid, but burn in oxygen at a temperature of about 900° with formation of pure carbon dioxide.

NOTES from the Marine Biological Station, Plymouth.—During the past fortnight the alga *Halosphæra viridis* has frequently been present in the tow-nettings. The proportion of Mollusc, Polychæte, and Cirrhipede larvæ to the rest of the floating fauna has become still greater. The medusa *Phialidium variabile* is obtainable in about the same numbers as previously, and a few *Obelia* medusæ have made their first appearance for the year; but, strange to say, *Rathkea octopunctata* has not been observed, and even the ephyræ of *Aurelia*, although numerous in the open Channel, have been scarce within the Sound. No Echinoderm larvæ have been yet observed. The Hydroids *Tubularia indivisa*, *Eudendrium ramosum*, and *Sertularia argentea*, and the Molluscs *Nassa reticulata*, *Lamellaria perspicua* and *Lamellidoris pusilla* are now breeding.

THE additions to the Zoological Society's Gardens during the past week include two Mozambique Monkeys (*Cercopithecus pygerythrus*, ♂ ♂) from East Africa, presented by Lt.-Gen. Owen L. C. Williams; a Hooded Crow (*Corvus cornix*) from Norway, presented by Mrs. Wroughton; a Puff Adder (*Vipera arietans*), a Hoary Snake (*Coronella cana*) from South Africa, presented by Mr. B. Matcham; a Hairy Porcupine (*Sphingurus villosus*) from Brazil, deposited.

OUR ASTRONOMICAL COLUMN.

A LARGE SUN SPOT.—During the foggy days of last week, when the brightness of the sun was not too great to permit direct observation, a sun-spot, which was very plainly visible to the naked eye, attracted general attention. It was first seen in the south-east quadrant on February 19, and will probably pass off the visible disc about March 2. It has been somewhat remarkable for its relatively large penumbra and the scattered character of the umbra; a very distinct nucleus was also observed. In the course of an interview, Mr. Maunder stated that the spot was at a maximum on February 20, when it was about 48,000 by 46,000 miles, and the area 1870 millions of square miles. It was therefore much smaller than the great spot of February 1892. Though the magnetic disturbances have not been so great as in the case of the 1892 spot, a marked effect on the Greenwich recording magnets was noticed at 3.15 p.m. on February 20, the disturbance lasting about twenty-seven hours. After an interval of about twenty-four hours, another and more intense storm commenced, and reached a maximum at 3 p.m. on February 23. In the case of the spot of February 1892, the violent magnetic storms occurred *after* the spot had passed the central meridian; but in the present instance, the disturbances seem to have preceded the central transit of the spot.

ANDERSON'S VARIABLE IN ANDROMEDA.—Prof. E. C. Pickering announces in *Astronomische Nachrichten* (No. 3213) that an examination by Mrs. M. Fleming of photographs taken at the Harvard College Observatory confirms the variability of the star in the constellation Andromeda (R.A. oh. 14m. 48s. Decl. +26° 10·3) observed by Dr. Anderson (NATURE, Nov. 30, 1893). The observations, and those quoted by Dr. Anderson, as having been made at Bonn and Cambridge, indicate that the period of the variable is 281 days, and that the next maximum will occur on March 30. A determination of the form of the light curve led to the interesting result that during the three months following a maximum, the diminution in light is at the uniform rate of one magnitude in twenty-five days; for the three months preceding the maximum the increase is also uniform, and at the rate of one magnitude in twenty-six days. Prof. Pickering points out that this great uniformity in the variation in light of the star appears less extraordinary if a similar uniformity in the diminution of the light of Nova Aurigæ is considered. From March 7 to March 31, 1892, the light of this star diminished from magnitude 6·3 to 13·3 with almost perfect regularity at the rate of three-tenths of a magnitude per day.

Following Prof. Pickering's note is one in which Dr. E. Hartwig gives observations to show that the next maximum of the variable under consideration will occur on March 10, and that the period of variability is 74·4 days.

A BRIGHT METEOR.—Mr. Andrew Greig writes to us as follows:—"A very bright meteor was seen at Dundee at 7h. 18½m. p.m. on Wednesday, February 21. It was a little to the east of south, and midway between Sirius and Orion's belt. It was falling in a westerly direction, or parallel to a line joining the stars Betelgeux and Rigel. It was visible for about three seconds. There was a slight haze above both southern and northern horizons at the time, but Vega could easily be seen low down in the north. The portion of the sky around Jupiter and the Pleiades was quite clear. 'Streamers' were observed in the north for about three minutes afterwards."

This meteor was also seen in North Lincolnshire. To an observer in that district it appeared in the north-west by northern part of the sky, and fell in a westerly direction. Among other places in which the object was observed are Colwyn Bay, Whitby, Howden, and Sandal; but no details as to the path it traversed, or the times of observation, have reached us from these places. An explosion was heard at Colwyn Bay, but no sound is mentioned by other observers.

THE BAKERIAN LECTURE.

AN investigation on the internal friction of liquids, carried out by Prof. T. E. Thorpe, F.R.S., and Mr. J. W. Rodger, formed the subject of the Bakerian Lecture delivered at the Royal Society on February 22. The following is an abstract of the communication:—

The purpose of this paper is to throw light upon the relations between the viscosity of homogeneous liquids and their chemical nature.

The first of the three parts into which the paper is divided contains a summary of the attempts which have been made, more particularly by Poiseuille, Graham, Rellstab, Guerout, Pribram and Handl, and Gartenmeister, to elucidate this question. Although it is evident from the investigations of these physicists that relationships of the kind under consideration do exist, it must be admitted that they are as yet not very precisely defined mainly for the reason that the conditions by which truly comparable results can alone be obtained have received but scant consideration.

For example, it seems futile to expect that any definite stoichiometric relations would become evident by comparing observations taken at one and the same temperature. Practically, nothing is known of a quantitative character concerning the influence of temperature on viscosity.

From the time which a liquid takes to flow through a capillary tube under certain conditions, which are set out at length in the paper, a measure of the viscosity of the liquid can be obtained.

An apparatus was, therefore, designed on this principle which admitted of the determination in absolute measure of the viscosity, and for a temperature range extending from 0° up to the ordinary boiling point of the liquid examined.

Full details of the conditions determining the dimensions of the apparatus and of the modes of estimating these dimensions, together with the methods of conducting the observations, are given in the paper, and the corrections to be applied to the direct results are discussed.

The question of the mathematical expression of the relation of viscosity of liquids to temperature is considered, and reasons are given for preferring the formula of Slotte—

$$\eta = c/(1 + bt)^n$$

η is here the coefficient of viscosity in dynes per square centimetre, and c, b, and n are constants varying with the liquid.

With a view of testing the conclusions set out at length in the historical section of the paper, and, in particular, of tracing the influence of homology, substitution, isomerism, and, generally speaking, of changes in the composition and constitution of chemical compounds upon viscosity, a scheme of work was arranged which involved the determination, in absolute measure, of the viscosity of some seventy liquids, at all temperatures between 0° (except where the liquid solidified at that temperature) and their respective boiling points.

Part ii. of the memoir is concerned with the origin and modes of establishing the purity of the several liquids; it contains the details of the measurements of the viscosity coefficients, together with the data required to express the relation of viscosity coefficients to temperature by means of Slotte's formula, and tables are given showing the agreement between the observed and calculated values.

In Part iii. the results are discussed. In the outset the factors upon which the magnitude of the viscosity probably depends are dealt with. The influence of possible molecular aggregations, as indicated by observations of vapour densities, boiling points, and critical densities, and, more especially, by measurements of surface energy, made by Eötvös in 1886, and more recently by Ramsay and Shields, are taken note of.

The deductions which may be made by considering the graphical representation of the results, showing the variations of viscosity coefficients with temperature, are then set forth.

For liquids which probably contain simple molecules, or for which there is little evidence of association of molecules at any temperature, the following conclusions may be drawn:—

(1) In homologous series the coefficient of viscosity is greater, the greater the molecular weight.

(2) An iso-compound has always a smaller viscosity coefficient than the corresponding normal compound.

(3) An allyl compound has, in general, a coefficient which is greater than that of the corresponding isopropyl compound, but less than that of the normal propyl compound.

(4) Substitution of halogen for hydrogen raises the viscosity coefficient by an amount which is greater, the greater the atomic weight of the halogen; successive substitutions of hydrogen by chlorine in the same molecule bring about different increments in the viscosity coefficients.

(5) In some cases, as in those of the dichlorethanes, substitution exerts a marked influence on the viscosity, and in the case of the dibromides and benzene, it may be so large that the compound of higher molecular weight has the smaller viscosity.

(6) Certain liquids, which probably contain molecular complexes, do not obey these rules. Formic and acetic acids are exceptions to Rule 1. The alcohols at some temperatures, but not at all, are exceptions to Rule 2; at no temperatures do they conform to Rule 3.

(7) Liquids containing molecular complexes have, in general, large values of $d\eta/dt$.

(8) In both classes of liquids the behaviour of the initial members of homologous series, such as formic acid and benzene, is in some cases exceptional when compared with that of higher homologues.

As regards the influence of temperature on viscosity, it is found that the best results given by Slotte's formula are in cases where the slope of the curve varies but little with the temperature. From the mode in which the values of the constants n and b are derived, it cannot be expected that their magnitudes will be related in any simple manner to chemical nature. With the exception of certain liquids, such as water and the alcohols, which are characterised by large temperature coefficients, and in which there is reason to expect the existence of molecular aggregates, the formula

$$\eta = c/(1 + \beta t + \gamma t^2),$$

obtained from Slotte's expression by neglecting terms in the denominator involving higher powers of t than t^2, gives a close agreement with the observed results, and in this formula the magnitude of β and γ are definitely related to the chemical nature of the substances.

In order to obtain quantitative relationships between viscosity and chemical nature, and to compare one group of substances with another, it is necessary to fix upon particular temperatures at which the liquids may be taken as being in comparable conditions as regards viscosity, and to compare the values of the viscosities at those temperatures.

The first comparable temperature which suggested itself was the boiling point.

A second comparable temperature was obtained by calculating values of corresponding temperatures by the method of van der Waals with such data as could be obtained.

The third basis of comparison consisted in using temperatures of equal slope, *i.e.* temperatures at which the rate of change of the viscosity coefficient is the same for all liquids.

At each of the different conditions of comparisons, the experimental results have been expressed according to the same system, in order to show at a glance relationships between the magnitudes of the viscosity constants and the chemical nature of the substances. The liquids are arranged so that chemically related substances are grouped together. Tables are constructed which give the values of the three different magnitudes derivable from measurements of the viscosity of the substances.

(1) Values of viscosity coefficients (η).

(2) Values of $\eta \times$ molecular area, *i.e. molecular viscosity*.

(3) Values of $\eta \times$ molecular volume, *i.e. molecular viscosity work*.

The coefficient η is the force in dynes which has to be exerted per unit-area of a liquid surface in order to maintain its velocity relative to that of another parallel surface at unit distance equal to unity. It seemed, however, that relations between viscosity and chemical nature would best be brought to light if, instead of adopting merely unit-areas, areas were selected upon which there might be assumed to be the same number of molecules. The *molecular viscosity* is proportional to the force exerted on a liquid molecule in order to maintain its velocity equal to unity under the unit conditions above defined. With the units chosen it is the force in dynes exerted on the molecular area in square centimetres under unit conditions. The *molecular viscosity work* may be regarded as proportional to the work spent in moving a molecule through the average distance between two adjacent molecules under unit conditions. In ordinary units it is the work in ergs required to move a surface equal to the molecular area in square centimetres through the molecular length in centimetres.

In the case of the comparison of the viscosity coefficients at the boiling point, it is found:

(1) As an homologous series is ascended, in a few cases the viscosity coefficient remains practically the same, but in the greater number of series the coefficients diminish. In one series the coefficients increase; in the case of the alcohols the coefficients vary irregularly with ascent of the series.

(2) Of corresponding compounds, the one having the highest molecular weight has in general the highest coefficient (the

aliphatic acids, and to a much greater extent the alcohols, do not conform with this rule).

(3) Normal propyl compounds have, as a rule, slightly higher values than allyl compounds; in the case of the alcohols, propyl compounds have much the higher value.

(4) The effect of molecular weight in some cases may be more than counterbalanced by that of constitution, or of complexity.

(5) The lowest members of homologous series frequently exhibit deviations from the regularity shown by higher members.

(6) An iso-compound has in general a larger coefficient than a normal compound, and the differences reach their maximum in the case of the alchohols.

(7) In the case of other metameric substances, branching in the atomic chain and the symmetry of the molecule influence the magnitudes of the coefficients; the ortho-position, in the case of aromatic compounds, appears to have a more marked effect on the coefficient than either the meta- or para-position. Acetone and ether have coefficients that are less than half the values given by the isomeric alcohols.

(8) One of the most striking points thus brought to light is the peculiar behaviour of the alcohols, and to some extent of the acids, as contrasted with that of other liquids.

Comparisons of molecular viscosity at the boiling point show—

(1) That, with the exception of the alcohols, dibromides, and the lowest members of homologous series, an increment of CH_2 in chemical composition corresponds with an increase in molecular viscosity.

(2) With the above exceptions, it is also apparent that the corresponding compound having the highest molecular weight has the highest molecular viscosity: the difference in molecular viscosity between the corresponding members of two correlated series is fairly constant.

(3) The relationships shown in the other tables are substantially of the same nature as those given by the viscosity coefficients.

The comparisons which give the largest deviation from regularity contain those substances which, as already shown, exhibit a peculiar behaviour, namely, the alcohols, acids, propylene dibromide, ethylene dichloride, &c.

In order to indicate how molecular viscosity at the boiling point is quantitatively connected with chemical nature, attempts were made to calculate the probable partial effects of the atoms on the molecular viscosity. Values were also assigned to the effects of the iso-grouping of atoms, the double linkage of carbon atoms, and the ring grouping.

Tables are given which show the concordance between the observed molecular viscosity and those calculated by means of these constants. In the case of forty-five liquids the difference between the observed and calculated values rarely exceeds 5 per cent. In the case of the isomeric ketones and aromatic hydrocarbons, the differences are in part due to constitutive influences, which cannot at present be allowed for in obtaining the calculated values.

In a second table are given those substances for which the differences exceed this 5 per cent. limit. These may be roughly classed as unsaturated hydrocarbons, polyhalogen compounds, formic and acetic acids, benzene, water, and the alcohols.

Similar fundamental constants for molecular viscosity work at the boiling point have also been deduced, and tables are also given showing the comparison between the observed and calculated numbers, the substances being classified into two groups, as in the case of molecular viscosity, according as the differences are less or greater than about 5 per cent.

On taking a general survey of the comparisons at the boiling point, it is evident that for the majority of the substances examined—the paraffins and their monohalogen derivatives, the sulphides, the ketones, the oxides, and most of the acids and the aromatic hydrocarbons—molecular viscosity and molecular viscosity work may be quantitatively connected with chemical nature. The remaining substances—unsaturated hydrocarbons, di- and poly-halogen compounds, formic acid, benzene, water, and the alcohols—present marked exceptions to the foregoing regularities.

As regards the comparison of the viscosity magnitudes at the corresponding temperature, it is found that, although the critical data are too unsatisfactory to warrant us in laying any particular stress on the relationships obtained under this condition of comparison, these relationships are similar to, even if less definite than, those obtained at the boiling point. For a property like viscosity, which alters so rapidly with temperature, a corresponding temperature is no better as a condition of comparison than the boiling point.

The third series of comparisons was made at temperatures at which $d\eta/dt$ is the same for the different liquids. Or, graphically, the temperatures may be defined as those corresponding with points on the viscosity curves at which tangents are equally inclined to the axes of coordinates. The temperatures are therefore those at which temperature is exercising the same effect on viscosity, and for shortness may be termed *temperatures of equal slope*. The temperatures were obtained by means of Slotte's formula.

It was apparent from the shape of the curves that all the liquids could not be compared at any one value of the slope, because the effect of temperature on the slope varied so much from substance to substance. In some cases—the whole of the alcohols for example—the slope at the boiling point was considerably greater than that at 0° in the case of some of the less viscous liquids. A slope was, therefore, selected at which as many liquids as possible could be compared. Another slope was then obtained at which the outstanding liquids could be compared with as many as possible of the liquids used at the original value of the slope. The relationships between the magnitudes of the viscosities of these liquids which could be compared at the two slopes were then found to be the *same at either slope*, so that general conclusions regarding the behaviour of all the liquids could be deduced. These are as follows:—

(1) Temperatures of equal slope tend to reveal much more definite relationships between the values of viscosity coefficients and the chemical nature of substances than are obtained at the boiling point.

(2) In all homologous series, with the exception of those of the alcohols, acids, and dichlorides, the effect of CH_2 on the value of the coefficient is positive, and tends to diminish as the series is ascended.

(3) Of corresponding compounds the one of highest molecular weight has the highest coefficient.

(4) Normal propyl compounds have slightly larger coefficients than the corresponding allyl compounds.

(5) An iso-compound has invariably a larger coefficient than a normal compound.

(6) In the case of other isomers the orientation of the molecule and branching of the atomic chain influence the magnitudes of the coefficients. Similar effects of constitution are also exhibited on comparing saturated and unsaturated hydrocarbons, and the variable effects produced by successive substitution of halogen for hydrogen.

(7) The alcohols, and to some extent the acids, still give results which are peculiar when compared with other substances.

As regards molecular viscosity at equal slope the following conclusions may be drawn:—

(1) For the great majority of the substances molecular viscosity at equal slope can be calculated from fundamental constants which express not only the partial effects of the atoms existing in the molecule, but also those due to different atomic arrangements.

The large effects which can be attributed to the ring-grouping of atoms, to the iso-linkage, to double-linkage, and to changes in the condition of oxygen in its compounds, as well as the smaller effects due to the accumulation of atoms of halogen in a molecule, render evident the quantitative influence of constitution.

(2) Of the remaining substances the chlormethanes, terrachlorethylene, ethylidene chloride and carbon bisulphide give deviations from the calculated values on account of constitutive influences not allowed for in obtaining the fundamental constants.

(3) The alcohols and water exhibit no agreement with the calculated values. The mode in which deviations vary indicates, in the case of the alcohols, that the disturbing factor is related to their chemical nature.

The results obtained from the consideration of molecular viscosity work at equal slope, are of precisely the same nature as those discussed under molecular viscosity.

The substances which give deviations from the calculated values fall into two classes. In the first the deviations are to be attributed to chemical constitution, inasmuch as similar disturbing effects may be detected in the magnitudes of other

physical properties which afford no evidence of being influenced by molecular complexity.

In the second are substances like the acids, water, and the alcohols, for which the disturbing factor is, no doubt, molecular complexity.

The question of the generality of the results obtained is next discussed. It is evident:

(1) That over such temperature ranges as the observations extend the results obtained at a particular value of the slope may be regarded as general for all liquids, with the exception of the alcohols, for which the relationships vary slightly as the slope alters. A general expression connecting the viscosity coefficient with the slope is given.

(2) It is further indicated, from comparisons made by the use of slopes which varied from liquid to liquid, and which were chosen according to definite systems, that in the present state of the question equal slope is the most suitable condition at which to compare the viscosities of different liquids.

With respect to the relationships existing between the magnitudes of the comparable temperatures of equal slope, it appears:—

(1) That these vary in a regular way with the chemical nature of the substances, except in the case of liquids like benzene and propylene dibromide, giving viscosity curves which are abnormal when compared with those of their homologues.

(2) The temperature relationships may also be regarded as general and thus independent of the value of the slope, except in the case of the alcohols, which, in this respect, as in that of viscosity at equal slope, are anomalous.

The rest of the memoir is concerned with the discussion of certain general conclusions regarding physicochemical comparisons; and it finally deals with other possible methods of obtaining and comparing viscosity magnitudes.

THE DYNAMICS OF THE ATMOSPHERE.

UNDER this title a series of articles appeared in the *Meteorologische Zeitschrift* for May, August, and September, 1893, from the pen of Prof. M. Möller, of Brunswick, which treat of many of the important processes that are at work in our atmosphere.

The principal feature in these discussions is that the author treats the various phenomena as the result of complicated processes, and inquires into their character separately, prior to attempting to draw conclusions from them, so that some relations are presented in a new form.

With regard to the part which aqueous vapour plays in the atmosphere, it is usually stated that the heat set free in condensation during the formation of clouds greatly favours the origin of ascending air-currents, but Möller takes another view of the matter. Two columns of air have usually been compared with each other, having at their base similar initial temperature, but in which the decrease of temperature with height proceeds in a different manner, as one column is supposed to contain dry air, that is very cold at the upper end, and the other moist air warmed by condensation. But the author considers that this difference of temperature does not actually occur in this manner, and that all theories based upon this assumption must lead to erroneous results. He states that as the air of the upper strata has risen up previously, it has consequently gone through the process of warming by condensation, so that the increase of heat caused by condensation cannot produce by itself a higher temperature in the ascending current than that possessed by the surrounding air, hence the cause of the upward impulse, which has been attributed to the aqueous vapour of the air, disappears. If it is wished to produce a circulation of the air in two vertical tubes in communication at both ends, the air in the bottom part of the one tube must be warmed, while that in the upper part of the other tube is cooled; but if the source of heat is applied at the top, a condition of stable equilibrium and rest takes place. In the same way the condensation of the aqueous vapour causes a warming of the upper strata of air, the effect of which is generally to produce a condition of stable equilibrium, contrary to the theory which assumes that the condensation of the vapour favours the ascending current, and consequently gives rise to depressions. The author attributes the chief cause of the origin of cyclones to horizontal differences of temperature in the earth's atmosphere, to the steep gradients of the upper strata caused by them, and the consequent strong movements of the air in those regions. He agrees in the main with the views of Ferrel, but attributes greater importance to the effect of friction against the rough surface of the earth. The air which rises at the equator, and moves in the upper regions towards the pole, takes, according to the law of the preservation of the moments of rotation, a west to east velocity, whose right-handed deflective force in the northern hemisphere is opposed to the poleward motive effect of the upper gradient.

According to Prof. Möller, this right-handed force over the dry zone, in the belts of high pressure, on both sides of the tropics, and in higher latitudes, becomes so great that a condition of equilibrium of the forces is produced in the direction of the meridians. Apart from local disturbances, the upper wind here follows the parallels of latitude, unless owing to friction, or the mixing of the upper and lower strata, a diminution of the upper current occurs, whereby the meridianal deflecting force of the upper gradients gains the mastery over the decreased right-handed deflective force arising from the centrifugal effect. Only then, and in proportion as this diminution of the upper current occurs, does the upper current follow the meridianal upper gradient. In this case a part of the energy gained in the upper currents of the atmosphere is transferred to the lower strata, so that there the velocities which are directed from west to east increase. The atmosphere, therefore, in the temperate and polar zones is like a caloric machine, which first produces by meridianal gradients of temperature the upper gradients of pressure, and consequently an air current from west to east at a great height, whose transference to the lower strata of air depends upon opportunities of friction or mixture of masses of air. The meridianal advance of air in the upper air-current is checked by the centrifugal force; for the advance to the pole increases the velocity of the west wind, and thus the centrifugal right-handed deflective force whose effect stops the meridianal advance of air to the pole. Möller states that this important relation of interchange was not clearly expressed in Ferrel's theory. He first assumes that a circulation between the hot and cold zones takes place unhindered, and, provided the circulation takes place, he makes the high velocities to exist in the upper current. Ferrel also computes the great forces which would be necessary in order to produce those high velocities, and he admits that these really do not exist. He speaks of this theory as only approximately correct, whereas the computed forces and great meridianal differences of pressure fail in nature, and the high westerly wind-velocities, such as his theory requires, do not exist.

Prof. Möller concludes (1) that the regular and undisturbed circulation of the atmosphere between the hot and cold zones is not accomplished in the manner hitherto supposed, and as has been presumed in Ferrel's calculations, and states that if Ferrel's theory is to become of practical use, it will be necessary to study more exactly the relations between the friction of air on the surface of the earth, and especially the friction or the mixture of air between upper and lower strata. (2) If friction of air against the earth's surface is great, the velocity of the winds is less; but if friction, or mixture of air, between upper and lower strata is great, then the lower winds blow more violently. (3) In higher latitudes no storm can be caused by horizontal meridianal gradients of temperature without mixture or friction between the upper and lower strata.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Savilian Professor of Astronomy, Mr. H. H. Turner, gave his inaugural address on Friday last, in the new schools, before the Vice-Chancellor and a large audience. The Professor illustrated his subject, "The International Photographic Chart of the Heavens," by numerous lantern-slides, and referred particularly to the large share in the work allotted to the Oxford Observatory, and to the progress which had already been made.

Prof. Sylvanus P. Thompson gave a lecture before the Ashmolean Society on Monday last, on the subject of "Magic Mirrors." The lecture was illustrated by numerous specimens and experiments, and was much appreciated by a large audience.

An election to the Sipthorpian Professorship of Rural Economy is announced to take place in Easter Term, 1894.

Candidates are to send in their applications to the Registrar of the University on or before April 21. The tenure of the Professorship is limited to three years, at the expiration of which the Professor may be re-elected for a further period of three years, but no one may hold the Professorship for more than six years consecutively.

The committee on Degrees for Research have presented a long report to the Hebdomadal Council, which has been approved by that body. The report contains recommendations that will beneficially affect the study of Science in the University. It is proposed that degrees of M.Sc. and M.Litt. shall be established which shall be open (*a*) to members of the University of Oxford who have taken the B.A. degree, and (*b*) to students, not being graduates of Oxford, who can give satisfactory proof of general education and fitness to enter upon a special course of study. Three years' residence will be required from the second class of students, or two years from those who have studied for at least two years in a university or local college approved by Convocation, or in an affiliated college. No candidate is to be admitted who is under the age of twenty-one, and every candidate not being a member of the University shall be required to matriculate, and to pursue his studies during his term of residence under the supervision of a committee appointed by a special Delegacy to be established for the purpose. In supplicating for the Degree, every candidate must produce a certificate from the Delegacy stating the line of study or research which he has pursued, accompanied by a report, drawn up by the candidate, of the work he has done.

CAMBRIDGE.—Honorary Degrees are to be conferred on the Earl of Kintore, Governor of South Australia, whose adventurous journey across that continent will be remembered, and on Prof. Ramón y Cajal, of Madrid, the Croonian lecturer of this year.

Lord Rayleigh has been appointed an Elector to the Professorships of Chemistry and of Mechanism, Sir R. Ball to the Plumian Professorship, Sir G. Humphry to that of Anatomy, Sir G. G. Stokes to the Jacksonian and the Cavendish Professorships, Dr. D. McAlister to the Downing Chair of Medicine, Dr. Hugo Müller to the Chair of Mineralogy, Prof. Chiene to the Professorship of Surgery, and Sir James Paget to that of Pathology.

Dr. Shore has been appointed an Examiner in Physiology in place of Dr. A. S. Lea, who is unable to examine owing to ill-health.

ON February 24, the Prince of Wales formally opened the new Polytechnic in Battersea, which has been erected at a cost of nearly £60,000. The institute forms the third of a trio of polytechnics in South London, the others being situated in the Borough-road and at New-cross, respectively. The latter institute, for which the Goldsmiths' Company provided the entire funds, namely £70,000, and an endowment of £5,000 a year, has now been open for some time, and has proved a signal success. The Borough-road institute cost about £50,000, and has been open for about a year.

DR JOHN T. HEWITT, Assistant-Demonstrator at the Cambridge University Chemical Laboratory, has been appointed by the Governors of the People's Palace to the vacant Professorship of Chemistry. Dr. Hewitt was a student of the Royal College of Science from 1884 to 1887. In 1886 he obtained a foundation scholarship at St. John's College, Cambridge, and was awarded a first class in chemistry in both parts of the Natural Science tripos. He afterwards studied in Heidelberg, and took the degree of Ph.D. in that University in 1892, having previously obtained a Hutchinson research studentship. Dr, Hewitt is a Doctor of Science of the University of London, where he obtained the exhibition and scholarship for chemistry. He has also successfully carried out some important chemical researches.

SCIENTIFIC SERIALS.

The Quarterly Journal of Microscopical Science for January, 1894, contains observations on the development of the head in *Gobius capito*, by H. B. Pollard. (Plates 21 and 22.) The stages of development of the brain, mouth, and mesodermal structures are described. The work was carried out during the occupation of the Oxford table at the Naples Zoological Station.—On the head kidney of *Myxine glutinosa*, by J. W. Kirkaldy. (Plate 23.) It would seem that the pronephros in Myxine may be regarded as a stage in the phylogenetic reduction of this organ—a reduction which continues in the Pisces until the tubular structure entirely disappears, and, further, that it represents in Myxine the mesoblastic part of the supra-renal bodies.—Report on a collection of Amphioxus made by Prof. A. C. Haddon in Torres Straits, 1888-89, by Arthur Willey. All the specimens belonged to the same species, *Epigonichthys cultellus*, Peters. One of the most remarkable features in its internal organisation is the fact that the gonads occur as a unilateral series of pouches confined to the right side of the body; in connection with this fact the author adds, that often in the Mediterranean form the gonadic pouches of the right side preponderate greatly over those of the left side in number.—On the orientation of the frog's egg, by Dr. T. H. Morgan and Umé Tsuda. (Plates 24 and 25.)—On the fossil Mammalia from the Stonesfield Slate, by E. S. Goodrich. (Plate 26.) In this excellent account of these very interesting fossils, we have detailed descriptions and figures of *Amphitherium Prevostii*, Blainv, *A. Oweni*, Osborn, *Phascolotherium Bucklandi*, Broderip, and *Amphilestes Broderipii*, Owen. The only specimen of *Stereognathus ooliticus*, Charlesworth, was in too fragmentary a state to be re-described. In a foot-note Prof. E. Ray Lankester gives some graphic reminiscences of another Stonesfield fossil, probably belonging to another species of Stereognathus which was once in his possession.—On a Polynoid with branchiæ (*Eupolyodontes Cornishii*), by Florence Buchanan. (Plate 27.) This species was found off the mouth of the river Congo by Mr. Cornish, of the cable ship *Mirror*; a list of the species belonging to the sub-family Acoëtidæ is given, and the new species with *Polyodontes gulo*, Grube, are placed in the new genus Eupolyodontes.—On some Bipinnariæ from the English Channel, by Walter Garstang. (Plate 28.)—On *Octineon Lindahli* (W. B. Carpenter), an undescribed Anthozoon of novel structure, by Dr. G. Herbert Fowler. (Plates 29 and 30.) This remarkable form was dredged in 1870 during the *Porcupine* expedition off the south coast of Spain, not far from Cape St. Vincent, in 364 fathoms of water. It was to have been described by Dr. W. B. Carpenter, who died before doing so; the specimens were then entrusted to Prof. Moseley, who was unable to finish the work before his death; now we have the memoir completed by Dr. Fowler. In a dead condition the animal presents the form of a thin sandy disc, not exceeding 0·4 of an inch in diameter. "In Octineon we have an Actinarian with the characteristic habit of a Zoanthid, with the twelve mesenteries of a Hexactinian, and the eight muscles of an Edwardsid," and the evidence seems in favour of the view that it is the type of a new and highly specialised family, descended from true Hexactinian ancestors.

American Meteorological Journal, February.—Recent foreign studies of thunderstorms: IV. Italy, by R. De C. Ward. Systematic study of thunderstorms in Italy was begun in 1877; in 1880 the Central Meteorological Office took up the work, and the results have been regularly published in its *Annals* by Dr. C. Ferrari. The majority of storms come from north-west and west, those from the western quadrant have the greatest velocity, and those which occur in summer have a greater velocity than those in spring or autumn. The chief causes of their development are high temperatures, high vapour pressure, and calm atmosphere. Ferrari's investigation of thunderstorm phenomena is the most complete of any yet published.—Certain climatic features of Maryland, by W. B. Clark. The records of temperature and rainfall, published by the State Weather Service, show an intimate connection between the climate and the topography of the State. The mean annual temperature of the extreme western portion is 50°, while along the eastern border it rises to 58°, and the variations of the seasons are still more pronounced. The rainfall also shows perceptible differences; in the west the average is 38·5 inches, and in other parts nearly 44 inches.—Ten miles above the earth, by H. A. Hazen. This paper contains an account of the ascent of a balloon sent up by M. G. Hermite in Paris, on March 21, 1893. The highest point reached is computed to be 52,500 feet, and, according to the law of the diminution in temperature, the lowest temperature was probably not far from −104° F., but the trace was lost, owing to the freezing of the ink in the thermograph pen. The other articles are: Measurement of the seasons, by H. Gawthrop (a method is proposed by which, using the daily means as the unit, the progress of a season may be determined and graphically illustrated), and the climate of Louisiana, by R. E. Kerkham, compiled from the State Weather Service records of the past six years.

Meteorologische Zeitschrift, December 1893.—Comparison of mercurial barometers with boiling-point thermometers, by Colonel H. Hartl. The author has made several comparisons with the above-mentioned instruments since 1876, and finds that properly constructed and verified thermometers form very good substitutes for barometers, and are capable of giving very accurate determinations of air pressure, especially where it is a question of differences of pressure, rather than of absolute values. They are very useful as a check on the aneroid, and the author considers them indispensable for travellers who wish to determine heights of mountains.—On the determination of differences of temperature and humidity between forest and field, by Dr. J. Schubert. A series of observations was made at Eberswalde during 1892 with carefully exposed instruments, the result being that the author considers that much of the difference hitherto found to exist may be due to imperfect exposure of the instruments, and to the times at which the observations were taken. He advocates further observations, with the use of the aspiration hygrometer, by which a free circulation of the air about the bulbs is ensured.

IN the number of the *Botanical Gazette* for December 1893, Mr. H. L. Russell completes his interesting account of the bacterial flora of the Atlantic Ocean in the vicinity of Woods Holl, Mass. He finds that bacteria exist in the mud of the ocean-bottom in large numbers, and that they multiply there freely, although they are not so numerous as in fresh water. The geographical distribution of the species is often extensive, and their vertical range exceeds that of the majority of the higher forms of life. The following new species are described:—*Bacillus limicola*, *B. pelagicus*, *B. litorosus*, and *B. maritimus*. Mr. M. A. Carleton describes a series of experiments on the germination of the spores of Uredineæ, especially in reference to the effects on the process of different chemicals. In the number for January 1894, Prof. Conway Macmillan proposes the terms archenema, protonema, and metanema, for the gametophytic structures below the ferns. Mr. A. Schneider describes the symbiosis of algæ and bacteria in the tubercles on the roots of *Cycas revoluta*. The bacteria belong to the genus *Rhizobium*. Although the roots are abundantly covered with many different kinds of algæ, the only species found in the cells of the tubercles was a *Nostoc*, probably *N. commune*. This abounds in the palisade-cells, where the *Nostoc*-colonies appear to take the place, and to serve the function of chloroplastids.

IN the *Journal of Botany* for February, Mr. Jesse Reeves describes the development of the stem and leaves of *Physiotium giganteum*, which differ from other acrogenous *Jungermannieæ* in the remarkable peculiarity of having a 2-sided instead of a 3-sided apical cell.—The Rev. W. Moyle Rogers adds yet three more new species (?) to the already long list of British *Rubi*, viz. *R. mollissimus*, *R. Powellii*, *R. britannicus*.

WITH the number for January 1894, the *Nuovo Giornale Botanico Italiano* commences its new series as the organ of the Italian Botanical Society, under the editorship of Prof. Arcangeli. The first number consists exclusively of papers on Italian botany.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 1.—"The Action of Heat upon Ethylene." By Vivian B. Lewes. From the work of the earlier observers, the text-books have accepted the equation

$$1.\ C_2H_4=C_2+2H_2$$

as representing the decomposition which takes place when ethylene is subjected to a very high temperature, whilst, on the evidence of the work done by Marchand, and Buff and Hoffman, they represent the change taking place at a lower temperature by the equation

$$2.\ C_2H_4=C+CH_4.$$

Berthelot, however, has come to the conclusion that two molecules of ethylene split up at a moderate temperature into acetylene and ethane.

The author has made an investigation upon the action which takes place at definite temperatures upon the ethylene, the products of decomposition being as quickly as possible removed from the heated zone.

The gas being passed through 140 mm. of heated tube, no change takes place until a temperature of 800° C. is reached, when traces of acetylene are observed; between 800° and 900° C. the acetylene increases in quantity, and large quantities of methane are generated, accompanied by liquid products. This action increases until just below 1200° C. when hydrogen begins to appear amongst the products of decomposition, whilst the moment the liberation of hydrogen commences, carbon also is deposited; and the formation of oil decreases until close upon 1500° C. when the decomposition of the ethylene is practically complete, and the products of decomposition are mainly hydrogen with some undecomposed methane, and a copious deposit of carbon.

When the products of decomposition of the ethylene are heated together for some time, ethane also is produced, but splits up at 900° C. into ethylene and hydrogen,

$$C_2H_6=C_2H_4+H_2.$$

Analyses of the products of decomposition show that the primary action of heat upon ethylene may be represented by the equation

$$3C_2H_4=2C_2H_2+2CH_4;$$

whilst the final decomposition is as represented by previous observers,

$$C_2H_4=C_2+2H_2,$$

and that between these two extremes there occur a large number of interactions due to the polymerisation of the acetylene formed from the ethylene, and also at higher temperatures from the methane, according to the equation

$$2CH_4=C_2H_2+3H_2.$$

February 1.—"On Hollow Pyramidal Ice Crystals." By Dr. Karl Grossmann and Joseph Lomas.

February 8.—"Researches on the Germination of the Pollen Grain and the Nutrition of the Pollen Tube." By Prof. J. Reynolds Green.

The whole of the researches described in the paper may be summarised as under:—

(1) Diastase and invertase are both present in pollen grains and can be extracted from them by the same treatment as has been found effectual in the cases of seeds and foliage leaves. The relative quantities vary a good deal; while some pollens contain both, others possess only one, which may be either of the two.

(2) At the onset of germination the amount of both diastase and invertase is usually considerably increased. In one species examined this increase was preceded by a primary diminution. When the pollen grain has lost the power of germinating, the quantity of diastase has considerably decreased.

(3) The pollen tube is nourished during its growth by plastic reserve material derived from two sources, the store of material in the grain itself, and a further store deposited in the style.

(4) The reserve store of the pollen grain consists of different materials in different species: starch, dextrin, cane sugar, maltose, and glucose being the forms in which it is found.

(5) The store in the style consists usually of the same carbohydrates, with the exception of dextrin.

(6) The style itself contains enzymes to assist in preparing the reserve materials for absorption by the pollen tube, while the latter excretes the same ferments during its progress down the conducting tissue.

(7) The absorption of food material appears to be one cause of the increase of enzyme found to occur during the germination.

(8) This absorption of food material is usually so active that the reserve store of the pollen grain is often largely increased by a temporary deposition, either in the grain or its tube, of some of the absorbed sugar in the form of starch.

(9) There is a certain amount of evidence pointing to the existence of zymogens in some pollens, particularly such as germinate in a faintly acid medium.

February 15.—"On the Straining of the Earth resulting from Secular Cooling." By Charles Davison.

In this paper the problem as to the total volume of the earth's crust folded and crushed above the surface of zero strain is considered on the supposition that the coefficient of dilatation is not constant, but increases with the temperature. By this means it

has been found that, after 100 million years, the depth of the surface of zero strain is 7·79 miles, the total volume of crust-folding about 6,145,000 cubic miles, and the mean thickness of the layer formed by spreading it over the whole earth 164·7 feet. This result is much larger than that obtained when the coefficient of dilatation is taken as constant.

If the conductivity increases with the temperature, or if the material which composes the earth's interior be such that the conductivity and coefficient of dilatation are greater in it than in the surface rocks, or if initially the temperature increased with the depth, these figures must be still further increased. It follows, therefore, that calculations as to the alleged insufficiency of the contraction theory to produce mountain ranges are at present inadmissible.

"Chemical Analysis of the Meteoric Stone found at Makariwa, near Invercargill, New Zealand, in the year 1886." By L. Fletcher, F.R.S.

The results of a microscopic examination of this meteorite by Prof. Ulrich have already been published. Mr. Fletcher has now completed the chemical analysis of the stone, and in this paper gives a detailed account of the method and his observations, for the convenience of future analysts of such bodies.

The interest of the investigation is not in the mineralogical results, but in the study of a composite method applicable to the most complicated meteoritic chemical analysis, namely, that of a partially-rusted meteoric stone.

Chemical Society, February 1.—Dr. Armstrong, President, in the chair.—The following papers were read:—Note on the liberation of chlorine during the heating of a mixture of potassium chlorate and manganic peroxide, by H. McLeod. Brunck has recently stated that oxygen prepared by heating a mixture of potassium chlorate and manganese dioxide, contains ozone but not chlorine. The author now shows that the reverse of this is true, the gas containing chlorine but not ozone.—The examination of some recent freezing-point determinations, by S. U. Pickering. The differences between the results of the freezing-point determinations made by the author and H. Jones are apparently due to inaccurate calibration of the thermometer employed by the latter.—Salts of dehydracetic acid, by J. N. Collie and H. R. Le Sueur. The salts of dehydracetic acid have the general composition $C_8H_9O_3M$; on heating at 145° they lose water, and the residual salts then have the composition $C_8H_7O_4M$. This water may be water of crystallisation; the question as to whether dehydracetic acid is a lactone or not, is hence still unanswered.—A new method of producing carbon tetrabromide, by J. N. Collie. A very large number of organic compounds yield carbon tetrabromide when heated with a strong solution of sodium hypobromite.—Metallic derivatives of acetylene. Mercuric acetylide, by M. Travers and R. T. Plimpton. Mercuric acetylide is a white explosive powder, and probably has the composition $3C_2Hg,H_2O$.—Synthesis of indene, hydrindene, and some of their derivatives, by W. H. Perkin, junr., and E. Révay. On heating barium hydrindenecarboxylate, indene, and not hydrindene, is obtained; the indene, however, seems to be isomeric with ordinary indene.

Mathematical Society, February 8.—Mr. A. B. Kempe, F.R.S., President, in the chair.—At the request of Lord Kelvin, P.R.S., Mr. J. J. Walker, F.R.S., exhibited and described Lord Kelvin's models of his "Tetrakaidecahedron." Votes of thanks were passed to Lord Kelvin and to Mr. Walker. A conversation ensued, in which Messrs. S. Roberts, F.R.S., Forsyth, F.R.S., MacMahon, F.R.S., Elliott, F.R.S., Colonel Cunningham, R.E., and the President took part.—Abstracts were communicated of the following papers:—On a class of groups defined by congruences, by Prof. W. Burnside, F.R.S., and some properties of the uninodal quartic and quintic having a triple point, by Mr. W. R. W. Roberts. Most of the properties of the curves, discussed by Mr. Roberts, are derived by the aid of Abelian integrals.

Linnean Society, February 15.—Prof. Stewart, President, in the chair.—Mr. W. B. Hemsley exhibited some germinating seeds of *Lemna* and some flowering plants of *Lemna gibba*, upon which, in his absence, some remarks were made by Mr. C. H. Wright. From the observations made it was suggested that, although *Lemna minor* and *L. gibba* are usually regarded as distinct, they are respectively the male and female plant of one species. On behalf of the Director of the Royal Gardens, Kew, Mr. C. H. Wright exhibited and made some remarks upon a collection of native plants from the neighbourhood of Cape Town, which had been presented to the Herbarium by Miss Yorke, and which was remarkable for the skilful way in which the natural colours of the flowers had been preserved.—On behalf of the Rev. J. G. Tuck, of Tostock Rectory, Bury St. Edmunds, there was exhibited a hybrid between the common house sparrow and the tree sparrow (*Passer montanus*), which had been taken near Bury on January 13 last. Only one instance of a similar wild hybrid was known to have been previously captured, although two or three instances were on record of the two species interbreeding in aviaries.—Mr. J. C. Willis gave an abstract of a paper on the "Natural History of the Flower" (part ii.), in which he dealt with the mode of fertilisation in *Brodiæa ixioides*, S. Watson, *Stanhopea tigrina*, Bateman, *Pimelia decussata*, R. Br. var. *diosmæfolia*, *Cotyledon umbilicus*, L., *Hydrolea spinosa*, L., and *Ziziphora capitata*, and made some remarks on cleistogamy in *Salvia Verbenaca*, L. A discussion followed, in which Dr. D. H. Scott, Prof. Reynolds Green, and Mr. A. B. Rendle took part.—The Secretary read a paper by Miss D. F. Pertz, on hygroscopic movements connected with seed-dispersal, in which the author partially reviewed the literature of the subject, and detailed the method of observation adopted by previous workers and by herself.

Zoological Society, February 20.—Prof. G. B. Howes in the chair.—A report was read, drawn up by Mr. A. Thomson, on the insects bred in the Insect-house during the season of 1893. Examples of seventeen species of Bombyces, twenty of Diurnal Lepidoptera, and twenty-four of Nocturnal Lepidoptera had been exhibited during the past season, of which many had not been shown in former years. Amongst these were specimens of the fine insect *Actias mimosæ*, from south-east Africa, hatched from cocoons presented by the Rev. H. A. Junod.—Mr. Oldfield Thomas called attention to the skin of a Giraffe from Somaliland, sent for exhibition by Mr. Rowland Ward, and pointed out its differences from the South African Giraffe.—A communication was read from Dr. R. W. Shufeldt, giving particulars of the methods used in preparing specimens of certain Invertebrates for public exhibition employed in the U.S. National Museum.—Mr. Sowerby read a communication forwarded to him by Dr. O. F. von Moellendorff, giving an account of a collection of Land-Shells from the Samui Islands, Gulf of Siam. These Land-Shells were referred to thirty-three species, of which many were described as new to science.—A communication from Dr. D. Sharp, F.R.S., contained a list of Hemiptera Heteroptera of the families *Anthocoridæ* and *Ceratocombidæ*, collected by Mr. H. H. Smith in the island of St. Vincent, with descriptions of new genera and species, prepared by Prof. P. R. Uhler, upon specimens submitted to him by the West Indian Committee.—Mr. O. Thomas read the third of his contributions towards our knowledge of the mammals of Nyasaland, based, as the two former, on specimens forwarded to the British Museum by Mr. H. H. Johnston, C.B., H.B.M. Commissioner in British Central Africa. The present paper contained remarks on thirty-five mammals, of which two were described as new, and were named respectively *Lepus whytei* and *Procavia johnstoni*.—A communication from Dr. R. W. Shufeldt gave an account of the conclusions to which he had arrived respecting the affinities of the birds of the order Steganopodes.

Royal Meteorological Society, February 21.—Mr. R. Inwards, President, in the chair.—The following papers were read:—Temperature, rainfall, and sunshine at Las Palmas, Grand Canary, by Dr. J. Cleasby Taylor. The author gave the results of his observations during the five years 1889–93. The island of Grand Canary occupies a position midway between the African continent and the most western of the Canary group. The mountain peaks rise to a little over 6000 feet, and are about twenty miles from the coast. The chief town and port of the island, Las Palmas, is consequently free from the influence of the mountains. The diurnal range of temperature fluctuates considerably with the variations in wind and sunshine. With a southerly wind (which usually dies down at sunset) the range is increased, but the greater part of the increase is due to a higher day temperature. With northerly winds persisting after sunset, the range may be very slight, particularly if the day has been cloudy. The sea temperature is dependent on causes outside the limits of the archipelago; local presence or absence of sunshine does not cause any difference. A boisterous northerly wind, with a high sea, may cause the temperature to fall quicker

than usual, or, if the temperature is rising, to check the rise; but any sudden variation is very rare. The rainfall is not great, though it is spread over a large number of days, the average yearly amount being 8·90 inches. The greater part of the rain falls during October to January, while the period from June to September is practically rainless.—Report on the phenological observations for 1893, by Mr. E. Mawley. This was a discussion of the observations made on the flowering of plants, appearance of insects, and the song and nesting of birds. The year 1893 was in complete contrast to its predecessor, being very forward throughout the United Kingdom. The February and March plants were later than usual in blossoming, especially in the colder parts of our Islands, but after this the dates were everywhere in advance of the average, and during the height of the flowering season the departures from the mean were often considerable.—Comparative observations with two thermometer screens at Ilfracombe, by Mr. W. Marriott. Some exception having been taken to the thermometer screen which has been in use at Ilfracombe for a number of years past, a Stevenson screen was placed at a distance of 60 feet from the old screen in October, 1892, since which date simultaneous observations in the two screens have been made daily at 9 a.m. The results of this comparison show that the temperature deduced from the two sets of observations agrees very closely, the old screen being only 0°·3 higher than the Stevenson.

CAMBRIDGE.

Philosophical Society.—February 12.—Prof. Hughes, President, in the chair.—On a suggested case of mimicry in the mollusca, by Mr. A. H. Cooke. The species concerned were *Strombus mauritianus*, L., and *S. luhuanus*, L., the shells of which differed from those of all other *Strombus* in their close resemblance to the shell of *Conus*, a genus with which they are known to live: *Strombus* being a frugivorous animal with small and weak teeth, and *Conus* on the other hand being carnivorous, with very large and barbed teeth, provided with a poison bag and duct. It was suggested that this resemblance must tend greatly to the advantage of the *Strombus*, since the dangerous properties of *Conus* would tend to prevent its being touched by predatory fishes.—On the evidence as to the extent of earth movements and its bearing upon the question of the cause of glacial conditions, by the President. Prof. Hughes referred to the former paper in which he discussed the first part of the question, viz. the evidence of glacial conditions offered by scratched stones and smoothed and striated rock surfaces. He then stated the second part of the question in the same form as that in which the astronomical theory of the cause of recurrent glacial conditions is usually put forward. He contended that there is abundant evidence of contemporary earth movements of such a kind and magnitude as would, if their possible effects were not destroyed or modified by other causes, produce greater vicissitudes of temperature than any that are required to explain the most extreme glacial conditions observed in past time. An examination of the succession of events as recorded in the crust of the earth shows that these greater movements of elevation and depression have been secularly recurrent, and an inquiry into the geographical distribution of the formations which are held to contain evidence of glacial action leads to the conclusion that they are arranged round basins, and further that around the rim of these basins we have the clearest proofs from independent evidence of marginal movements of great intensity. The average fall of temperature as we ascend is observed to be about 1° F. for every 300 feet. Therefore the reduction of temperature due to such elevations as would result from known upheavals is quite sufficient to explain the occurrence of glaciation anywhere. A consideration of the geographical causes of glacial conditions explains why the effect has not always followed when the upheaval is known to have been great enough to have produced it: seeing that it is along the axes and areas of greatest movement that the greatest denudation takes place and the actual elevation represents only the excess of uplift over denudation.—On the fertilisation of some species of Medicago in England, by J. H. Burkill. The floral mechanism of four species of Medicago (*sativa*, L., *falcata*, L., *silvestris*, Fries, and *lupulina*, L., was discussed, and lists of insect-visitors given. The processes which unite the alae and carina hold the staminal tube in position in the unexploded flower, while the basal processes of the alae serve as triggers whereby an insect may explode it. The stigma is rendered fertile by rubbing as in Lotus, but in *M. lupulina* in older unexploded flowers becomes receptive and self-fertilised. Flies form a larger percentage of the insect-visitors in England than in Germany.—Contributions to the geology of the gosau beds of the Austrian Salzkammergut, by H. Kynaston.

EDINBURGH.

Royal Society, February 5.—Prof. Copeland, Astronomer Royal for Scotland, in the chair.—Dr. John Murray gave an address on the floor of the ocean at great depths. He discussed the character of the deposits and the organisms found at the sea-bottom by the *Challenger* expedition. Exclusive of the *protozoa*, certain species were found in Antarctic waters which corresponded to species found in Arctic waters, while no such species were found in intervening tracts. This may be supposed to have been due to the production of the same species, from different origins, under the same conditions; but it is more in accordance with modern ideas to suppose that they had a common origin. Dr. Murray suggested that the common origin was referable to a period when the whole ocean had a fairly uniform high temperature of perhaps 70° or 80°. Under this condition there might have been a universal fauna. As the polar regions became colder, similar portions of the fauna became adapted to the like conditions of the northern and southern tracts; while the portion which was forced to retreat from the colder regions was now represented by the fauna of the coral reefs and tropical waters.

February 19.—Sir Douglas Maclagan, President, in the chair.—Mr. John Aitken read the third part of a paper on the number of dust-particles in the atmosphere of certain places in Great Britain and on the continent. Observations had been taken at Hyères, Cannes, and Mentone. There the air was never found to be very pure, the lowest number of dust-particles recorded being 600 per cubic centimetre. At the Italian lakes the conditions were found to be somewhat similar. When the wind blew up the slopes from the valleys, the number of dust-particles was greater than when it blew across the mountain tops. On the Righi it was also found that the air from the mountain was purer than the air from the plains. The haze increased with the number of particles. A connection was also observed between the amount of dust and the appearance of the sunset. When there was much dust, the light was warm and soft; when there was little, the lighting on the landscape was cold, clear, and sharp. A careful series of observations had also been taken at Kingairloch, which, along with others, had been used in the determination of constants in equations connecting the haze with number of dust particles, &c.—A paper, by Mr. George Romanes, containing a suggestion as to the probable nature of electrification, was communicated.

PARIS.

Academy of Sciences, February 19.—M. Lœwy in the chair.—On linear equations of the second order containing an arbitrary parameter, by M. Emile Picard.—On certain developments in series, required in the theory of the propagation of heat, by M. H. Poincaré.—Typhoid fever in Paris, for the period 1884-1893; its autumn and winter increase. An abstract of a memoir, by M. de Pietra Santa, giving his conclusions concerning the general decrease of this disease and the causes of this decrease.—Observations of the new planet AV (Courty, 1894, February 11), made at the Paris Observatory, by M. G. Bigourdan.—Observations of the planet 1894, AV, made by the great equatorial of the Bordeaux Observatory, by MM. L. Picart and F. Courty.—Results of the solar observations made at the Royal Observatory of the Roman College during the fourth quarter of 1893, by M. P. Tacchini.—On the tetrahedra conjugate with respect to a quadric, and of which the edges are tangents to another quadric, by M. H. Vogt.—On a case of degeneration of a general projective system, by M. F. Engel.—On the movement of two points joined by a spring, by M. L. Lecornu.—On a system of two pendulums joined by an elastic thread, by M. Lucien de la Rive.—A new simplified method for the calculation of rapidly alternating currents, by M. A. Blondel.—The symmetrical aplanatic objective, by M. Ch. V. Zenger. The author has constructed systems of lenses imitating as far as possible the conditions obtaining in the human eye. He gives the necessary mathematical investigation. Two lenses, a plano-convex lens of phosphate crown glass, and a plano-concave of borate crown glass of less refracting and greater dispersive power, are combined to produce a system for which it is claimed, that (1) the achromatism is exact for the entire length of the spectrum;

(2) astigmatism is corrected very thoroughly ; (3) spherical aberration, with a convenient aperture $\left(\frac{1}{F} = \frac{1}{20} \text{ to } \frac{1}{30}\right)$, is reduced to the minimum value of a second of arc ; (4) the curvature of the field is absolutely corrected.—On the temperature of the higher regions of the atmosphere, by MM. Gustave Hermite and Georges Besançon. A reply to a criticism of a recent communication.—On the minimum electromotive force necessary for electrolysis to take place, by M. Max Le Blanc. The author claims priority over M. Nourrisson, and quotes some of his results from the *Zeitschrift physik. Chem.* 1891, p. 299.—Observations on the preceding note : the limits of electrolysis, by M. Berthelot. A memoir by the author published in 1882 ("Sur les limites de l'électrolyse," *Ann. Chim. Phys.* [5], 27, p. 88) carries the whole subject further than the papers by MM. Le Blanc and Nourrisson.—On the fusibility of isomorphous mixtures of some double carbonates, by M. H. Le Chatelier. A study of mixtures of sodium and potassium carbonates with calcium, strontium, and barium carbonates in such proportions that the alkaline carbonate and the alkaline-earthy carbonate are in equivalent quantities. Lithium carbonate behaves similarly to the alkaline-earthy carbonates.—On the allotropic transformation of iron under the influence of heat, by M. Georges Charpy. Conclusions are drawn from the experimental evidence quoted, indicating that the transformation is more rapid at more raised temperatures, but appreciable time is required, and hence duration of heating as well as temperature should be regarded in metallurgical operations.—Constitution of orcin, by M. de Forcrand. A thermal study ; the results indicate that the phenolic hydroxyl groups occupy the meta position with regard to each other ; the first has a slightly higher, the second the same thermal value as ordinary phenol.—On the ethylphenols, by MM. A. Béhal and E. Choay.—On the multirotation of sugars, by M. P. Th. Muller. The reaction producing the multirotation of sugars is of the first order ; it proceeds in accordance with the law of the active masses. A constant at any given temperature measures the progress of the reaction. The speed of transformation is markedly greater for the pentoses than for the other sugars.—On the reciprocal affinities of the Myxosporidiæ, by M. P. Thélohan.—Researches on the structure of Mucorini, by MM. P. A. Dangeard and Maurice Léger.—On the *rôle* of *Plantago alpina* in mountain pastures, by M. E. Guinier.

BERLIN.

Physiological Society, January 26.—Prof. du Bois Reymond, President, in the chair.—Dr. Dembo, of St. Petersburg, spoke on the physiological value of the various modes of slaughtering animals, and came to the conclusion that the most humane method consists in cutting the large blood-vessels of the neck. When this is done, unconsciousness sets in within a few seconds of the operation, while the movements made are merely symptoms of the cerebral anæmia. Further, the flesh of animals bled to death keeps best.—Dr. von Noorden gave an account of part of the experiments he has carried on in conjunction with Prof. Zuntz, on the action of quinine on the metabolism of man. With a constant diet extending over a long period, and after nitrogenous equilibrium was established, daily increasing doses of quinine were administered, with the result that during the time it was given, and for a day afterwards, the output of nitrogen was markedly lessened, but later on rose again to its initial value. Phosphorus showed the same falling off as did the nitrogen, whereas uric acid was only lessened in the period subsequent to the administration of quinine. Under the action of the drug the leucocytes diminished in number, but increased again later on. Careful investigation of the respiratory interchange showed a very slight but distinctly increased consumption of oxygen, probably to be explained entirely by the considerably increased ventilation of the lungs while the drug was being taken ; this fell again subsequently to its normal magnitude. Dr. Ullmann, owing to the lateness of the hour, was only able to state his view that the red blood-corpuscles of man are spherical ; he will give the basis for this view at a subsequent meeting.

February 9.—Prof. du Bois Reymond, President, in the chair.—Prof. Zuntz had made experiments with a Pettenkofer respiration apparatus at Göttingen, on the respiration by the skin and intestine of the horse. He first of all found that the total output of carbon dioxide in twenty-four hours was 4200 grm. Excluding that from the lungs, the remainder due to the skin and intestine amounted together to 145 grm., and an additional 22 grm., from volatile hydrocarbons. The latter can only be methane, and hence come from the intestine. Now since the gases of the intestine have a constant composition as regards methane, carbon dioxide and hydrogen, it became at once possible to calculate how much carbon dioxide comes from the skin, and how much from the intestine.

Physical Society, February 2.—Prof. Kundt, President, in the chair.—Prof. Goldstein spoke on the kathodic light, distinguishing the five following kinds of radiant rays :—(1) The yellow rays of the first zone, which are very strongly developed at the hinder side of the kathode, when there are holes in the latter. These rays are propagated in straight lines, are not affected by magnets, and exhibit no phosphorescence. (2) The rays of the second zone, which extend a long way into the space occupied by the kathodic light, may be concentrated by a bent kathode, are propagated in straight lines, are bent out of their course by a magnet, and are phosphorescent when they strike the inner wall of the tube. (3) The rays of the third zone, which are propagated uniformly in all directions, can turn a corner and throw no shadows. (4) A fourth kind of rays which produce inverted images of the electrode, and are arrested by screens. (5) A fifth kind is ordinarily invisible, but gives rise to bright stars where the rays fall on the wall of the tube. All the above five kinds of rays occur mixed in the light of the kathode, and intersect each other. In the "secondary negative light," which is developed when the tube in which the discharge takes place has constrictions on it, and which is seen at the end of the constriction turned towards the anode, Prof. Goldstein had observed two distinct kinds of kathodic light. Further, since the secondary negative light can pass over into the anodic light, the latter must also consist of kathodic rays. When a metallic plate with holes in it is placed in the middle of a vacuum tube, at whose ends the electrodes are inserted, he observed that artificial kathodic rays are produced on that side of the plate which is turned towards the anode. The above phenomena had been observed in air, nitrogen, oxygen, hydrogen, carbon dioxide, and mercury vapour, and were demonstrated at the end of the meeting.

Meteorological Society, February 13.—Prof. Hellmann, President, in the chair.—Prof. von Bezold spoke on the various modes of discriminating between clouds, as, for instance, by reference to their dimensional appearance, their form, structure, and height, and then proceeded to go very fully into their discrimination as based upon their mode of formation. Clouds are formed either as the result of cooling (resulting from either radiation or contact), or by mixing, or by adiabatic expansion (more strictly speaking, expansion with insufficient heat supply). Condensations resulting from cooling give rise to earth clouds and the various mist clouds which more rarely occur at higher levels. Stratus clouds result from mixing, as also do the overhanging caps of föhn clouds on mountain tops, the cloud-streamers of cumulus clouds, and more especially the cloud-waves at the junction between two winds which are passing each over the other. Adiabatic expansion gives rise to cumulus clouds. The speaker illustrated his remarks by a series of cloud-photographs and sketches.

DIARY OF SOCIETIES.

LONDON.

THURSDAY, MARCH 1.

ROYAL SOCIETY, at 4.30.—Preliminary Note on Bi-lateral Degeneration in the Spinal Cord of Monkeys (Macacus sinicus) following Uni-lateral Lesion of the Cortex Cerebri : Dr. E. L. Mellus.—On the Effect of Magnetisation upon the Dimensions of Wires and Rings of Annealed Iron : S. Bidwell, F.R.S.—On the Relations of the Secular Variation af the Magnetic Declination and Inclination at London, Cape of Good Hope, St. Helena, and Ascension Island, as exhibited on the Magnetarium : H. Wilde, F.R.S.—Terrestrial Refraction in the Western Himalayan Mountains : General Walker, F.R.S.—Researches on the Structure, Organisation, and Classification of the Fossil Reptilia—Part IX., Section 1, On the Therosuchia ; Section 2, The Reputed Mammals from the Karroo Formation of Cape Colony : Section 3, On Diademodon ; Section 5, On the Skeleton in New Cynodontia from the Karroo Rocks : Prof. Seeley, F.R.S.—On a Spherical Vortex : Prof. M. J. M. Hill.—On Correlation of certain External Parts of Palæmon serratus : H. Thompson.

LINNEAN SOCIETY, at 8.—Algological Notes from Cumbræ—On the Origin of the Filamentous Thallus of Dumontia filiformis : George Brebner.—Entomostraca and the Surface Film of Water : D. J. Scourfield.

ROYAL INSTITUTION, at 3.—The Vendânta Philosophy: Prof. Max Müller.

CHEMICAL SOCIETY, at 8.—Aërial Oxidation of Terpenes and Essential Oils: C. T. Kingzett.

CAMERA CLUB, at 8.—Light Waves in a Shadow; W. B. Crofts.

SOCIETY of ANTIQUARIES, at 8.30.

FRIDAY, MARCH 2.

ROYAL INSTITUTION, at 9.—The Theory of the Cochlea and Inner Ear: Prof. J. G. McKendrick.

SANITARY INSTITUTE, at 8.—Scavenging Disposal of House Refuse: C. Mason.

INSTITUTION OF CIVIL ENGINEERS, at 7.30 (Students' Meeting).—Efficiency and Economy of Elevators: Herbert W. Umney.

GEOLOGISTS' ASSOCIATION (University College), at 8.—The Hythe Beds of the Lower Greensand, in the Liphook and Hind Head District: Binstead Fowler.—Tertiary Man: J. B. M. Findlay.

SATURDAY, MARCH 3.

ROYAL INSTITUTION, at 3.—Light, with special reference to the Optical Discoveries of Newton: The Right Hon. Lord Rayleigh, F.R.S.

SUNDAY, MARCH 4.

SUNDAY LECTURE SOCIETY, at 4.—Glimpses of the Life, Lore, and Legend of Old Japan (with Oxy-hydrogen Lantern Illustrations): R. W. Atkinson.

MONDAY, MARCH 5.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Society's Rooms, Burlington House), at 8.—The Zymean Metallurgy: Admiral J. H. Selwyn.—The Commercial Production of Chlorine by the Ammonia Soda Process: F. Bale.—Notes on Lithographic Varnish: F. H. Leeds.

VICTORIA INSTITUTE (8 Adelphi Terrace, Strand), at 8.—The Origin of the Australian Race: Dr. John Fraser, F.R.S.

TUESDAY, MARCH 6.

ROYAL INSTITUTION, at 3.—Locomotion and Fixation in Plants and Animals: Prof. C. Stewart.

SOCIETY OF ARTS, at 8.—Travels in the Basin of the Zambesi: M. Foa.

ZOOLOGICAL SOCIETY, at 8.30.—On the Factors that appear to have influenced Zoological Distribution in East Africa (to be illustrated with Lantern Slides): Dr. J. W. Gregory.—On the Habits of the Flying Squirrels (Anomalurus) of the Gold Coast: W. H. Adams.—On Two Cases of Colour-variation in Flat-fishes illustrating Principles of Symmetry: W. Bateson.

SANITARY INSTITUTE, at 8.—Diseases of Animals in Relation to Food Supply: Prof. A. W. Blyth.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Papers to be further discussed: The Liverpool Overhead Railway: J. H. Greathead and Francis Fox.—Electrical Equipment of the Liverpool Overhead Railway: Thomas Parker.

ROYAL VICTORIA HALL, at 8.—Lakes: W. W. Watts.

WEDNESDAY, MARCH 7.

SOCIETY OF ARTS, at 8.—Refrigerating Apparatus: Prof. Carl Linde.

GEOLOGICAL SOCIETY, at 8.—The Systematic Position of the Trilobites: H. M. Bernard.—Landscape Marble: Beeby Thompson.—On the Discovery of Molluscs in the Upper Keuper at Shrewley in Warwickshire: Rev. P. B. Brodie.

THURSDAY, MARCH 8.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Minute Structure of the Nervous System: Prof. S. Ramón y Cajal, of Madrid

ROYAL INSTITUTION, at 3.—The Vendânta Philosophy: Prof. Max Müller.

INSTITUTION OF ELECTRICAL ENGINEERS (25 Great George Street, Westminster, S.W.), at 8.—A Note on Parallel Working through Long Lines: W. M. Mordey.

CAMERA CLUB, at 8.—Composite Heliochromy by Three-colour Printing: F. E. Ives.

MATHEMATICAL SOCIETY, at 8.—Groups of Points on Curves: F. S. Macaulay. On the Buckling and Wrinkling of Plating supported on a Framework under the influence of Oblique Stresses, and on a Simple Contrivance for Compounding Elliptic Motions: G. H. Bryan.—On the Motion of Two Pairs of Cylindrical Vortices which have a Common Plane of Symmetry: A. E. H. Love.

SOCIETY OF ANTIQUARIES, at 8.30.

FRIDAY, MARCH 9.

ROYAL INSTITUTION, at 9.—The Making of a Modern Fleet: Dr. W. H. White.

PHYSICAL SOCIETY, at 5.—Calculating Machines, and especially a New Harmonic Analyser: Prof. O. Henrici, F.R.S.

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

ROYAL ASTRONOMICAL SOCIETY, at 8.

MALACOLOGICAL SOCIETY, at 8.

SATURDAY, MARCH 10.

ROYAL INSTITUTION, at 3.—Light, with special reference to the Optical Discoveries of Newton: The Right Hon. Lord Rayleigh, F.R.S.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Modern Plane Geometry: G. Richardson and A. S. Ramsey (Macmillan).—Essays in Historical Chemistry: Prof. T. E. Thorpe (Macmillan).—Comité International des Poids et Mesures, Seizième Rapport (Paris, Gauthier-Villars).—Travaux et Mémoires du Bureau International des Poids et Mesures, Tome viii. (Paris, Gauthier-Villars).—Annuaire de Observatoire Municipal de Montsouris pour l'Année 1894 (Paris, Gauthier-Villars).—Light, an Elementary Text-Book, Theoretical and Practical: R. T. Glazebrook (Cambridge University Press).—The Flowering Plants of Western India: Rev. A. K. Nairne (W. H. Allen).—Object Lessons in Botany from Forest, Field, and Garden: E. Snelgrove (Jarrold).—The Alchemical Essence and the Chemical Element: M. M. P. Muir (Longmans).—Statistics of the Colony of Tasmania (Tasmania).—Hume, with Helps to the Study of Berkeley: T. H. Huxley (Macmillan).

PAMPHLETS.—Report of Observations of Injurious Insects and Common Farm Pests during the Year 1893, &c.: E. A. Ormerod (Simpkin).—Die Lehre von der Wellenberuhigung: Dr. M. M. Richter (Berlin, Oppenheim). Twenty-fourth Annual Report of the Wellington College Natural History Society, 1893 (Wellington College).—On the Definitions of the Trigonometric Functions: Prof. A. Macfarlane (Boston).

SERIALS.—American Journal of Science, February (New Haven).—Journal of the Franklin Institute, February (Philadelphia).—Zoologische Abhandlungen—Berichte der Naturforschenden Gesellschaft zu Freiburg i. B. viii. (Williams and Norgate).—Astronomy and Astro-Physics, February (Wesley).—Royal Natural History, Vol. i. Part 4 (Warne).—Proceedings of the Royal Society of Victoria, Vol. vi. new series (Williams and Norgate).—Journal of the Royal Horticultural Society, January (117 Victoria Street).—Journal of the Polynesian Society, Vol. ii. No. 4 (Petherick).—Journal of the Institution of Electrical Engineers, No. 108, vol. xxii. (Spon).—Kryptogamen-Flora von Schlesien, 3 Band, 2 Hälfte, 2 Lief (Williams and Norgate).—Journal of the Institute of Jamaica, December (Kingston).—Meteorological Record, vol. xiii. No. 50 (Stanford).—Quarterly Journal of the Royal Meteorological Society, January (Stanford).—L'Anthropologie, tome iv. No. 6 (Paris, Masson).—Zeitschrift für Physikalische Chemie, xiii. Band, 2 Heft (Leipzig, Engelmann).—The Humanitarian, March (Sonnenschein).—Journal of the Royal Microscopical Society, February (Williams and Norgate).—Bulletin de l'Académie Royale des Sciences de Belgique, tome 27, No. 1 (Bruxelles).—Journal de Physique, February (Paris).—Bulletin of the American Museum of Natural History, vol. v. 1893 (New York).—National Academy of Sciences, Vol. vi.: Eighth Memoir: Further Studies on the Brain of *Limulus polyphemus*, with Notes on its Embryology: A. S. Packard.—Records of the Geological Survey of India, vol. xxvi. Part 4 (K. Paul).

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