THURSDAY, JUNE 17, 1897.

PROFESSOR KLEIN AND TECHNICAL EDUCATION IN GERMANY.

A MOVEMENT regarding the higher technical education in Germany was started a few years ago by Prof. Klein, in conjunction with some of his colleagues (Nernst and others) at the University of Göttingen, which may become a most important factor in the development of technical education as well as of science. It has, however, from the very outset, met with violent opposition, both in University and in engineering circles.

An account of Prof. Klein's scheme, and of the discussion to which it has given rise, cannot fail to be of interest to all concerned with technical education.

The first publication of Klein's on this subject is contained in the lithographed memoir dated Easter 1895, and which has been published in the *Zeitschrift des Vereins Deutscher Ingenieure*, January 1896. In it is proposed the establishment of a physico-technical institute at the University of Göttingen.

The object of this institute he states to be to give opportunity to persons who already possess a certain amount of scientific or technical education to increase both their knowledge and their power of using it.

It is not intended for the education of large numbers, but rather to help the exceptional few who, in consequence of their talents or other favourable circumstances, can spend more time on their education.

Or, as it stands in the original—

"Das zu gründende Institut soll wissenschaftlich oder technich bereits bis zu einem gewissen Grade vorgebildeten Personen Gelegenheit zu weiterer Vertiefung ihres Wissens und Könnens auf physikalisch-technischem Gebiete liefern. Hierbei wird es sich nie um Massen ausbildung, sondern nur um die Förderung einiger Weniger handeln, denen Talent oder sonstige glüchliche Umstände ein Uebriges auf ihre Ausbildung zu wenden gestatten."

The projected institute should combine all the appliances of modern physics with those technically used, but so that the first are subservient to the latter.

In physics the study of nature is nearly always conducted with experiments carried out in the smallest dimensions, whilst the engineer works towards the mastery over nature on the largest scale. The institute should combine both *micro-* and *macro-physics*.

The following are given as the more important departments of the institute: "Precisions-Mechanik" (measuring instruments); theory of elasticity and strength of material; kinematics, including hydraulics and experimental ballistics; practical thermo-dynamics and practical electricity.

It is added that it will scarcely be possible to establish all these at once.

Lectures of a practical nature are to be added on all the subjects.

The importance of practice in drawing and construction is also dwelt upon. The chief thing, however, will be the work in the laboratory.

It is pointed out that this scheme will enable the engineer to take a University degree by a scientific thesis on some technical subject.

The qualifications of a director and an estimate of the necessary expenditure are next discussed. The latter is put down at about 15,000*l*. as the initial expense, and the annual cost as 750*l*., exclusive of the director's salary.

Then follows a more minute discussion of the plan and its relation to the Reichsanstalt in Charlottenburg, its connection with the University, the advisability of such an institute from the engineer's point of view, the benefit it will be to the University, and the suitability of Göttingen for such an institute.

The first thing which will strike every one in reading this will be that there is nothing more proposed here than is, or might be, carried out in many of the higher technical schools, and that the whole has been devised at the University somewhat in ignorance of what the technical schools are doing. Nothing, therefore, seems more natural than that from these a unanimous voice against it should have been raised. Klein himself has fully acknowledged this defect in this first statement of his scheme.

To form a true idea both of his high aims and of their importance for technical education, it is necessary to enter into the criticism already mentioned, which the plan has received from engineers and engineering professors, and into a number of further publications by Klein on the subject, mostly addresses read at meetings of engineers and teachers.

A perusal of these papers brings out clearly the following points.

There has grown up in Germany a strong feeling of antagonism between the technical high schools ("Technische Hochschule" is the name now generally given in Germany to the colleges devoted to higher technical education) and the Universities. The new life infused into Germany since its unification, and the great impulse given thereby to German industries, has naturally had its influence on the technical high schools and on technical education in general; but the Universities have remained almost uninfluenced by it. They have remained stationary whilst the others have progressed, and the engineers have more than ever looked with sovereign contempt on these ancient and, to their minds, fossilised seats of learning.

But their progress has been hampered by the unsatisfactory preliminary preparation of the students on entering on their technical studies, and so the whole question of secondary education comes in, just as it does in England. To remedy this, and make the school teaching less classical, and to bring it into closer connection with the requirements of modern life, the technical high schools now claim that the teachers of mathematics and science should be educated by them, and not at the Universities. At the same time, they feel the need of attaching to themselves, or where they exist already to extend, just such laboratories as Klein described, and they maintain that these can only be useful to the development of industry if they are under their direction, and further, that any money given by the Government to the Universities would be taken from *them* and utterly wasted.

There has also been going on a gradual reformation in the programmes recommended to the students, and an endeavour to restrict the purely theoretical parts, and to dwell more on the increase of power in the students to apply their knowledge instead of increasing the knowledge itself, and altogether to bring the teaching into closer connection with practical needs ; to increase the *Können* as opposed to the *Wissen*.

It may be mentioned here that the engineering course in Germany extends over four years, and the students generally enter about the age of eighteen, having, as a rule, spent one year at works beforehand ; so that they do not enter practical life till they have, on an average, reached an age of about twenty-three years or more, as one year of military service has to be taken into account. Even then those who want to enter into the service of the State are tied down by the necessity of passing a final examination at about the age of twenty-seven.

It is felt that this age is altogether too high, and to remedy this requires, in the opinion of the technical professors, that the students should be better prepared at school, so that the more elementary part of mathematics and physics can be left out of their course.

The most active of these technical professors is Prof. Riedler, at Charlottenburg, who is well known in this country as a successful practical engineer. His plans for reform have been published in the *Zeitschrift*, 1896, and from recent numbers of the same periodical it becomes apparent that his proposals have in the main been carried out at Charlottenburg. In reading through these, one thing is very striking : a great deal of what he writes on the aims of the highest technical education might have been written by Klein in favour of his plans ; in fact, Riedler lays it down as a necessary duty of the technical high schools to care for the highest scientific education of a few engineers.

He says already in 1895 (*Zeitschrift*, August 10, 1895), after discussing the needs of the average students, "Die Hochschule muss jedoch mehr bieten, sie muss einer beschränkten Zahl wissenchaftlich Begabter die höchste Stufe Mathematischer Bildung zu erwerben ; aber diese muss eine fruchtbare sein und kann erst dem Fachwissenschaftlichen studium nachfolgen

"Die Universität Leipzig hat angeblich diese höchst zeitgemässe Aufgabe erfasst, sie wäre aber für die Technische Hochschule näher liegend. Wo sollen die Universitäten ins gesamt auch nur eine Lehrkraft hernehmen, die den Ingenieuren das versprochene und Nothwendige bieten könnte?"

Riedler develops his ideas still further in 1896 in several articles (*Zeitschrift*, pp. 301, 337, 374), and also criticises Klein's scheme, of course as a strong opponent.

From these quotations it is clear that he feels the same need for the highest technical education as Klein ; but we may well turn his question round and ask where will he find a professor who can teach the *highest* mathematics to technical students, and who is at the same time a practical engineer? Here Klein comes in ; his plan will help to educate such men.

Riedler has in these papers a fling at higher mathematics as cultivated at the Universities, where "Abel and Riemann" count much, where one lives in regions in which θ-functions disappear, and in hypo- or meta-geometry, where "dimensions cease and manifoldnesses begin," and where the student learns "gymnastics in four dimensions."

It is easy from a "practical" point of view to make light of many parts of pure mathematics. Even Klein professes that he has often had doubts whether those theories in which the mathematician delights are really worth the trouble of increasing and developing, and in his opinion they would not be if they should never be of use in application to physical and engineering problems.

But, he adds, he has always come away from such contemplations with the conviction that his (and all mathematicians') optimistic views are justified by the belie that they will assist in due time in subjugating nature to science. In fact, the history of science is so full of examples that it is unnecessary to quote any.

If Riedler should succeed in getting the influence of all those speculations banished from the Hochschule, these will soon become as fossilised as the Universities, in his opinion, are at present.

But let us return to Klein's plans. His chief idea, as gathered from the various papers and from his own expressions during his recent visit to England, can be stated briefly enough.

He wants to bring together again theory and practice ; he wishes the Universities to take their proper place in modern German life, which differs from that of former days by its enormous energy in industry and commerce. He acknowledges that much has been done outside the Universities, and for purely practical purposes, to develop science ; that altogether new methods of investigation have been invented by engineers, and not only in physical investigation but even in mathematics.

He wishes to introduce these at the Universities to enable them to fulfil their duties properly, and he hopes by thus raising these institutions to enable them so to develop science that the results will be practically useful and repay the debt to engineers which science now owes them.

But he also hopes greatly to improve the education of mathematical and science teachers. There can be no doubt that the chief education of these must and will remain in the hands of the Universities—that they cannot be left to the technical schools. It is quite impossible to establish schools exclusively for future engineers, because it is impossible to settle at an early age what career a boy will select, and the majority of schools must be of a general character.

But what is highly desirable is that all teachers, not only the scientific ones, should be better prepared in science, and should gain a higher idea of the value of practical work, and that the old spirit according to which education can only be gained through the old languages, should be broken.

Not only the would-be engineers, but all boys must be made to feel this change, and therefore all teachers must be imbued with modern notions. To have some educated at the University and some at the technical schools would intensify the existing antagonism between science and classics. This ideal education of teachers can only be obtained at the Universities, and here only if these are themselves modernised. Klein's scheme tends to bring this about ; it does not exclude the possibility of some teachers of science and mathematics being educated at high schools, nor that many of these should spend a part of their time in studying at a high school ; it would be easy to devise a plan by which this could be accomplished.

Klein also hopes to help the engineer directly. The problems taken up by University men are at present without direct connection with practical needs, simply because the latter are unknown at the Universities. Klein wants to make these needs known to the University teachers in order to make it possible to direct their energies in the channels useful to engineers. Again, by having at hand a technical laboratory, and having connected with this all the intellectual resources of the University, it will be possible to bring to bear on technical problems such scientific power as is not likely to be found elsewhere.

To the same end he wishes to make important English scientific papers on technical subjects accessible to German physicists and engineers through translations, and a beginning will be made with Prof. Osborne Reynolds' paper on "Friction of Lubricated Bearings." Dr. Routh's "Rigid Dynamics" will also be translated.

It will be seen from this that Klein's scheme does not affect the ordinary education of engineering students, but that he takes a far higher flight which will not affect the routine at the high schools. Indirectly it cannot fail to raise the whole profession, the whole education of Germany; and if it is carried out in the spirit in which it is conceived, and is ably supported by his colleagues, it will have far-reaching consequences.

That the original memorandum did not reveal the full meaning of Klein's scheme can be explained by supposing that he had himself suffered from the want of direct contact with the engineering profession, and, besides, by his taking it for granted that every one would understand that he was speaking only of the *highest* part of the education of engineers, and that he did not dream of establishing a new engineering school to compete with the old ones.

As soon as he became aware of the opposition raised, he tried by personal intercourse to put himself right, and to destroy the false impression originally created. He went to meetings of the Engineer's Verein at Aachen and Hanover, in 1895, and expounded his plans, with the result of converting many to his views. When he found that the high schools were preparing schemes for laboratories of their own, he at once gave up all idea of asking the Government for money, considering that here the high schools had the first claim, and set about to make private means available in English and American fashion. He succeeded in interesting influential and wealthy manufacturers in his cause, who formed a committee which has promised and guaranteed him a sum sufficient to start one laboratory. For this purpose the thermodynamic laboratory has been selected, and is now in course of erection. As to the choice of a director, he has asked Prof. Linde's advice, who has recommended a pupil of his own; and all will agree that Linde's name is sufficient guarantee that the new director has been educated in a truly practical spirit.

Prof. Klein's plan does not in the least collide with the legitimate aims of the technical high schools; such collision only takes place with regard to the education of teachers, and here the claims of Riedler and others seem to us to be altogether unreasonable.

Klein is altogether the right man to carry out the plan successfully. His singleness of mind is conspicuous to every one who has come, however slightly, in contact with him. As a mathematician he is known and honoured all the world over. He possesses a strong faculty for geometrical conceptions, and likes, with wonderful success, to clothe every mathematical investigation in a geometric garb, or to illustrate it geometrically. His book on the *Ikosaeder* is a brilliant example of this. He, more than any other, has tried to remain in contact with the school teachers of mathematics, and has often put the results of profound mathematical speculations in such a form that they become available for school teaching.

To make the teaching of geometry more real he started, when Professor at the Munich Technical High School, the modelling of surfaces by the students; and the whole large collection of models on sale by Brill in Darmstadt may be said to have grown out of this. For the same reason, he has introduced at the University a course of geometrical drawing. He dwells not less on the necessity of developing facility in performing arithmetical calculations.

All engineering teachers in England will wish that English schoolmasters had been drilled in these two directions.

By descent, and from the environments in which he grew up, he has, from his youth, been familiarised with industry and manufacture.

The traditions of Göttingen, too, are greatly in his favour, and have helped to ripen his plans. Here Gauss worked for years at all possible problems ranging from pure abstract theory of numbers to the invention of an electric telegraph, and of a method of signalling by the sun's rays, now so extensively used in the English army. He enriched science as well as engineering with many important gifts; the theory of least squares, the absolute measure of force, the theory of magnetism, and all his work in connection with Weber.

What Gauss did alone, that Klein wishes to continue in combination with others; he justly observes, also, that a small town is more suited for his experiment than a large town with all its distractions.

We can only wish him success in his bold undertaking, and feel sure that, even if German engineers should carry their antagonism so far as to try to starve his undertaking by preventing young men from making use of the opportunity he offers them, which is most improbable, there will come to him, as heretofore, many eager students from England and America. O. HENRICI.

A WELL-KNOWN TEXT-BOOK OF CHEMISTRY.

A Manual of Chemistry, Theoretical and Practical (based on Watts' edition of Fownes' Manual). By William A. Tilden, D.Sc., F.R.S. Pp. xvi + 599. (London: J. and A. Churchill, 1897.)

THE preface to the original edition of Fownes' *Manual* is dated October 5, 1847. The merits of that book, published about half a century ago, were known to all. But, inasmuch as Prof. Tilden says in his preface to the present work "the last traces of Fownes have disappeared in the process" of re-writing, it is a manual of chemistry by Dr. Tilden, and not Fownes' book, that is to be reviewed here.

The task undertaken by the reviewer is a difficult one. I have tried to discover the principles on which the book is constructed, and to follow the method whereby these principles are applied. I trust, and I expect, that the criticisms I make will not be regarded by the author as the flippancies of an irresponsible reviewer, but that he will believe I am serious and as anxious as he is, up to my lights, to promote the study of chemistry.

What is the subject-matter of chemistry? If I am justified in taking this book as (among other things) Dr. Tilden's answer to that question, then, in my opinion, the answer is wrong.

The opening sentence of the *Introduction* reads well.

"The science of chemistry has for its object the study of the composition of the materials out of which are formed the earth, the sea, the air, and the organised and living beings which inhabit them. Chemistry also seeks to explain the composition of bodies and their properties."

If this is taken with the statement on page 12,

"it is no longer sufficient to determine composition. The aim of the chemist is to ascertain the relation of composition to the physical properties of a body,"

we have a description of the subject-matter of chemistry which seems to me fairly adequate. Would it not have been better to have omitted the word *physical* in the last sentence of the words quoted?

But the book does not fulfil the promise of the *Introduction*. The study of the compositions of bodies; the study of the properties, especially the reactions, of bodies; and the study of the connections between the compositions and the properties of bodies; that, surely, is the business of chemistry. And the one method by which this business can be conducted successfully is the comparative method. If a student is to acquire a genuine knowledge of that branch of natural science called chemistry, it seems to me he must be led constantly to compare and contrast facts in order that he may be prepared to receive, and comprehend, the generalisations of the science. The foundation cannot be laid firmly unless the builder is thinking of the structure he means to raise upon it. To vary the illustration: if the student of chemistry has shot over him loads of sterilised facts he soon is smothered; and if attempts are made to restore him by drawing him out now and then and submitting him to a cold douche of theory, the spark of life that was left in him is likely to be washed away.

After carefully reading much of this book, I am driven to the conclusion that it fails to connect the facts it records with one another, and with the generalisations which rest on the facts, marshal these facts into order, and suggest other facts. Moreover it seems to me that the generalisations of the science are not stated with sufficient fulness, lucidity, and suggestiveness; that the hypotheses of chemistry are not enunciated in such a way as makes it possible for the student to hold them firmly in his mental grasp, and at the same time to be ready to let them go when they have served their purpose of aiding clear thinking; and that the theories of chemical science are not brought into just proportion with the facts and the hypotheses which they ought to bind together and to vitalise.

I admit the enormous difficulty of dealing accurately, lucidly, and suggestively with the vast quantity of facts that has been accumulated by the labours of generations of chemists. I admit the insuperable difficulty of fitting all the many hypotheses of chemistry into their proper places. I do not deny the impossibility of treating the theories of the science, especially in an elementary book, so as to command the assent of so fractious a fraternity as the chemists. Still I think that a serious and painstaking effort should be made by every writer of a manual of chemistry to compare and contrast facts with facts, and to show that the hypotheses and the theories of the science rest on, while they pass beyond, and illuminate, the facts of the science.

It would be manifestly unfair, even in a review to which the writer's name is attached, to find such fault with a book as I have found with Dr. Tilden's *Manual*, without going into some details to justify the fault-finding.

On pp. 16 to 20 a brief account is given of chemical nomenclature and notation. The facts regarding the compositions of compounds which are conveyed by chemical formulæ are expressed in these pages in the language of the theory of atoms. But that theory has not been explained to the student; it has been sketched in the merest outline only. Indeed the theory could not be explained at this early stage of the student's progress. This method seems to me to be entirely wrong; I am certain it cannot conduce to correct thinking.

The *Introduction* is followed by chapters wherein are recounted, and illustrated, the preparations, and some of the properties, of the non-metallic elements and their more important compounds. These chapters also contain lucidly written accounts of those general properties of gases which are of importance to the chemist; of the structure of flame; of some of the phenomena of solution; and of other important matters. Then follow chapters on the laws of combination, the atomic and molecular theory, classification, crystallisation, allotropy and isomerism, heat and chemical affinity, and electrolysis. These are succeeded by accounts of the preparations and properties of the metals and the compounds of the metals.

It is not with the chapters or paragraphs which convey information about the elements and their compounds that I find fault. Much, I think one may say most, of what is contained in these chapters is written clearly and accurately; a selection is made—I think on the whole a good selection—from the enormous number of those facts which are the building stones of the edifice of chemistry. What I complain of is that these building stones are not employed to construct a building; they are arranged in heaps, and each heap is duly labelled;—but, that is all. If chemistry is a collection of bundles of information loosely held together by a few strings of generalisation, then the method of this book is excellent. The separate pieces of information are conveyed in clear and accurate terms. But, in my opinion, the binding strings are very fragile and they do not prevent the contents of the bundles from being scattered.

Many of the chapters which deal with the principles of the science are unsatisfactory. The *laws relating to combining proportions* are enunciated on pp. 236 to 238 These laws are not stated in sharp and decisive terms For instance

"The *law of definite proportions* affirms that when two substances unite together to form a given compound they can unite only in a fixed proportion ; . . ."

Why "*two substances*"? What exactly is "*in a fixed proportion*"? Why "they *can* unite"? Would not a student find much difficulty in understanding the conclusion that is drawn from the law of reciprocal proportions? This conclusion is

"For each element, therefore, there is a fixed proportion in which it enters into any state of chemical union."

The laws of chemical combination cannot be understood without the help of examples worked out fully from the basis of analytical and synthetical data. I cannot find in these pages any statement of the nature of the evidence whereon these fundamental laws rest ; nor can I discover any suggestion of the vast importance of these generalised statements of facts—the laws of chemical combination—which we have every reason to regard as true natural laws.

On p. 238 sixteen lines are devoted to *the atomic theory of Dalton*. I am certain that no student could obtain, from the author's statement of this theory, a clear mental image of the Daltonian conception of the atom. On this page occurs the statement

"a group of atoms united together chemically is called a molecule."

And on p. 240, after the enunciation of the law of Avogadro, we read

"by a molecule is here understood a small portion of the substance of the gas made up of atoms which do not separate from one another during the movements of the molecule."

This is altogether insufficient. Reference is made, it is true, to "Kinetic Theory, p. 239"; but no clear and sufficiently detailed statement of what is to be understood by the word *molecule* is to be found in the paragraphs devoted to that theory.

As regards the methods employed for determining the relative weights of molecules and the relative weights of atoms, I do not think that a student of fair intelligence and perseverance will be able to realise these methods as definitely as they ought to be realised, even by a very careful consideration of the paragraphs devoted to these subjects on pp. 241 to 251. About 10 pp., 254 to 264, are concerned with the very difficult subject of *valency* or *atomic value* and the application thereof to constitutional formulæ.

". . . an atom of certain elements can replace or be substituted for only one atom of hydrogen, whereas the atoms of other elements can replace 2, 3, 4, &c., atoms of hydrogen."

Then follow reactions meant to illustrate this statement. And then we read

"This difference of combining or saturating power, originally called *atomicity*, now more appropriately called *valency*, is sometimes denoted by placing dashes . . ."

This is, in my opinion, slipshod and hazy writing, and it cannot but induce to slipshod and hazy thinking.

There is an extraordinary statement on pp. 255, 256 about *the law of even numbers*. This "law," we are told, is that

". . . in all such compounds [saturated or normal compounds] the sum of the perissad elements (that is, elements whose atoms are of uneven valency) is always an even number."

Take the case of the gaseous molecule NO. *The sum of the perissad elements*, to use the author's loose phrase, in this compound is not an even number. Perhaps this compound is not a "saturated or normal compound"? Well, define what you mean by "saturated or normal," and then show that *the law of even numbers* is of any value as an aid to accurate research and accurate thinking. The existence of the three gaseous molecules InCl, $InCl_2$, $InCl_3$ disposes of the law of even numbers, if the *law* is anything more than a mere playing with numbers.

I have tried to get some clear notions about *heat and chemical affinity* from the pages which deal with that subject ; but I have failed. These pages give one a little information about some portions of thermal chemistry ; but the subject of chemical affinity is not really touched on at all.

On p. 287 there is a guarded, but still misleading, statement which comes perilously near an enunciation of Berthelot's *law of maximum work*, which "law" is both false in fact and untrue in principle.

To sum up the complaints I make against this book. There is a want of proportion. There is a failure to appreciate the relative importance of the various parts of the science. There is a failure to describe facts of observation as such, and then to show how hypotheses arise and react on these facts, until a general theory is attained, which illuminates the foundations whereon it rests, and suggests the lines on which search must be made for more facts.

I admit the vast difficulty of writing an elementary manual of chemistry. The past is strewn with failures, to which I have myself contributed. I am exceedingly sorry to say that, in my opinion, this book is not a success. M. M. PATTISON MUIR.

PHILOSOPHY AND PHILOSOPHERS.

History of Philosophy. By Prof. A. Weber. Translated by Dr. F. Thilly. Pp. xi + 630. (London : Longmans and Co., 1896.)

System der Philosophie. Von W. Wundt. Zweite umgearbeitete Auflage. Pp. xviii + 689. (Leipzig : Engelmann, 1897.)

FOR Prof. Weber the chief interest of his subject obviously lies in the post Kantian schools, and his own solution of the problem of philosophy, as shaped by the influence of the conceptions and methods of the natural sciences on the one hand, and by the exigencies of ideal and optimist ethics on the other, is in the direction of a "concrete spiritualism." The key-word of this he finds in will or force rather than reason, but a *Wille zum Guten* in place of Schopenhauer's will to live. It is in virtue of his firm hold upon modern problems that his review of the way in which they have been historically evolved is so far successful that some, at least, of the dry bones of the History of Philosophy are made to live. Those writers whose antagonism to a dualist metaphysic makes them forerunners of the post-Kantian development—Bruno for example, and more especially Spinoza and Leibniz—are exceptionally well treated, and of the teachers who drew their inspiration from Kant, Fichte and Herbart, and particularly Schelling and Schopenhauer, are handled sympathetically and with discrimination.

Prof. Weber's book has the defects of its qualities. The amount of space allotted to some of the greater philosophers, such as Plato and Aristotle, is restricted, and they are dealt with rather as exponents of phases in development than as thinkers whose positive solutions of the problem are of enduring interest. Thus the *Phædrus* is summed up as "opposing the selfish rhetoric of the sophists with the true eloquence of the philosopher, whose chief object is the knowledge of the invisible world." There is a technical mistake in saying that Aristotle's "first philosophy" has for its object "the queen of the categories—substance." The biological point of view, which is so pronounced in Aristotle, is not brought out, and, in general, it is Aristotle as he influenced later philosophy that Prof. Weber presents to his reader. In the statement that "the *matter* of Plato, Aristotle, and Plotinus is not the matter of the materialists, but what Schelling and Schopenhauer would call *will* or the will-to-be," the suggestiveness is, in part at least, that of a *suggestio falsi*.

In his treatment of Kant, too, Prof. Weber has the after-development so vividly before him that the exegesis of the first *Critique* is somewhat injuriously affected. "Prior or *à priori* to" is, as Prof. Weber uses it, an incorrect phrase. The distinction between image and schema is lost by loose terminology. And, as is perhaps natural, the Refutation of Idealism is slurred as nonessential. Indeed the issue, as between Kant and Berkeley, is not understood; and it is significant that in the account of the latter the *Siris* is not mentioned. Berkeley, that is. to say, is labelled idealist and a precursor of Hume, and his own intellectual development has no account taken of it. Another notable omission in the modern period is in the case of Lotze, who is just named and dismissed.

On the other hand, the scholastic period, which has devoted to it a larger proportion of space than is usual, is covered with some success, Prof. Weber's theological and ethical interests giving life to the inquiry. Anselm is admirably handled.

The translation is from the fifth French edition of the Strassburg Professor's book. The American translator has added in notes and appendix an adequate bibliography, without criticism, and with a not unnatural preference for transatlantic editions and translations.

Many of Prof. Wundt's metaphysical views were familiar to the world even prior to the appearance of his "System" so long ago as in 1889; and to offer an appreciation in detail of a well-known work by so great a teacher would be at once an impertinence and an anachronism. In welcoming, however, the second revised and slightly enlarged edition of the "System," it is perhaps permissible to recall some of its characteristics.

Prof. Wundt's idea of a philosophical system is a connected view of existence which shall satisfy both the demands of the understanding and the needs of feeling. It must be strictly *meta*-physical, after and based upon the experiential sciences. Its method may be described, perhaps, as a criticism of working categories, passing from conceptions of the understanding to the transcendent ideas and finding, as the end of the *Regressus* in each limited field, an inadequate point of view which needs supplementing, until we reach our Ontology. The basis of this is Will. But Prof. Wundt can as little accept what he calls Universal Voluntarism as he can the *intellectus infinitus*. Will, without something to will or without a relation of interaction in which to realise itself, is void, abstract, and not will as we know it. The solution of the problem he finds in a system of relatively independent wills in whose interaction ideas (*Vorstellungen*) arise. The principle of unity lies in the moral ideal of humanity. Collective will is a reality, but not in the sense of the school which derives from Schopenhauer.

Prof. Wundt is more happy, however, in his criticism of particular categories. His treatment of purposiveness in organic evolution is quite masterly, though he attaches somewhat too much importance to what he calls *Heterogonie* of ends. In this edition he refers specially to the controversy between Prof. Weismann and his critics in its most recent form, and declares definitely in favour of use-inheritance, though he draws a distinction between the suddenly acquired qualities of an individual and the gradually acquired characters which have become ingrain by like response to like stimulus repeated from generation to generation. He notes with some candour that it might in theory be maintained that the latter are transmitted because they alone are able to affect the germ-plasm. We do not venture to deal with Prof. Wundt's *Holoplasma* and its relation to the views of Nägeli.

The book stills lacks an index, a deficiency specially annoying since the same and allied subjects are taken up under more than one heading. H. W. B.

THE CORAL REEFS OF SAMOA.

Ueber den Bau der Korallenriffe und die Planktonvertheilung an den Samoanischen Küsten nebst vergleichenden Bemerkungen. By Dr. Augustin Krämer. With an appendix "Ueber den Palolowurm," by Dr. A. Collin. 8vo. Pp. ix + 174. (Kiel and Leipzig: Lipsius and Fischer, 1897.)

DANA'S main contribution to the Darwinian theory of coral reefs was a persuasive argument based on the geographical distribution and varying size of atolls and reef-grounds. Darwin had shown that if his theory were true, its most important corollary was that certain lines across the Pacific Ocean were lines of subsidence, and that others are either rising or stationary. Dana pointed out that as we approach the supposed lines of subsidence the areas of the coral reefs diminish, islands of non-calcareous rocks disappear, and the coral islands all become atolls, which gradually contract in size; after this comes a tract of sea without islands, and of great depth. Then, the axis of subsidence having been passed, small atolls reappear, the reverse series of changes occurs, until we reach an area of broad fringing reefs round some rocky island. Dana's most striking illustration of this method of reef distribution was the archipelago of Samoa, in which he described a gradual passage from the westernmost, rocky island of Savaii eastward, past reefs of diminishing size, to the last member of the group, the small Rose Atoll. Beyond that island there are some 900 miles of open sea, until the small atolls of the Society Islands begin another series leading up to the great Paumotu Archipelago. Dana explained the distribution of the reefs by assuming that the line between Rose Atoll and the Paumotus had rapidly subsided. This suggestion was in harmony with all the known facts. It has been the argument least shaken during the discussion on Dr. Murray's theory, and has accordingly kept some men firm in the Darwinian faith. Funafuti was originally recommended by the original Coral Island Boring Committee as a suitable site for a bore-hole, after it had been tested by this principle in order to minimise the chance of stumbling on an area of rising sea-floor.

Now, however, Dr. Krämer, in a detailed description of the Samoan reefs, shows that the facts are not exactly as stated, and that another explanation is available. Dr. Krämer's book opens with a sketch of the literature on the coral reef controversy, which is neither complete nor altogether accurate; for he numbers Admiral Wharton among the defenders of Darwin's theory, and Prof. Sollas among its opponents. He then gives an account of the topography, meteorology and geology of the Samoan group, after which follows a detailed description of the coral reefs. The next section of the book discusses the conditions which determine the limits of coral-reef formation, and in which the most original remarks are those dealing with the influence of heliotropism. (His observations on heliotropism in corals have, by the by, an important bearing on the question of the validity of coral species founded on the nature of the corallum.) He concludes his contribution to the reef controversy by a chapter entitled "a new view of the origin of atolls." Dr. Krämer points out, during his description of the Samoan reefs, that they are not disposed exactly as they should be to agree with Dana's suggestion, that the eastern end of the archipelago is undergoing rapid subsidence. The reefs are not as regularly arranged as has been thought. Proceeding from west to east, Savaii has no very extensive reefs except on the east coast; Upolu, the next island, has large fringing reefs at the west end, fringing and small barrier reefs in the middle section, and unimportant fringing reefs at the east end; Tutuila has only a fringing reef on the southern shore, and two submarine barrier reefs further out; Manua has no important reefs; finally, the easternmost island of the chain is Rose Atoll. These facts appear conclusive that the Dana argument will not hold for its typical locality.

Krämer then proceeds to discuss the origin of the remarkable shapes of atolls, which Darwin thought it was impossible to explain on the view that atolls formed either on the rims of volcanic craters or on submerged banks. Krämer invokes the aid of great geyser eruptions, in order to widen the bases and alter the forms of submarine volcanoes. He points out that the distribution of volcanic ejectamenta depends not only on its specific gravity, for ocean currents and tides carry the material and pile it up in the dead water to the lee of volcanic islands. He reproduces a chart from Dana, showing how the trend of the coral archipelagoes agrees with that of the ocean currents in their neighbourhood; and he supports this by similar charts of the Paumutu and Marshall Islands. The difficulty of deep lagoons he explains by assuming that atolls with such, originated on crater rims; and he is more inclined to Murray's solution theory than are most writers on coral islands, although he remarks that it does not seem sufficient by itself.

The concluding section of Dr. Krämer's book deals with some biological problems of the Pacific Ocean. A few pages are devoted to the reef fauna, considered in reference to its ethnological relations, and then follows a longer account of the Plankton. The author describes his apparatus and methods at some length. The most interesting result given in this section of the book are his statistics of the comparative poverty of the tropical Plankton compared with that of the temperate zones. In an appendix on the Palolo, a worm largely eaten by the Samoans, Tonguese and Fijians, Dr. Collin re-describes its structure from excellent material collected by Dr. Krämer. He agrees with Quatrefages and Ehlers that it is a member of the genus *Lysidice*, and that Gray's genus, *Palola*, must be given up.

J. W. G.

OUR BOOK SHELF.

A Treatise on Practical Plane and Solid Geometry. By T. J. Evans and W. W. F. Pullen. Pp. vi + 400. (London: Chapman and Hall, Ltd., 1897.)

IN these 400 pages the joint authors present the student, particularly the one who wishes to restrict his work to the Science and Art Department syllabus of the honours stage of the annual examination held in geometry, with the solutions of a series of problems arranged in an orderly and progressive manner. The problems are, for the most part, those which have been set at the examinations held during the years 1887 to 1896, and their solutions are accompanied, in many cases, by useful hints. There are also included the theories of isometric projection, shadows, and perspective, and several interesting miscellaneous examples, besides some of the less difficult problems which are of fundamental importance. It is not advisable for a student to limit himself entirely to the reading of such a book as this, but using it in connection with a good text-book its value will be very much enhanced: for this reason, the authors have made ample references to existing standard works. No less important are the excellent and clearly printed figures, to the number of 200, which accompany the text; these should be well studied, and, in most cases, re-drawn by the reader himself. For advanced students and teachers this collection of problems and proofs will, without doubt, prove a most useful help in their work.

Les Transformateurs de tension à courants alternatifs. By F. Loppé. Pp. 206. (Paris: Gauthier-Villars. Masson and Co.)

Électromoteurs et leurs Applications. By G. Dumont. Pp. 183. (Same publishers.)

Électro-métallurgie. By A. Minet. Pp. 195. (Same publishers.)

THESE books are the three latest additions to the well-known series published under the title of the Encyclopédie scientifique des Aide-Mémoire. All the volumes in the series have proved handy and serviceable to students of science and technology.

The first part of M. Loppé's work deals briefly with the theory of the transformer, and ideal conditions of construction; the second part is devoted to the classification of transformers, details of construction, the description of principal types, and the determination of the dimensions of the various parts of a transformer required to satisfy specified conditions.

M. Dumont begins his volume with a short account of the various means used for the distribution of energy. He then deals successively with different kinds of continuous current and alternate current electromotors, the advantages and disadvantages of the two types, and systems of electrical transmission of power.

M. Minet's volume is one of four which it is proposed to publish on electrolysis and electro-chemistry. One will deal with theories of electrolysis; another with electro-chemistry; electro-metallurgy is the subject of the present volume; and electric furnaces and their applications will be treated in the fourth volume. The general laws of electrolysis are described in the introduction to the volume before us, then methods of working in the wet way, with electrolytes containing dissolved salts, and afterwards processes of electro-metallurgy in the dry way, which includes the electrolysis of substances brought to a fluid state by igneous fusion, and electro-thermic reductions.

Cheese and Cheese-making. By James Long and John Benson. Pp. viii + 150. (London: Chapman and Hall, 1896.)

Though this little volume bears the names of two authors, they can hardly be regarded as collaborateurs. What was the origin of the book does not appear, for there is no preface or introduction. Mr. Long writes five chapters at the beginning and three at the end, whilst the intermediate chapters, four in number, are by Mr. Benson. Each author writes independently of the other, and their respective contributions might equally well have appeared as separate pamphlets. The volume, of course, suffers from this lack of cohesion. Mr. Long's chapters are devoted to the principles of cheese-making, the trade in foreign cheese, soft cheese manufacture, Gorgonzola and the varieties of blue or moulded cheese, other varieties of fancy cheese, the milk industry, the principles of butter-making, and creameries and factories. For a chatty or discursive account of the numerous varieties of foreign cheese it may be safe to consult the volume, but the details of manufacture are hardly given with sufficient precision to possess any value for purposes of instruction. Occasionally, too, Mr. Long is a little uncertain in his choice of words, as when he makes reference to districts "where the most luxurious crops are grown"—he no doubt had luxuriant crops in mind. Mr. Benson deals with the best methods of manufacturing Cheddar, Stilton, Cheshire, and Wensleydale cheeses respectively. More care has been bestowed upon this part of the work, which in the hands of an intelligent person might usefully be employed as a guide to the making of the four varieties of English cheese specified. Connoisseurs will agree with Mr. Benson "that a well-made Stilton stands without rival amongst the better-known varieties of cheeses." One disadvantage of the dual but not joint authorship is that there is considerable repetition. Another is that the volume has no index. So well known a continental cheese as the Gruyère seems to have escaped notice, though the Gervais, Bondon, and Coulommiers receive attention. There are no illustrations.

The Naturalist's Directory. Pp. 102. (London: L. Upcott Gill, 1897.)

It would be interesting to know what the editor of this book means by a naturalist, for we should then be better able to understand why most people whom we regard as naturalists do not appear in his list. The title-page informs us that the book is intended "for the use of students of natural history, and collectors of zoological, botanical, or geological specimens, giving the names and addresses of British and Foreign naturalists, natural history agents, societies and field clubs, museums, magazines, &c." But we have looked in the list for the names of about twenty well-known naturalists, and have not found one of them included. Perhaps the Directory only contains the names of amateur naturalists, or of naturalists inviting exchanges or correspondence?

In "a list of the principal natural history work published during 1896 in the British Isles," we notice a work on metallurgy, and several on chemistry. If these are branches of natural history, then the editor, to be consistent, should include chemists and metallurgists in the Directory.

Flowering Plants. By Mrs. Arthur Bell (N. D'Anvers). Pp. 204. Illustrated. (London: George Philip and Son.)

Though this book is said to be "complete in itself," it it is not a sufficient guide to the beginner in botany, for the first chapter begins with the supposition that another volume has been read, and the meanings of such terms as "calyx," "corolla," "stamens," "pistil" are regarded as part of the mental stock-in-trade of the reader. The book has been written to introduce the reader in an easy and pleasant way to the common flowering plants; but though we read, on p. 157, "You can easily find either the common or the ivy-leaved Toad-flax for yourselves," we search in vain for any description sufficient to enable a young reader to recognise this plant. Most of the illustrations are reproductions of photographs. A few of them are good, but they are usually quite inadequate to enable the learner to identify specimens of the plants he will meet during his country walks.

Twelve Charts of the Tidal Streams near the Channel Islands and Neighbouring French Coast. By F. Howard Collins. (London: J. D. Potter, 1897.)

These charts show by arrows the tidal streams around the Channel Islands and as far as the neighbouring coast of France, when it is high water at St. Peter's Port, Guernsey; one, two, three, four and five hours after high water at that port; and six, five, four, three, two, and one hour before high water there. Hence, knowing the time at which high water occurs at St. Peter's Port on any particular day, the direction of the tidal streams in the neighbourhood covered by the charts at any time before or after high water can be seen. The charts are based upon Admiralty observations, and should be of service to yachtsmen in the Channel.

Guide to the Genera and Classification of the North American Orthoptera found North of Mexico. By Samuel Hubbard Scudder. Pp. 87. (Cambridge, Mass.: Edward W. Wheeler, 1897.)

The tables and bibliographies contained in this book will prove very serviceable to students of Orthoptera in America. All the seven families of Orthoptera are found in the United States, but a large amount of work remains to be done upon them, and this volume will assist in the collection and study of material required for advancement. The author states that he "contemplates a general work on the classification of our Orthoptera, of which this is merely a Prodromus, and which may serve its purpose until the material at hand has been more thoroughly studied."

Aids to the Study of Bacteriology. By T. H. Pearmain and C. G. Moor, M.A. Pp. 159. (London: Baillière, Tindall, and Cox.)

A good general idea of the science of bacteriology, especially in its pathogenic aspects, can be derived from this little book. As an introduction to the "Applied Bacteriology" of the same authors, the book should be welcomed by medical students and by all practitioners who wish to know something of the methods of bacteriological research, and to understand the significance of the results obtained.

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.*]

On a Method of reproducing Astronomical Photographs.

PROF. MAX WÖLF, in his excellent article on the "Reflector and Portrait Lens in Celestial Photography," published in your issue of April 22 last, mentions a method of "reproducing nebulous masses" from original negatives, and refers to my reproduction of a photograph of the nebula M.8, done in collaboration with Mr. Lunt.

I have since tried the method on a number of other clusters and nebulæ with uniform success.

My practice now is to use a very slow plate capable of giving good contrast, and to give it the least possible exposure during contact-printing from the original negative. I use the ordinary Pyro-ammonia developer with half of the normal quantity of ammonia indicated, and with an excess of bromide. If there is the slightest indication of an image within five minutes, the plate is rejected as too much exposed. The development is continued for about forty-five minutes, with an occasional addition of a little more ammonia; the plate is, of course, kept rocking all the time in the dark. From the positive thus obtained a second negative is secured, and from it a second positive, and from the last a third negative, which is used for final printing on paper. The method of development is throughout the same as mentioned above.

Faint details in outlying portions, for instance, in the photographs of the corona can be very easily brought out in this manner.

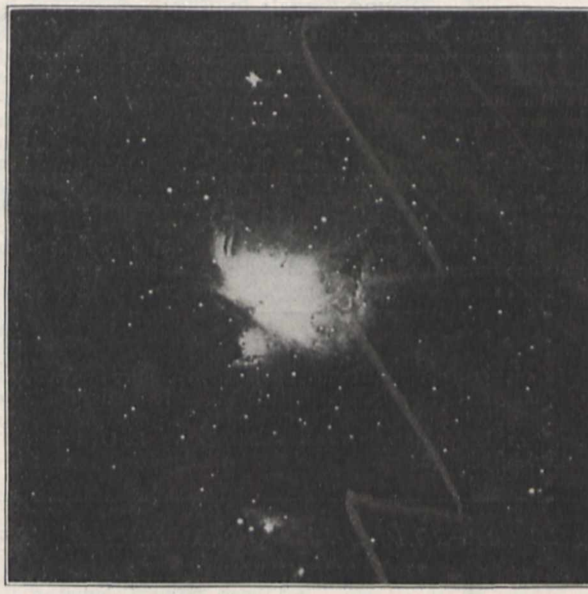
No intensification by mercury or otherwise is employed by me, and I consider it absolutely inadmissible, as it is liable to affect the grains in the neighbourhood of the image, and thus to give a false extension of nebulous matter. The pure process of successive copying and bringing out contrast is perfectly legitimate; Scheiner and others having shown that the image does not spread thereby.

I beg to forward for your inspection the original negatives and reproduced copies of M.8 and the Orion nebula, and shall be glad if you can make use of them. K. D. NAEGAMVALA.

June 8.

THE GREAT NEBULA IN ORION.

Original negative.



Negative twice re-copied.

On Mimicry.

DURING the discussion on Mimicry at the last meeting of the Entomological Society, the fact that so many mimetic species are scarce, in comparison with the non-mimetic allies and the models, was brought forward as an argument against the efficiency of mimetic resemblance. Amongst the Indo-Australian Papilios this phenomenon is strikingly illustrated by *Papilio alcidinus* and *caunus*, which resemble their models to a surprising degree. As both these rare species deviate widely from their nearest relatives, it occurs to me that the theory of Mimicry, which says that Homœochromatism and Homœomorphism between imitating and imitated species are the outcome of *selection*, can give a satisfactory explanation of the scarcity of individuals of mimetic forms. If we concede for the sake of argument that, for instance, *Papilio alcidinus* has acquired that wonderful similarity in colour and form to its model, an Uraniid moth, in consequence of a continued selection in the one direction, it is obvious that the result of such a one-sided selection will not only be similarity to the immune model, but also physiological one-sidedness. The more rigorous the selection is, the better will the mimetic species become adapted to its model, and the more will it lose its adaptability to new biological factors. Therefore, when changes in the biological conditions of the area inhabited by the mimetic form take place, such ever-occurring changes as have been described by Wallace in "Natural Selection," the mimetic species, best adapted in one direction, will be at a disadvantage to its relatives which have not been subjected to rigorous, one-sided selection. Consequently, the most striking "mimics," in spite of, or rather in consequence of, the resemblance to immune species, are, in the long run, the less favoured in the struggle for existence, which means that they will become relatively scarce. From this consideration it is apparent to me that the selection of those specimens which are the very fittest in any *special* direction is in itself a danger to the species, and can lead to destruction. The peculiar bearing which this suggestion has on the theory of Natural Selection, especially on the principle of utility, is evident.

Zoological Museum, Tring, June 7. KARL JORDAN.

Immunity from Mosquito Bites.

THE note of your correspondent (NATURE, No. 1438), relative to the above subject, leads me to point out that my own experience is the counterpart of that there presented. More than twenty years ago, as a young man, I camped during the months of May and June in the forest which bordered the south shore of Lake Superior, a region teeming with varied forms of insect-life, among which the mosquito held a conspicuous although not the most obnoxious place. I had previously been very sensitive to mosquito stings, and suffered acutely from them during the entire period spent in camp, my hands and face being so closely covered with the peculiar hard lumps resulting from the sting, that they presented in place of soft flesh only a series of contiguous swellings.

The temporary discomfort thus occasioned has since been abundantly recompensed. For many years afterwards mosquitos displayed a marked antipathy towards my blood, rarely stinging me if any other person were available as a subject for their attacks. This kind of immunity I have now partially lost, but even to the present time a mosquito sting occasions me very little annoyance. It is followed by no swelling, and the pain ceases within a few moments after the proboscis is withdrawn. GEO. C. COMSTOCK.

Washburn Observatory, Madison, Wis., U.S.A.

Sound Signals in Fog.

REFERRING to one of your Notes on page 130, I will take the opportunity of repeating a suggestion which I have several times made privately, viz. to have on board ship not a double emitter but a double receiver of sound:—a pair of trumpet-mouths or collectors or ears, one at each side of the ship, with the bulk of the ship as a shadow-throwing object between (like the head), and with tubes leading from them into the the captain's or other quiet cabin. The listen-out-man, having these tubes in his ears, would be able to hear distant sounds and estimate their direction with greater precision than if he trusted to his own small collecting organs, but I apprehend in just the same sort of way, and almost without training.

June 12. OLIVER J. LODGE.

Fire-fly Light.

IN answer to Prof. Silvanus Thompson's inquiry in NATURE of June 10, it may be stated that the "Johanniskäfer," or "Johanniswürmchen," is the common glow-worm, *Lampyris noctiluca*, L., or *Lampyris splendidula*, L. E. OVERTON.

Zürich, June 12.

THE APPROACHING TOTAL ECLIPSE OF THE SUN.

I.

THE failure of so many of the eclipse parties last year to secure observations, makes it a matter of congratulation that the weather prospects of the eclipse to be observed in India on January 22 next year seem to be as favourable as they possibly can be. I propose in the present article to refer generally to the objects to be attained, and to give an account of the proposed arrangements so far as I know them; and to show how fair the prospect of success this time is, I will begin by referring to a note drawn up by Mr. Eliot, F.R.S. Meteorological Reporter to the Government of India, in order to give the chief meteorological features of the tract of country in India through which the line of totality will pass.

The note begins by giving a general idea of the Indian climate.

"It may be premised that the year in India may be divided into two seasons or periods—the north-east or dry monsoon (or season), and the south-west or wet monsoon. During the south-west monsoon winds of oceanic origin prevail, and the whole of the period is one of frequent rain over the greater part of India. The chief features of this period, lasting from June to December, are moderately high temperature, moderate diurnal range of temperature, high humidity, much cloud, and more or less frequent rain. The amount of cloud and rain differ very considerably in different parts of the country, depending upon their position with respect to the neighbouring seas and the mountain ranges in India, and other conditions. The south-west monsoon winds usually withdraw from Northern India in September or October, and from the Bay of Bengal and Southern India in December. Hence the months of November and December form a transition period from the conditions of the wet to the dry monsoon, the change commencing in Upper India, and extending slowly eastwards and southwards.

"During the dry or north-east monsoon (extending from January to May), winds of land origin prevail in the interior of India. In Northern India these land winds blow down the larger river valleys, and are hence westerly over the Gangetic plain, the largest river plain in India.

"The first two months, January and February, form the cool weather of Northern and Central India and the Deccan. The mean temperature of the day ranges between an average of 71° in the Deccan (Berar, the Central Provinces, and Hyderabad), and 54° in the Punjab. The diurnal range of temperature is large in amount, varying between 25° to 35° or 40° in the interior. The air is usually very dry, skies free from cloud, and winds light, more especially in the Punjab and more remote districts of the interior. The disturbances of this period are feeble cyclonic storms of large extent, which cross Northern India from west to east, and give much cloud and light, to moderate rain in the plains and hills of Northern India. Temperature increases rapidly in March, and that month and the two following months of April and May form the hot weather season. The intensity of the hot weather conditions increases from March to May. The chief features of the weather of this period in the interior of India are high day temperature, large diurnal range of temperature, great dryness of the air, and strong day winds which raise clouds of dust, and more or less obscure the sky and sun. Cyclonic storms of large extent are of comparatively rare occurrence in this period. On the other hand, small local hot weather storms—including hailstorms, thunderstorms, and duststorms—are of frequent occurrence, and tornadoes are of occasional occurrence, in Bengal chiefly."

It follows from this sketch that the eclipse will occur in the middle of the cold weather and at the most favourable time of the year for travelling in India. Light north-east winds, fine weather, and smooth sea are to be expected. Cyclonic storms are of exceedingly rare occurrence in either sea during the month, and the chance of a gale or of stormy weather in the month off the coast of the Konkan (from Bombay to Karwar) is, according to Mr. Eliot, less than 1/50. He states:—

"The weather is throughout the month of January almost uniformly fine, with clear or lightly-clouded skies over the whole of the Peninsula. Light north-easterly to easterly winds obtain in the Deccan, or interior of the Peninsula. The west coast districts are protected by the West Ghats from these winds, and light land and sea breezes prevail. The most remarkable feature of the meteorology of the coast area from Bombay south to Karwar in January is the freedom of the skies from cloud. Disturbances are of very rare occcurence, and fine weather is hence almost a certainty during the whole of the month. There is, however, usually much dust in the air, raised by the dry winds in the Deccan."

Among other most important matter in Mr. Eliot's note is a table showing average temperature, humidity, cloud and rainfall data in January at certain stations in India near the line of totality. We gather that the mean temperature of the month of January in the Konkan coast districts is 76°, with a diurnal range of 20°. In the Deccan (*i.e.* at Sholapur, &c.) and the Central Provinces the mean temperature of the day in January is approximately 70°, and the diurnal range nearly 30°. In Bihar the mean daily temperature of the month is 62°, and the diurnal range 23°.

Mr. Eliot points out that since the air is very dry over the interior, and the mean daily humidity percentages at stations in the Deccan, Central Provinces, and Berar averages about 40°, any instruments brought out from Europe, such as photographic cameras, &c., should be constructed to withstand the action of this great dryness of the air. With regard to cloud, the data show that the coast districts between Karwar and Ratnagiri (which includes the line of totality) is on the mean of the month more free from cloud than any other part of the line of totality.

"The amount of cloud is practically uniform in amount over the Deccan and Central Provinces, and is slightly greater in Bihar than in the Deccan or Central Provinces. The amount of cloud is very large at Darjeeling in January, and mist or fog almost invariably forms after clear nights in the morning (about 9 or 10 a.m.), and prevails more or less steadily until late in the afternoon, when it gradually disappears."

Rain is of rare occurrence during the month of January in the Konkan and Deccan. Its probability increases in proceeding from west to east. In the Konkan the average number of rainy days in the month is only 0·2, and in the eastern districts of the North-western Provinces the average number is 2, and in Bihar 1·2.

"The probability of a rainy day in January is hence about six times as great in Bihar as in the Konkan in January. The probability of any given day in January being rainy in the Konkan is less than 1/150, and in Bihar 1/25."

Mr. Eliot remarks, in connection with this, that skies are usually remarkably clear after rain in the Gangetic plain, and the atmospheric conditions for astronomical observations are at such times much finer than are ever obtainable in the Konkan or Deccan.

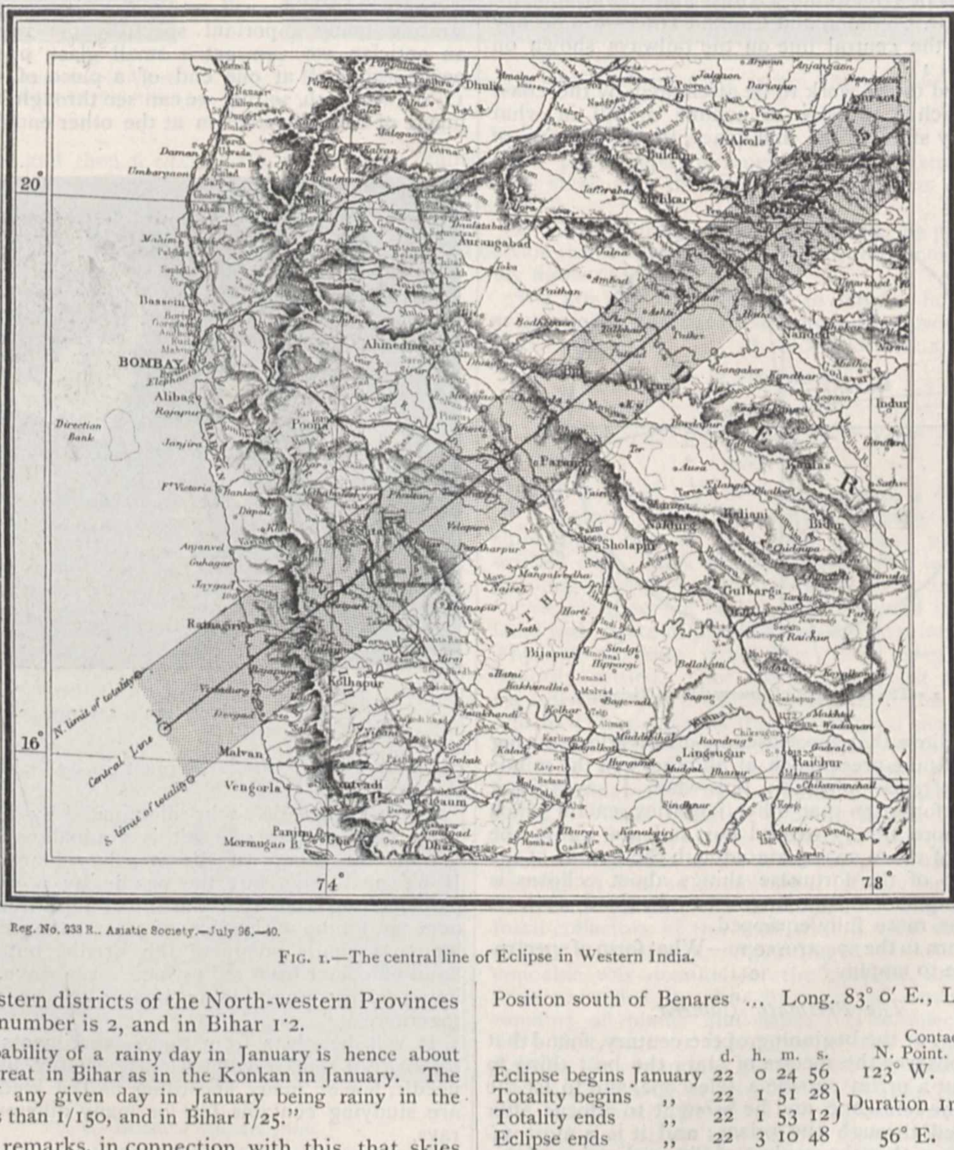
The local astronomical conditions at three points along the line of totality are thus stated in the "local particulars" issued from the Nautical Almanac Office. Local mean times and the points of contact for direct image are given.

Rajapur ... Long. 73° 35′ E., Lat. 16° 40′ N.

		d.	h.	m.	s.	Contact from N. Point.	Contact from Vertex.	Sun's altitude.
Eclipse begins	January	21	23	13	58	121° W.	100° W.	52°
Totality begins	,,	22	0	47	42	Duration 2m. 1s·9		53°
Totality ends	,,	22	0	49	44			
Eclipse ends	,,	22	2	15	51	55° E.	13° E.	44°

Nagpur ... Long. 79° 8′ E., Lat. 21° 9′ N.

		d.	h.	m.	s.	Contact from N. Point.	Contact from Vertex.	Sun's altitude.
Eclipse begins	January	21	23	56	20	123° W.	118° W.	50°
Totality begins	,,	22	1	26	33	Duration 1m. 17s·7		46°
Totality ends	,,	22	1	27	51			
Eclipse ends	,,	22	2	49	15	55° E.	10° E.	35°



Reg. No. 233 R.. Asiatic Society.—July 96.—40.

FIG. 1.—The central line of Eclipse in Western India.

Position south of Benares ... Long. 83° 0′ E., Lat. 24° 40′ N.

		d.	h.	m.	s.	Contact from N. Point.	Contact from Vertex.	Sun's altitude.
Eclipse begins	January	22	0	24	56	123° W.	128° W.	46
Totality begins	,,	22	1	51	28	Duration 1m. 43s·6		40°
Totality ends	,,	22	1	53	12			
Eclipse ends	,,	22	3	10	48	56° E.	10° E.	29°

The Joint Committee of the Royal and Royal Astronomical Societies have determined to send out three parties to observe, one on the coast and two inland, at stations to be subsequently decided upon. It has been arranged that the party from the Solar Physics Observatory will occupy the coast station if the Admiralty can grant the use of a man-of-war to allow an attempt to be made to repeat the *Volage* programme of 1896.

In this case the station will possibly be the old fort at Viziadurg, for which point the following astronomical conditions hold, according to the Superintendent of the Nautical Almanac (Fig. 2).

Assuming the position of Viziadurg to be 16° 32′ N., and 73° 22′ E., the times of contact are (local mean time):—

	d.	h.	m.	s.	
1898.—January	21	23	12	20	
,,	22	0	46	9	$P_2 = 241°$
,,	22	0	48	14	$P_3 = 51°$
,,	22	2	14	33	

These times are 4h. 53m. 28s. in advance of Greenwich.

The land parties—which will include the Astronomer Royal, Prof. Turner and Mr. Newall, representing the Observatories of Greenwich, Oxford and Cambridge, together with Dr. Common and Captain Hills—will occupy stations near the central line on the railways shown on the map (Fig. 1).

With regard to the work to be attempted by the coast party, to which I propose to confine myself in what follows, I may state, in the first place, that I am one of

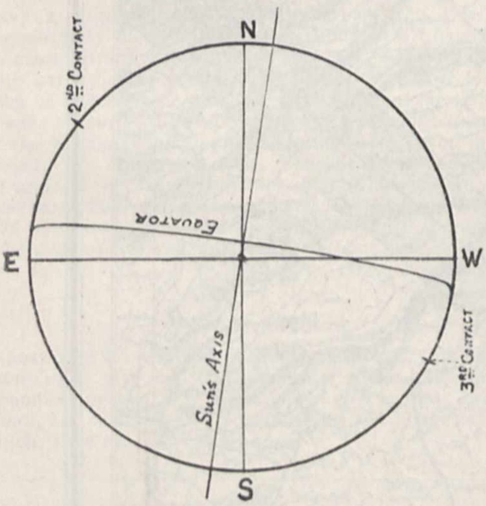


FIG. 2.—The conditions of observation at Viziadurg.

those who believe that spectroscopic observations during eclipses must take precedence of all others in the minds of students of solar physics; but when I say this, it must not be forgotten that other inquiries remain which are much more simply carried out, and are within the competence of those unacquainted with the details of the subject; one of the fortunate things about eclipses is that photographers and amateurs can do good work as well as those more fully equipped.

But to return to the spectroscope—What form of spectroscope are we to employ?

The Prismatic Camera.

Fraunhofer, at the beginning of the century, found that in order to observe the spectra of stars the best thing to do was to put a prism outside a telescope, and to let the light enter the telescope and be brought to a focus after it had passed through the prism; and it is a most unfortunate thing, that the neglect of the application of this principle has landed us probably in a delay of fifteen or twenty years in gathering knowledge on this subject. Now the spectroscopes with which most are familiar are armed with a slit through which the light to be examined is made to enter, and the rays are next rendered parallel before they enter the prism in a part of the instrument called the collimator. After passing the prism they are again collected to a focus by means of a telescope.

But a spectroscope need not be so complicated as this, for after all the object of the instrument is to disperse white light as we see it dispersed in a rainbow, and what nature accomplishes by a rain-drop we can do by a prism; hence, if we simply pass a ray of white light through a prism, we find that after it has so passed through, it is changed into a beautiful band, showing all the colours of the rainbow. This prism then is the fundamental part of the instrument, and the most complicated spectroscope which we can imagine simply utilises the part which the prism plays in breaking up a beam of white light into its constituent parts from the red to the violet. Between these colours we get that string of orange yellow, green, and blue, which we are familiar with in the rainbow. For sixpence any of us may make for ourselves an instrument which will serve the purpose of demonstrating many important spectroscopic results. From an optician we can get a small glass prism for sixpence; glue it at one end of a piece of wood about 12 × 1 × ½ inch, so that we can see through it a coloured image of a needle stuck in at the other end of the piece

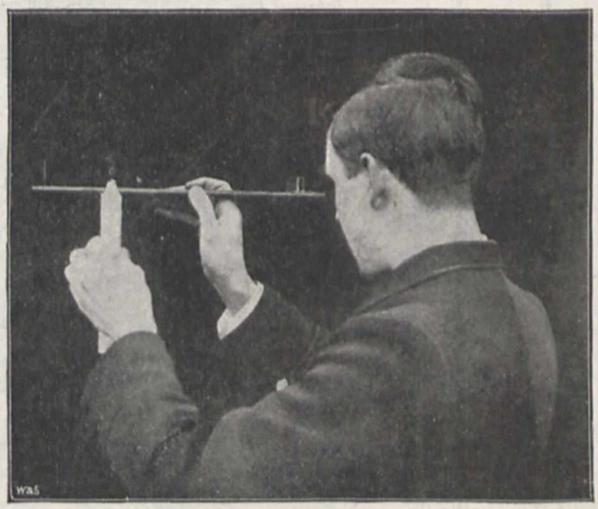


FIG. 3.—A simple form of spectroscope.

of wood (Fig. 3). This we must do by looking sideways through it.

Allow the needle to be illuminated by the flame of a spirit lamp into which salt is gradually allowed to fall. We see an image of the needle coloured in orange. If we next illuminate the needle by a candle or gas flame, taking care that the direct light from the candle does not fall upon the face of the prism, we then get no longer a single image of the needle, but a complete band of colour from red to blue. We have, in fact, an innumerable multitude of images of the needle close together.

It will be clear from these experiments that in our *impromptu* spectroscope we see simply images of the needle, few or many, according as the kind of light we are studying contains few or many differently coloured rays.

In the more complicated instrument we pass from an illuminated needle to a fine straight slit through which light is allowed to enter. We generally talk of "line" spectra for the reason that a narrow slit is employed, the image of which is a line. In the "lines" seen in the spectra of the heavenly bodies we have so many celestial hieroglyphics which we have to translate into chemical language by comparing their positions with those we observe in the spectra of terrestrial light sources.

But a straight slit is not the only kind of aperture we can employ; we may replace it by a ring, for instance.

What we shall see in passing from the spectrum of a candle to the spectrum of a spirit-lamp flame with salt in it, using first a straight and then a circular slit, is shown in the accompanying woodcut (Fig. 4).

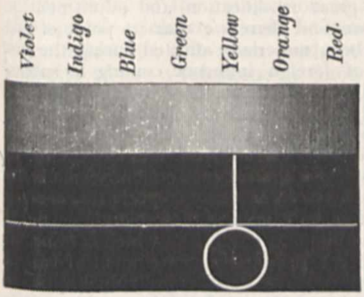


FIG. 4.—The spectra of continuous and discontinuous light sources, the latter seen with a line and circular slit.

If we examine a very complicated light source we shall arrive at the same result, a spectrum characterised by a large number of bright circles or lines (Fig. 5).

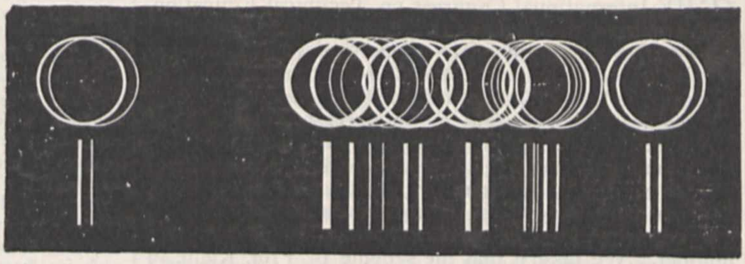


FIG. 5.—The spectrum of a complicated light-source as seen with a circular and a line slit.

FIG. 6.—Details of objective prism.

We have seen that in an ordinary spectroscope, when we are studying light sources close to us, the rays have to be made parallel before they pass through the prism. But the heavenly bodies are at such a distance from us that their light reaches us in a parallel beam, so that one part of the spectroscope, the collimator, may be dispensed with. A star as a point is part of a line slit; hence the success of Fraunhofer's arrangement for observing stellar spectra, to which I have referred. In an eclipse we get a bright narrow ring round the dark moon. There is our ring slit. Hence the so-called "slitless spectroscope," or "prismatic camera," as it is called when photography is employed, used to study the spectra of stars and the sun's chromosphere during eclipses.

The way in which, in the prismatic camera, the prism is fixed outside the object-glass, is shown in the accompanying figure (Fig. 6).

We are now in a position to inquire how this arrangement has been used during eclipses since 1871.

J. NORMAN LOCKYER.

(*To be continued.*)

THE OLD RED SANDSTONE OF LORNE.

THE terraced hills of Lorne, though a familiar feature in the scenery of western Argyllshire, have not yet had their geology properly worked out. Their peculiar topography, however, has long been known to arise from the outcrops of successive sheets of lava, lying upon and intercalated with strata of purple shale and conglomerate. The age of these strata has never been satisfactorily settled. For many years past I have regarded them as probably belonging to the Lower Old Red Sandstone, for their lithological characters present a close resemblance to those of the great basin of that age in central Scotland, which I have distinguished by the name of "Lake Caledonia." While recently mapping in the district, Mr. R. G. Symes, of the Geological Survey, came upon an exposure of the sedimentary rocks, which seemed to him so promising a locality for fossils that he requested the assistance of one of the fossil-collectors of the staff with a view to more minute examination. Accordingly, Mr. A. Macconochie was detailed for the purpose, and was soon rewarded by the discovery of undoubted remains of plants and fishes. The specimens were first sent to the Office of the Survey in Edinburgh, where the plants were recognised by Mr. B. N. Peach as portions of *Psilophyton*, and the fish-remains as parts of *Cephalaspis*. His identification of the ichthyolites was immediately confirmed by Dr. R. H. Traquair. The specimens were then forwarded to the Jermyn Street Museum, where they have been again examined by Mr. E. T. Newton, who entirely agrees with the opinion already pronounced regarding them.

The occurrence of a genus of plants and another of fishes so characteristic of the Lower Old Red Sandstone of central Scotland is of singular interest and importance, for it definitely fixes the geological age of the volcanic series of western Argyllshire and its accompanying sedimentary deposits. ARCH. GEIKIE.

INTERNATIONAL CONGRESS ON TECHNICAL EDUCATION.

THE International Congress on Technical Education, referred to in last week's NATURE, was opened on Tuesday, at the rooms of the Society of Arts, under the presidency of the Duke of Devonshire. The meeting of the Congress in London is due to this Society, and to the City Companies, which guaranteed the necessary expenditure.

The subject of higher technical education claims the attention of all who are concerned with the progress of science and the development of arts and industries. The pressing importance of the question is indicated by the article which appears in another part of this number. We take it that the scheme of Prof. Klein, to establish an educational system which will bring theory and practice more closely together, is the ideal organisation. The man of science and the engineer should be one; for both need to understand the practical aspects of nature, and both are constantly inventing methods of investigation. Prof. Klein wishes to give life to fossilised Universities, and lead them "so to develop science that the results will be practically useful, and repay the debt to engineers which science now owes them." This aim, coming from one who has enriched mathematics with so many remarkable contributions, should do much to break down the supposed barrier between the investigator working in his laboratory and the engineer working towards the mastery of nature on a larger scale. For the details of the scheme, we refer our readers to the article in another place. To our mind, the plan proposed will do much to advance higher technical education; and it will perhaps lead to the development of teachers who are good mathematicians as well as practical men. In all countries there are signs of increasing interest in methods of education, so that Prof. Klein's views will doubtless receive consideration outside Germany.

In opening the International Congress, the Duke of Devonshire pointed out that each country could learn much from the experience and organisation of others. It is for this reason that such Congresses have a beneficial effect. In the course of his address, the Duke of Devonshire is also reported by the *Times* to have made the following remarks:—

It is in a double capacity that I have the honour of offering a welcome to the International Congress on Technical Education. We have in this country a Department of Education, but its functions are almost entirely limited to elementary education, and we have not in our Administration any Minister who properly corresponds to the Minister of Education of other Governments. Nevertheless, the President of the Council is the Minister on whom the nearest approach to responsibility for education rests, and the Vice-President, Sir John Gorst—who, I trust, will take part in the future proceedings of the congress—is the Minister who, representing the Government on educational matters in the House of Commons, shares with the President a large part of his responsibility. It is, therefore, partly in our official capacity that Sir John Gorst and I take part in these proceedings. The comparatively unorganised condition of education as a whole has led to the formation of unofficial and irresponsible associations to promote and help to organise special branches of education to meet the growing needs of the country. Turning to the business of the congress, its previous assemblies have done much to increase public interest in the very important question of technical instruction; and the well-arranged and representative programme of the present assembly justifies the hope that its deliberations on the present occasion will be no less fruitful than in the past. The present time is well chosen for an international congress on technical instruction. In all countries there are signs of increasing interest in foreign methods of education. Systems of education, indeed, cannot be transferred ready-made from one country to another. Education is a thing too closely interwoven with national life and habits to permit any such easy transference. But when every allowance has been made for this it remains true that each country can learn very much from the experience and the educational organisation of other countries. Educational ideas and ideals may be communicated, although systems of administration cannot be transferred without great modification and adjustment to special circumstances; we find therefore that in point of fact English education has been materially affected during the last sixty years by waves of foreign influence coming in succession from France, Holland, Germany, Switzerland, America, and Scandinavia. And in some respects there is no department of education in which methods of teaching and plans of organisation can be more readily transferred from one country to another than is the case in technical instruction, which is the subject of the present congress. In many respects this country has been the debtor in this long process of foreign educational exchange. But there is one point at least in which continental critics are now paying Great Britain the compliment of careful study and even of admiration. The need for individual initiative and for freedom of local experiment has always been fully recognised in English education, and in no grade of it has this been more the case than in technical instruction. While the central Government, through its administrative departments, has not failed to give a certain measure of guidance to the new movement, it has thrown the greater part of the responsibility on the local authorities, believing that (in technical education especially) there must be great elasticity in administration and incessant adaptation of the means and form of instruction to meet the great variety of the industrial and commercial needs which exist in the different localities, but can only be ascertained and fully tested by local experiment. The local authorities have, with few exceptions, risen to their new responsibilities with an alacrity and enterprise which deserve high commendation. All of those who are labouring for the extension and improvement of technical instruction in Great Britain, as well as in Ireland, where a remarkable movement is now in progress for the furtherance of technical education, will learn much from the reports brought by the foreign delegates. They will also take special interest in the accounts to be given by distinguished visitors of technical education in Canada, in India, and in Australia. To British hearers probably no part of the discussions will be more instructive than that which is to be devoted to the subject of commercial education. In the field of higher commercial education, Great Britain is believed by many competent observers to be seriously behind several of the continental nations. Attention would also be usefully directed to the influence of Germany, and especially the Realschulen of Berlin, in producing, by means of a carefully planned modern secondary education, given by trained teachers of the highest attainments, an increasing number of youths eminently fitted to profit by the highest kinds of technical education, and to promote the commercial interests of their country.

Papers chiefly relating to different aspects of the teaching of chemistry were then read and discussed.

ALVAN G. CLARK.

A NOTE of extreme sadness is mingled with the congratulations that have followed the completion of the Yerkes telescope. Hardly is the object-glass in its cell, and before the final adjustments can possibly be complete, the intelligence comes that the artist, who has laboured so earnestly and so successfully in the work of figuring object-glasses of the largest size, is struck down suddenly by apoplexy. Ten years ago, Alvan Clark, the founder of the firm, died, after completing the lens of the Lick telescope, but before he could witness its complete installation and be assured of its final success. The son, Alvan G. Clark, was probably aware of the excellence of the Yerkes telescope, both from his own experience and the certificate of Prof. Keeler; but he, too, is denied the pleasure of seeing it used under the most favourable conditions, and of hearing expressed the full satisfaction of those astronomers in whose hands the telescope is placed.

It is impossible to disconnect the life of Alvan G.

Clark from that of the firm with which he was associated throughout his life. It would be ungenerous to deny him his share in the success that has attended the use of such astronomical triumphs as the Washington telescope, the Pulkova, or the Lick, because they were completed in his father's lifetime. His practical participation in the work of the firm as far back as 1862, is attested by his discovery of the companion of Sirius in the course of the optical trials to which he was submitting the first large telescope the firm had constructed. Here his capacity to use a telescope is shown as effectually as he afterwards demonstrated his power to make one, and though the opportune discovery may have done much to strengthen the reputation of the firm, it did not tempt him to join the ranks of astronomical observers in preference to those of the practical optician. Possessed with the tradition of the workshop, and inheritor of his father's skill and experience, he has been content to supply the means for others to use, and in this way has rendered no mean service to astronomical science. None of those who have won an acknowledged position for accurate or for delicate work by means of the instruments the famous house of A. Clark and Sons has placed in their hands, would deny the obligation they are under to those who have devoted themselves freely and unselfishly to secure the best that art can devise, or skill and patience execute. In precisely the same manner Mr. Clark would acknowledge his indebtedness to those who have supplied him with the glass, out of which he has constructed those lenses, wherewith he has broken the record of all previous efforts in the same direction. The house of Feil, among others, has rendered him the same kind of service that he has rendered to astronomy —services that are not covered by a mere monetary payment. When we hear of the discovery of some minute speck of light, and admire the skill and dexterity of manipulation of the astronomer who has added another fact to the history of observational astronomy, it is well to remember all the causes that have contributed to his success, not to rob him of his deserved popularity and reputation, but to remind ourselves of the intimate connection pervading many branches of science and industry.

We have alluded to some of the large telescopes in which the reputation of the son is worthily joined with that of the father. We may recall another, the Bruce photographic telescope, whose successful figuring rests entirely with the younger Clark. Here the difficulty of construction was much increased by the fact that the final focal length of the combination was agreed upon between the contracting parties, and that very considerable accuracy was demanded in maintaining the original agreement. Mr. Clark triumphed over all difficulties, we believe, to the complete satisfaction of Prof. Pickering, and, if we correctly understood Mr. Clark, without the assistance of the method of "pilot" glasses or small objectives, constructed of similar glass and of like curves to those intended to be used in the construction of the finished lenses.

America has lost, perhaps, her ablest practical optician. Others starting with his experience and assisted by a lavish generosity will no doubt in time surpass his masterpieces; but his loss is a great one, and at this particular juncture will be keenly felt in the new Chicago Observatory.

NOTES.

THE sum of 297,000 francs has been subscribed for the Pasteur statue which is to be erected in Paris. M. Falguières has been commissioned to design the statue.

AT the meeting of the Paris Academy of Sciences last week, it was announced that subscriptions amounting to twenty-five thousand francs had been collected in Russia towards the fun for the erection of a statue of Lavoisier, and that this sum had been forwarded to the Academy.

THE International Postal Union has decided that natural history specimens and objects for scientific collections, shall be regarded as samples, and charged at the rate of a halfpenny for every two ounces.

WE learn from the *Bulletin* of the Botanical Society of France that it is intended to recognise in perpetuity the services rendered to viticulture in France by the late botanists, M. P. Duchartre and M. F. Laforgue, by placing commemorative marble plates on the houses where they were born, both in the neighbourhood of Béziers.

IT is stated in *Science* that Miss Catherine W. Bruce, of New York City, has again shown her great interest in astronomy by sending Prof. J. K. Rees, Director of the Columbia University Observatory, a cheque for fifteen hundred dollars. The money is to be used in publishing the observations and reductions for "Variation of Latitude and the Constant of Aberration," made by Profs. Rees and Jacoby and Dr. Davis.

DR. G. SANARELLI delivered a lecture at Montevideo on Thursday last, upon the etiology and pathogenesis of yellow fever, with special reference to the yellow fever bacillus discovered by him (see NATURE, February 18, vol. lv. p. 370). There was a very large attendance at the lecture, including a number of scientific delegates from all parts of South America, the members of the Diplomatic Body, and the principal authorities. Dr. Sanarelli confirmed his previous announcement that the cause of yellow fever is a bacillus named by him icteroid, which is rarely found either in the blood of yellow fever patients or in their bodies after death, because it easily disappears. Dr. Sanarelli said that he would shortly make experiments in preventive vaccination, and hoped to discover a curative serum.

THE Council of the Royal Society of Edinburgh have awarded the following prizes:—The Gunning Victoria Jubilee Prize for 1893-96 to Mr. John Aitken, for his brilliant investigations in physics, especially in connection with the formation and condensation of aqueous vapour; the Keith Prize for 1893-95 to Dr. Cargill G. Knott, for his papers on the strains produced by magnetism in iron and in nickel; the Mackdougall-Brisbane Prize for 1892-95 to Prof. John G. M'Kendrick, for numerous physiological papers, especially in connection with sound; the Neill Prize for 1892-95 to Mr. Robert Irvine, for his papers on the action of organisms in the secretion of carbonate of lime and silica, and on the solution of these substances in organic juices. The prizes will be presented by Lord Kelvin at the last meeting of the session, July 5.

WE regret to announce the following deaths:—Dr. Matthew Charteris, professor of materia medica in Glasgow University; Mr. Alvan Clark, the well-known manufacturer of lenses for telescopes; Prof. Dr. R. Fresenius, the distinguished chemist; Mr. Ney Elias, who won the gold medal of the Royal Geographical Society about twenty-five years ago, for his journey from Pekin to St. Petersburg, and since then explored a part of the desert of Gobi, and traversed the Pamirs; Rev. Alexander Freeman, a Fellow of the Royal Astronomical, Mathematical, and Physical Societies, and deputy for the Plumian Professor of Astronomy at Cambridge in 1880-82; the distinguished Austrian metallurgist, Prof. Peter von Tunner, at the age of eighty-nine. In 1875 he was elected an honorary member of the Iron and Steel Institute, and in 1878 received from that society the Bessemer Gold Medal in recognition of his important discoveries connected with the metallurgy of steel.

A VERY severe shock of earthquake was felt at Calcutta, at 5 o'clock last Saturday afternoon, June 12. It is stated that, from first to last, the disturbances continued for fully five minutes. Few houses escaped damage of some description, and many are in ruins. Many church towers and spires collapsed, and most of the public buildings were badly damaged by the disturbances. Reuter's agency reports that the area affected by the earthquake was very extensive. Telegrams received from Simla, Agra, Bombay, Manipur, and from places far down in the Central Provinces, report that a shock was felt almost at the same time as the earthquake occurred at Calcutta. The shock appears even to have left its record on seismometers on this side of the earth. Prof. Milne obtained at Newport, Isle of Wight, on Saturday morning, a seismographic diagram of an earthquake of unusual magnitude. It began at about 11.30 a.m., and lasted three hours. Further, a Reuter telegram from Paris states that the seismograph at Grenoble registered an earth tremor at 11.28 on Saturday morning. Both these records evidently refer o the Calcutta earthquake.

PRESIDENT MCKINLEY has transmitted to the Senate the report on forestry made by the Committee of the National Academy of Sciences at the request of the Secretary of the Interior. The following general scheme of administration of forest preserves is submitted:—A forestry bureau under a director, who is to be president of an advisory board, consisting of himself, an assistant director, and four forest inspectors. It also provides that the bureau shall have a disbursing officer, clerks, and legal advisers; twenty-six head foresters, twenty-six assistants, to constitute a permanent corps; two hundred rangers and various assistant rangers, the salary roll calling for an annual appropriation of 250,000 dollars, with preference of appointment to West Point graduates. The Legislature of the State of New York at its recent session granted one million dollars for the purchase of forest preserves in the Adirondachs; and a surveyor has just been appointed to survey the lands about Indian Lake, in order to acquire them for the State under this Act.

THE great anthropological expedition sent out by President Morris K. Jesup, of the American Museum of Natural History, left New York for British Columbia a few days ago, in charge of Dr. Franz Boas, curator of the anthropological section of the museum. His associate, Mr. Harland J. Smith, preceded him, and Dr. Livingstone Farrand, of Columbia University, accompanies him. The headquarters of the expedition will be situated in British Columbia, where about thirty Indian dialects are spoken. The language and habits of the Indians will be carefully studied, and elaborate anthropometrical observations made. Mr. Smith will engage in archæological researches in the southern portion of the territory, and several other parties will be scattered throughout British Columbia. An expedition to Alaska is contemplated for next spring; also, at some time in the near future, an expedition to Southern Siberia. All this work is under the general supervision of Prof. F. W. Putnam, though he will not take the field in person, at least for the present; the field work being under the direction of Dr. Boas.

IT has been briefly announced that next year Captain Sverdrup proposes to take the *Fram* up Smith Sound to the north-west coast of Greenland for the purpose of prosecuting exploration in that direction. Though Dr. Nansen will not accompany the expedition, the *Times* states that there is reason to believe that he is taking an active share in the direction of the expedition. The object will be to penetrate north through Smith Sound and Robeson Channel as far north as possible along the north-west coast of Greenland. An attempt will be made to discover how far Greenland extends northward, and to survey the north-west, north, and north-east coasts. In short, one prime object will be to complete the exploration of the Greenland coast, a considerable extent of which is still quite unknown.

LIEUT. PEARY has been detached from duty at the Brooklyn Navy Yard, and granted five years' leave of absence in order to enable him to prosecute his Arctic researches. He expects to begin the first trip on July 10, sailing from Boston, and will be away three or four months. Prof. C. H. Hitchcock, of Amherst, and Prof. Geo. H. Barton, of the Massachusetts Institute of Technology, will accompany him, and also probably a party from Yale. The route will be from Boston to Sydney, U.S., thence through the Gulf of St. Lawrence and the Belle Isle Straits to Resolution Island and the Greenland coast, then along the coast 1200 miles to Melville Bay. The scientific parties will be landed on the way, and picked up by the ship on its return trip in September. The main object of this trip is to prepare for a longer one of three or four years to be undertaken next year, and to attempt to reach the Pole by gradual approaches, and colonising Eskimos in high latitudes. Lieut. Peary states that he is assured of funds sufficient to prosecute the work for five years if need be, but the name of the donor is withheld. The scheme, however, has the endorsement of the American Geographical Society and the American Museum of Natural History.

THE results of a preliminary study of the conditions which exist in highly rarefied media under discharges of electricity are described, by Prof. John Trowbridge, in a paper entitled "The Energy Conditions necessary to produce the Röntgen Rays" (*Proc. Amer. Acad. of Arts and Sciences*, vol. xxxii. No. 14, April 1897). It appears from the experiments "that the discharge in a Crookes' tube, when on the point of emitting the Röntgen rays most intensely, is an oscillatory one, and that each discharge encounters a resistance less than five ohms. An estimate of the great amount of energy thus developed in an exceedingly small interval of time can be obtained if we suppose that Ohm's law holds for individual oscillations. This reservation is an important one, for the investigations I have described in this paper show that a discharge of six inches in length encounters no more resistance during its oscillations than one of two inches in length. In popular language, it can be maintained that a discharge of lightning a mile long encounters no more resistance than one of a foot in length. Ohm's law does not hold good for electrical discharges in air and rarefied gases. It is well known that a voltaic arc can be started in a vacuum. My experiments lead me to believe that in every case the arc is started by a spark which breaks down the medium, and the arc follows. I am led to believe that electrical oscillations are of the nature of voltaic arcs, and that the discharges in Crookes' tubes are voltaic arcs. I am thus forced to the conclusion that under high electrical stress the ether breaks down and becomes a good conductor."

DR. H. H. HILDEBRANDSSON, Director of the Meteorological Observatory at Upsala, has recently communicated to the Royal Swedish Society of Sciences the results of an important investigation upon the "Centres of action of the atmosphere," or the regions at which are situated the mean barometric maxima and minima. The monthly differences of the pressure of the air from the mean, as being the principal meteorological element, were calculated for the years 1875-84 at sixty-eight stations, distributed as widely as possible over the surface of the globe; the mean differences were then plotted upon monthly charts. The results obtained from the lines of equal differences show: (1) That the differences are greater in winter than in summer, and increase from the equator towards the polar regions, and also that the barometrical variations at certain localities, *e.g.* at the Azores and in the vicinity of Iceland, are almost always opposite in sign, especially when the figures are large. (2) That the greatest differences are found in January and July in the vicinity of Greenland and Iceland on the one hand, and to the north of Russia, between the White Sea and St. Peter burg, on the other. The discussion seems to establish the fact that a kind of oscillation exists at all places in the pressure of the air between a centre of action of high pressure and another adjacent centre of low pressure. The author states that a closer study of these relations promises to lead to practical results for the prediction of weather for long periods.

THE current number of the *Annales de l'Institut Pasteur* contains M. Pottevin's annual report for 1896 on the anti-rabic inoculations conducted during the past year at the Paris Pasteur Institute. The number of persons treated was 1308, less than in any previous year since the Institute was opened. This diminution is attributable to the fact that patients, instead of going to Paris from all parts of the country, undergo the inoculations at the institutes now established at Lille and Marseilles; also similar institutes have been founded in Algiers and Turin, districts which formerly sent considerable numbers of cases to Paris. During the ten years which have elapsed since the opening of the Paris Institute, 18,645 persons have been treated there, and an interesting table is appended showing the nationality of the patients, from which it appears that England contributed no less than 870 individuals, and more than any other country; Belgium coming next, with 429. In some of the departments of France cases of rabies have steadily diminished, thanks to the energetic measures taken by the local authorities; whilst in others, where less vigorous steps have been taken to guard against its dissemination, the number of cases has increased. It is in the southern districts of France that, M. Pottevin tells us, "possess the sad distinction of containing the largest number of bitten persons, and of paying the most dearly for disobedience to the laws of the sanitary police."

IN north latitude 70° 40′ 11″·3, where the most northerly town in the world—namely, Hammerfest—is situated, there is a monument which was visited by most of those who went to Norway to obtain a view of the total solar eclipse. This monument consists of a fine granite pedestal and pillar supporting a large terrestrial globe made of copper, and was placed there to commemorate the completion of a grand piece of surveying work. The primary object of this survey was, as Mr. Fowler writes in an interesting article in *Knowledge* (June), the measurement of the earth, and to provide a permanent mark in order that the measurements may be repeated at any future time if considered desirable. Without entering into the details of a trigonometrical survey, and how a triangulation is accomplished, we will limit ourselves to the inscription, written in Latin and Norwegian, on the pillar, referring the reader to the article in question for details. "The northern termination of the arc of meridian of 25° 20′ from the Arctic Ocean to the river Danube, through Norway, Sweden and Russia, which, according to the orders of His Majesty King Oscar I., and the Emperors Alexander I. and Nicholas I., and by uninterrupted labours from 1816 to 1852, was measured by the geometers of the three nations."

PROF. P. TACCHINI, of Rome (*Atti dei Lincei*, vi. 9), describes a remarkable thunderstorm which passed over Italy on April 24, in which the rain was mixed with sand and seeds of the *caroub* that had evidently been transported from Africa.

IN a preliminary note published in the *Rendiconto della R. Accademia delle Scienze fisiche e Matematiche* (Naples), Dr. R. V. Matteucci and Dr. E. Giustiniani announce the discovery for the first time of the element selenium among the products of the "fumaroli" of Vesuvius. Dr. Matteucci has also completed a brief but accurate investigation of the dynamical phenomena connected with the eruption of 1895, of which he gives an account in the same journal.

FROM a series of investigations on the effect of cutaneous excitations on the formation of red blood-corpuscles, Prof. H. Kronecker and Dr. A. Marti, writing in the *Atti dei Lincei*, draw the following conclusions: (1) Feeble irritations of the skin promote the formation of red blood-corpuscles, but modify the formation of hæmoglobin in different ways. (2) Strong irritations of the skin determine a diminution of the number of red corpuscles, and, in a minor degree, of the hæmoglobin contained in the blood. (3) Darkness diminishes the number of blood-cells; after about a fortnight, a minimum is reached which is followed by a limited increase. (4) Continued exposure to intense light (even at night with electric light) induces the formation of red blood corpuscles, and also, in a lesser degree, of hæmoglobin.

A RÖNTGEN Society has been formed, with Prof. S. P. Thompson as the president. The intention of the founders is that the Society shall occupy a position between those devoted purely to medicine, to physics, or to photography. Some of the members will study the sources of the Röntgen rays, others the applications; some the induction coils, others the tubes and the various forms and adaptations of the apparatus used in the production of the rays. Röntgen photography has been found serviceable in so many branches of scientific investigation that the Society appeals to a large constituency for support. It should be the means of increasing the efficiency and applications of the rays, and should also be of assistance to surgeons and others who have entered the new field of work without previous training in physics.

To the June number of the *Strand Magazine*, and also to *McClure's Magazine*, Prof. S. P. Langley contributes an interesting illustrated narrative of his experiments with flying machines, and the development of the aerodrome to the condition in which it was able to demonstrate the possibility of mechanical flight. A description of the aerodome was given by Prof. Langley in these columns a year ago (vol. liv. p. 80, May 28, 1896), and the first successful flight of the machine was then described by Mr. Alexander Graham Bell.

ANOTHER name must be added to the long list of martyrs who have given up their lives while endeavouring to effect the conquest of the air. The latest victim is Dr. Wölfert, who had devoted many years to the problem of aerial navigation, and who claimed to have invented a navigable balloon. The Berlin correspondent of the *Times* says that Dr. Wölfert had made an arrangement with the officers of the ballooning section of the army to put his invention to a practical test at Tempelhof on Saturday last. The officers and a number of persons interested in aerial navigation assembled to witness the ascent. The balloon was of the new cigar-shaped form. The car was a square basket made of bamboo cane, and contained a benzene motor of eight-horse power, partly constructed of aluminium, and driving at one end of the car a propeller of the same material. At the other end of the car was a so-called helm, consisting of bamboo staves covered with linen sails. The balloon had already been tested on several occasions, and was said to have attained a very high rate of speed against the wind. Dr. Wölfert was accompanied in his ascent by a mechanic named Knabe. At first the balloon ascended steadily and began to make good progress against the wind in the direction of the suburb of Rixdorf, to reach which and to return to Tempelhof was the task set himself by its inventor. Suddenly, however, when the balloon was sailing at a height of about 1000 feet, flames shot up from the car and the balloon exploded with a loud report and was precipitated, a burning mass, into a wood-yard below. The mounted officers hurried to the spot, and, after the flames had with great difficulty been partially extinguished, the mutilated remains of Dr. Wölfert and his companion were found amidst the ruins of the car. It is believed that the valve of the balloon was opened with the intention of descending, and that the gas, in escaping from the balloon, became ignited by the benzene.

ALL who work for the advancement of natural knowledge have reason to be grateful to the Smithsonian Institution. Under the administration of this renowned organisation come the U.S. National Museum, the Bureau of Ethnology, the Bureau of International Exchanges, the National Zoological Park, and the Astro-physical Observatory—all of which have largely contributed to the progress of science. By the exchange service the operations of the Institution extend almost to the ends of the world. How immense this branch of the work now is may be gathered from the fact that more than 24,000 correspondents are upon the exchange lists, about eleven thousand being establishments and thirteen thousand individuals. The correspondents are distributed in nearly four thousand different places, from Disco, Greenland, in north latitude 70°, to Port Stanley, Falkland Islands, in latitude 50° S.; and they extend east and west so as practically to embrace the earth. The distribution of the correspondents is indeed proportional to the spread of civilisation, and the educational status of Spain as compared with France, or China in comparison with Japan, can be rightly inferred from their relationships with the Smithsonian Institution alone.

ANOTHER work for which the Smithsonian Institute deserves the gratitude of men of science is the general appendix now printed with the Report of the Secretary. This appendix preserves for us year by year a number of very valuable papers, covering a considerable range of scientific investigation and discussion. The collection of carefully selected contributions usually contains the most important and interesting articles and addresses which were published during the year covered by the Report in which they are included. The volume just received contains thirty contributions of this character, gathered from the published literature of 1895. There are several papers which won prizes or commendation in the Hodgkins Prize Fund competition; addresses delivered at the Ipswich meeting of the British Association by Prof. W. A. Herdman and Mr. W. T. Thiselton-Dyer; a translation of a discourse by Prof. W. Ludwig von Graff on "Zoology since Darwin," and other translations from German and French journals; several papers on American archæology; a translation of the address delivered by the late M. Jules Simon at the centenary celebration of the Institute of France; a paper on science in early England by Mr. C. L. Barnes; a paper on the plan of research in education, contributed to *Science Progress*, by Dr. H. E. Armstrong; and a memorial address on Huxley, by Prof. Theodore Gill. These are but a few of the subjects of the reprinted publications; but they suffice to show the comprehensive character of the collection, and will serve to call attention to a veritable storehouse of information.

"THE ELECTRICIAN" Company are about to issue a work by Mr. W. Clark Fisher on the "Potentiometer and its Adjuncts," being a description of a universal system of electrical measurement.

MR. A. W. BENNETT has been appointed by the Council of the Royal Microscopical Society editor of the Journal of the Society, in succession to Prof. F. J. Bell.

THE Geological and Natural History Survey of the Chicago Academy of Sciences has issued its first "Bulletin," consisting of a monograph of the Lichen-flora of Chicago and its vicinity, by Mr. W. W. Calkins.

M. J. CARDOT (Stenay, Meuse, France) is about to publish a catalogue of all the species and varieties of *Sphagnum* or bog-moss, with the synonymy and geographical distribution of each species and variety. It will comprise 215 species, nearly 600 varieties, and more than 500 synonyms.

A TYPE-HERBARIUM of Lichens and a lichenological library have been instituted at Chambésy, near Geneva, under the direction of the curator of the Herbier Boissier. In memory of a late distinguished lichenologist, it will be known as the "Salle Müller-Aargau."

MESSRS. WHITTAKER AND CO. will shortly publish a volume on "Organic Chemical Manipulation," by Dr. J. T. Hewitt. The first part of the book will give an account of the methods adopted in organic analysis and the determinations of molecular weight, the second part being devoted to a typical set of organic preparations, systematically arranged and intended to give an idea of the methods adopted in organic work.

THREE publications from three of our public schools have been received during the past few days. From Harrow School has come the second volume of "Harrow Butterflies and Moths," by J. L. Bonhote and Hon. N. C. Rothschild. The first volume of this praiseworthy work has already been noticed in NATURE (vol. lii. p. 388). The present volume includes the Macro-lepidoptera not described in the former volume, and eight of the Pterophoridæ recorded from the Harrow district. The locality, time of appearance, and distinguishing features of the different species are noted; so that the volume will prove of service to collectors, as well as a record of permanent value to entomological science.—The Rugby Natural History Society have just issued their report for 1896. The papers printed in the report are on the Macro-lepidoptera of Hertfordshire, from personal observation, by H. W. Blathwayt; Lichens, by R. A. Worthington; the Aboriginals of Australia, by C. Ansted; and Photomicrography, by K. Lucas. We are glad that the Society is able to give evidence of its vitality; for we regard the expeditions made by the members, and the encouragement given to individual observation, as of the highest educational value.—The report of the Marlborough College Natural History Society is even more complete than that from Rugby. It contains papers by E. Meybrick, on the vertebrate animals (except birds) of the Marlborough District, the cretaceous fossils of the district, and botanical classification, and also a paper on acids, by R. G. Durrant. The Society appears to be in a very flourishing condition, and the reports of the various sections testifies to commendable enthusiasm of the members. A particularly interesting feature is the anthropological report containing statistics of weights and measurements of members of the school.

THE additions to the Zoological Society's Gardens during the past week include two American Flying Squirrels (*Sciuropterus volucella*) from North America, presented by Miss Lucy Sanderson; a Grey Squirrel (*Sciurus griseus*) from North America, presented by Mr. D. S. Millar; fourteen Common Chameleons (*Chamæleon vulgaris*) from Egypt, presented by Dixon Bey; two Eyed Lizards (*Lacerta ocellata*) from Southern Europe, presented respectively by Lieut.-Colonel Willoughby Verner and Mr. G. K. Gude; three Common Squirrels (*Sciurus vulgaris*), British; an Eroded Cinixys (*Cinixys erosa*) from West Africa, purchased; four Humboldt's Penguins (*Spheniscus humboldti*) from Western America, received in exchange; a Thar (*Capra jemlaica*, ♂), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

NEW SOUTHERN VARIABLE STARS.—During the past few years Prof. Kapteyn has been obtaining the negatives for the Cape Photographic *Durchmusterung*, but, owing to great pressure of work at the observatory, a minute examination of the plates could only until quite recently be made. As a result of such a search several new variable stars have been discovered; and if this examination had been commenced earlier, there is little doubt that five other variables discovered independently would have been credited to the Cape Observatory. The list of new variables now published by Dr. Gill (*Astr. Nachr.*, 3426) includes four well-marked variables, their positions for 1875 and magnitudes being given in the following table. The range of magnitude, as given by the plates examined, is shown in the third column.

α (1875·0) h. m. s.	δ (1875·0) ° ′	Range of magnitude.	
4 50 56	−21 24·9	9·25 — 9·8	Nov. '95 and Feb. '96
8 41 3	−50 6·4	9·6 — 10·0	Jan.–April '96
9 28 41	−36 3·8	8·8 — 8·9	May 14, 28, '90
		8·7 — 9·6	Feb. 22, 24, and March 7, '96
12 2 55	−44 43·7	8·95 — 9·75	March '96

The same communication also refers to stars of the 9th magnitude, or brighter, which are contained in the Cordova *Durchmusterung*, but are missing, or barely visible, in the Cape plates. The variability of five other stars has in this way been established.

THE 1897 MAXIMUM OF MIRA CETI.—Prof. J. A. C. Oudemans communicates a paper by Dr. Nyland, of Utrecht, who carefully observed the variable Mira Ceti from August 5, 1896, to March 10, 1897, although as he states the weather restricted his observations to a great extent. On the whole, however, the observations were fairly distributed over this period, with the result that a very good curve could be drawn through the points when laid out on millimetre paper. The curve which is included in the communication (*Astr. Nachr.*, No. 3426) indicates that on September 2, 1896, this star was at its minimum brightness, 8·50 mag.; while on January 11, 1897, it had risen to a maximum, namely 3·70 mag. These magnitudes would correspond to 8·8 and 3·5 on the scales of Schönfeld and Argelander. This further stated that the magnitude at this period of maximum was very small, in fact among the fourteen observed maxima in the years 1840–1859 only one was observed (1847 November 16) that was dimmer than that of 1897.

COMET DENNING 1894 I.—Prof. Schulhof compares (*Bulletin Astronomique*, Tome xiv. p. 168) the observed places of this comet with those given by the ephemerides. Using his second system of elliptic elements (*Astr. Nachr.*, No. 3231) he finds that the corrections to the ephemerides is very considerable for the five last observations made at Nice. He has then employed his third system of elements (*Astr. Nachr.*, No. 3236) for the representation of these observations, but still this does not reduce the differences very considerably. Prof. Schulhof finally formed his five normal places and represented them by the fourth system of elements (*Astr. Nachr.*, No. 3276.) In this way he formed a table giving the corrections to be applied to the provisional ephemerides and the deduced positions. The elements he finally uses are, as he says, probably a little nearer the truth than those of M. Lamp (*Astr. Nachr.*, 3278). With regard to the relation between Brorsen's Comet and that of the one in question, M. Lamp showed that the two comets on January 24, 1881, passed nearly simultaneously the same point in space where their orbits coincided, namely, $l = 284° 27'$, $b\ 6 = -1° 46'$, $r = 5·1827$, and both he and Mr. Hind have considered this comet of Denning's as a fragment of that of Brorsen. Prof. Schulhof does not, however, seem to think this hypothesis is confirmed. The elements of the two comets, he states, are too dissimilar to allow of such an assumption, π and ☊ differing by 15°, and the inclination by nearly 24°. The two velocities at the period indicated above differed by as much as three kilometres per second, and such an increase in velocity, he states, is probably too large to be caused by the shock of an explosion.

OBSERVATIONS OF MARS.—The current number of the *Bulletin de la Société Astronomique de France* (June) is devoted mainly to observations of Mars made by several well-known observers. Mr. Percival Lowell records some curious observations of the Sea of Sablier, or Syrtis Major. This marking has always been looked upon as an expanse of water or a sea; but Mr. Lowell's recent observations seem to corroborate those of Prof. W. H. Pickering, who examined this spot with a polariscope, and could detect no sign of polarisation. He says that the Syrtis Major is neither an ocean, nor a sea, nor anything analogous, but something very different, namely, a large expanse of vegetation. The changes observed in this marking in 1896 seem, at any rate, to suggest such an explanation as offered by Mr. Lowell.

The other observations included are:—Mr. R. Patxot Jubert's, made at the Observatory of Sant Feliu de Guixols Gerona (Spain); Mr. José Comas Sola's, made at Barcelona; Mr. V. Cerulli's, made at Teramo (Italy); Mr. A.-A. Wonaszer's, made at Kis-Kartal; and MM. Flammarion's and Antoniadi's, made at the Observatory of Juvisy. M. Antoniadi gives also a map of the whole surface as seen by him during the opposition of 1896, and a comparison of this with charts made at other previous oppositions is of great interest. The observations made during 1896 indicate, on the whole, that great changes take place on the planet's surface. The question of vegetation and a small water supply seems, perhaps, to account for the observed facts more than any other hypothesis yet advanced, and this explanation is in conformity with rapid seasonal changes which have recently become so apparent.

SIGNALLING THROUGH SPACE WITHOUT WIRES.[1]

IN 1884 messages sent through insulated wires buried in iron pipes in the streets of London were read upon telephone circuits erected on poles above the housetops, 80 feet away. Ordinary telegraph circuits were found in 1885 to produce disturbances 2000 feet away. Distinct speech by telephone was carried on through one quarter of a mile, a distance that was increased to one and a quarter mile at a later date. Careful experiments were made in 1886 and 1887 to prove that these effects were due to pure electro-magnetic waves, and were entirely free from any earth-conduction. In 1892 distinct messages were sent across a portion of the Bristol Channel between Penarth and Flat Holm, a distance of 3·3 miles.

Early in 1895 the cable between Oban and the Isle of Mull broke down, and as no ship was available for repairing and restoring it, communication was established by utilising parallel wires on each side of the Channel and transmitting signals across this space by these electromagnetic waves.

In the electro-magnetic system two parallel circuits are established, one on each side of a channel or bank of a river, each circuit becoming successively the primary and secondary of an induction system, according to the direction in which the signals are being sent. Strong alternating or vibrating currents of electricity are transmitted in the first circuit so as to form signals, letters and words in Morse characters. The effects of the rise and fall of these currents are transmitted as electro-magnetic waves through the intervening space, and if the secondary circuit is so situated as to be washed by these ethereal waves, their energy is transformed into secondary currents in the second circuit which can be made to affect a telephone, and thus to reproduce the signals. Of course their intensity is much reduced, but still their presence has been detected though five miles of clear space have separated the two circuits.

Such effects have been known scientifically in the laboratory since the days of Faraday and of Henry, but it is only within the last few years that it has been possible to utilise them practically through considerable distances. This has been rendered possible through the introduction of the telephone.

In July last Mr. Marconi brought to England a new plan. My plan is based entirely on utilising electro-magnetic waves of very low frequency. It depends essentially on the rise and fall of *currents* in the primary wire. Mr. Marconi utilises electric or Hertzian waves of very high frequency, and they depend upon the rise and fall of electric force in a sphere or spheres. He has invented a new relay which, for sensitiveness and delicacy, exceeds all known electrical apparatus.

The peculiarity of Mr. Marconi's system is that, apart from the ordinary connecting wires of the apparatus, conductors of very moderate length only are needed, and even these can be dispensed with if reflectors are used.

[1] Abstract of a discourse delivered before the Royal Institution, June 4, by W. H. Preece, C.B., F.R.S.

The Transmitter.—His transmitter is Prof. Righi's form of Hertz's radiator.

Two spheres of *solid* brass, 4 inches in diameter, are fixed in an oil-tight case of insulating material, so that a hemisphere of each is exposed, the other hemisphere being immersed in a bath of vaseline oil. The use of oil has several advantages. It maintains the surfaces of the spheres electrically clean, avoiding the frequent polishing required by Hertz's exposed balls. It impresses on the waves excited by these spheres a uniform and constant form. It tends to reduce the wave-lengths—Righi's waves are measured in centimetres, while Hertz's were measured in metres. For these reasons the distance at which effects are produced is increased. Mr. Marconi uses generally waves of about 120 centimetres long. Two small spheres are fixed close to the large spheres and connected each to one end of the secondary circuit of the "induction coil," the primary circuit of which is excited by a battery, thrown in and out of circuit by the Morse key. Now, whenever the key is depressed sparks pass between the small and large spheres, and since the system formed by the large spheres contains capacity and electric inertia, oscillations are set up in it of extreme rapidity. The frequency of oscillation is probably about 250 millions per second.

The distance at which effects are produced with such rapid oscillations depends chiefly on the energy in the discharge that passes. A 6-inch spark coil has sufficed through the system of spheres up to four miles, but for greater distances we have used a more powerful coil—one emitting sparks 20 inches long. It may also be pointed out that this distance increases with the diameter of the large spheres, and it is nearly doubled by making the spheres solid instead of hollow.

The Receiver.—Marconi's relay consists of a small glass tube four centimetres long, into which two silver pole-pieces are tightly fitted, separated from each other by about half a millimetre—a thin space which is filled up by a mixture of fine nickel and silver filings, mixed with a trace of mercury. The tube is exhausted to a vacuum of 4 mm., and sealed. It forms part of a circuit containing a local cell and a sensitive telegraph relay. In its normal condition the metallic powder is virtually an insulator. The particles lie higgledy-piggledy, anyhow in disorder. They lightly touch each other in an irregular method, but when electric waves fall upon them, they are "polarised," order is installed. They are marshalled in serried ranks, they are subject to pressure—in fact, as Prof. Oliver Lodge expresses it, they "cohere"—electrical contact ensues, and a current passes. The electric resistance of Marconi's relay—that is, the resistance of the thin disc of loose powder—is practically infinite when it is in its normal or disordered condition. It is then, in fact, an insulator. This resistance drops sometimes to five ohms, when the absorption of the electric waves by it is intense It therefore becomes a conductor. It may be that we have in the measurement of the variable resistance of this instrument a means of determining the intensity of the energy falling upon it. This variation is being investigated both as regards the magnitude of the energy and the frequency of the incident waves. Now such electrical effects are well known. In 1866 Mr. S. A. Varley introduced a lightning protector constructed like the tube, but made of boxwood and containing powdered carbon. It was fixed as a shunt to the instrument to be protected. It acted well, but it was subject to this coherence, which rendered the cure more troublesome than the disease, and its use had to be abandoned. The same action is very common in granulated carbon microphones like Hunning's, and shaking has to be resorted to to decohere the carbon particles to their normal state. M. E. Branly (1890) showed that copper, aluminium and iron filings behaved in the same way. Prof. Oliver Lodge, who has done more than any one else in England to illustrate and popularise the work of Hertz and his followers, has given the name "coherer" to this form of apparatus. He has much improved it. Marconi "decoheres" by making the local current very rapidly vibrate a small hammer-head against the glass tube, which it does effectually, and in doing so makes such a sound that reading Morse characters is easy. The same current that decoheres can also record Morse signals on paper by ink. The exhausted tube has two wings which, by their size, tune the receiver to the transmitter. Choking coils prevent the energy escaping. Oscillations set up in the transmitter fall upon the receiver tuned in sympathy with it, coherence follows, currents are excited, and signals made.

In open clear spaces within sight of each other nothing more is wanted, but when obstacles intervene and great distances are in question height is needed; tall masts, kites, and balloons have been used. Excellent signals have been transmitted between Penarth and Brean Down, near Weston-super-Mare, across the Bristol Channel, a distance of nearly nine miles.

It is curious that hills and apparent obstructions fail to obstruct. The reason is probably the fact that the lines of force escape these hills. Weather seems to have no influence; rain, fogs, snow and wind, avail nothing.

There are some apparent anomalies that have developed themselves during the experiments. Mr. Marconi finds that his relay acts even when it is placed in a perfectly closed metallic box. This is the fact that has given rise to the rumour that he can blow up an ironclad ship. This might be true if he could plant his properly tuned receiver in the magazine of an enemy's ship. Many other funny things could be done if this were possible. I remember in my childhood that Captain Warner blew up a ship at a great distance off Brighton. How this was done was never known, for his secret died shortly afterwards with him. It certainly was not by means of Marconi's relay.

The distance to which signals have been sent is remarkable. On Salisbury Plain Mr. Marconi covered a distance of four miles. In the Bristol Channel this has been extended to over eight miles, and we have by no means reached the limit.

It is easy to transmit many messages in any direction at the same time. It is only necessary to tune the transmitters and receivers to the same frequency or "note." Enough has been done to prove its value, and to show that for shipping and lighthouse purposes it will be a great and valuable acquisition.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Mr. R. A. Buddicom, Scholar of Keble College, has been elected to the University Biological Scholarship at Naples.

The University, in view of the visit of so many distinguished men to England for the Diamond Jubilee celebrations, has decided to confer the honorary degree of D.C.L. on Her Majesty's Premiers, amongst others, at this year's Commemoration. The following will therefore be the recipients of this honour:—The Hon. W. Laurier, Premier of the Dominion of Canada; Hon. Sir W. V. Whiteway, K.C.M.G., Premier of Newfoundland; Hon. Sir J. Gordon Sprigg, K.C.M.G., Premier of Cape Colony; Hon. G. H. Reid, Premier of New South Wales; Hon. G. C. Kingston, Premier of South Australia; Hon. Sir H. M. Nelson, K.C.M.G., Premier of Queensland; Hon. G. D. Taubman-Goldie, K.C.M.G., Governor of the Royal Niger Company; and Mr. E. H. Godkin, of New York.

The Junior Scientific Club met on June 9 and 16. Papers were read by Mr. R. R. Marett (Exeter), on the sanctions of savage morality; and by Messrs. P. Elford (St. John's) and N. E. Moss (Trinity) on artificial silks; E. H. Hunt (Balliol) and A. S. Fisher (New College).

Convocation on Tuesday unanimously passed a decree conveying the cordial thanks of the University to the Worshipful Company of Drapers for their munificent offer to erect a new building for the Radcliffe Library at the expense of 15,000*l*.

CAMBRIDGE.—Prof. Fitzgerald, of Dublin, has been appointed an Examiner for the Adams Prize, in the place of the late Mr. E. J. Stone.

The Senior Wrangler is Mr. W. H. Austin, of Trinity. Six out of the first seven Wranglers are from the same College. In Part II. of the Tripos, Messrs. Barnes and Wilkinson, of Trinity (bracketed second, 1896), and Mr. Houston, of St. John's (bracketed fifth, 1896), are placed in the first division, the Senior Wrangler of last year being in the second division. No ladies are classed as Wranglers this year.

IT is stated in the *American Naturalist* that work will soon be in full progress on the erection of a portion of the new Museum of Archæology and Palæontology, for the University of Pennsylvania. A botanical garden, covering ten acres, will be laid out around the museum. The site of the structure was ceded to the University by the city on condition that a museum of art and science, surrounded by a botanical garden, be erected on it. The portion to be erected immediately will cost not less than 500,000 dols., while the cost of the whole building will amount to 4,000,000 dols.

THE following are among recent appointments:—Dr. J. Franz, Assistant Professor of Astronomy at Königsberg, to be Director of the Breslau Observatory, and Professor of Astronomy in the University there; Dr. Frech to be full Professor of Geology in the University of Breslau; Dr. Carl Paal to be full Professor of Pharmaceutical and Applied Chemistry in the University of Erlangen; Dr. Paul Samassa to be Associate Professor of Zoology in the University of Heidelberg; Dr. Bredt, of Bonn, to be full Professor of Chemistry in the Polytechnic Institute at Aix; Dr. E. B. Copeland to be Assistant Professor of Botany in the University of Indiana; Mr. William George Hibbins, Whitworth Exhibitioner, and Research Scholar of the Mason College, Birmingham, to be additional Assistant in the Mechanical Engineering Department of the Merchant Venturers' Technical College, Bristol.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 3.—"The Sensitiveness of the Retina to Light and Colour." By Captain W. de W. Abney, C.B., D.C.L., F.R.S. Received May 10, 1897.

The author treats first of the extinction of the sensation of light on the centre of the retina. He made his reduction of the intensity of the light falling on the illuminated spot with a new piece of apparatus, which consisted of a gelatine wedge bent so as to make an annulus. He describes this wedge and its graduation, showing how its readings can be utilised, they being proportional to the logarithm of the intensity of light passing through it.

It is found that the smaller the spot of illuminated surface, the less reduction in intensity of the light is required, and that the amount of reduction of the light falling on the spot which just produces no sensation of light, is connected with the size of the spot by a simple formula, $I = x^m$, where I is the intensity and x the diameter of the spot. Further, he finds that it is the smallest diameter which governs the necessary reduction in intensity, and not the area of the illuminated surface. Having experimented with the extinction of light at other parts of the retina, he finds that it obeys the same law. Since a large and a small area having the same actual illumination appear to be of different brightness, an investigation was made of the relative luminosities of the two, and it was found that the two were connected by a very simple law.

The reduction of the intensity of a coloured ray to extinguish all colour was next measured with areas of different dimensions, and it was shown that again the intensity of the reduced light was connected with the size of the spot by a simple expression similar to that of the extinction of all light, but the exponential coefficient differed, indicating that light and colour were not connected together in the manner which might be expected.

The author then deals with the question of colour fields, and finds that all colour fields are of the same form, the extent depending solely on the illumination and the area of the surface the image of which falls on the retina. He finds that there is a connection between the intensity of the colour and the extent of the field which can be expressed by a formula, as also can the connection between the size of the spot of illuminated surface and the extent of field. He gives the curves of illumination for equal colour fields, and the curves of extent of field for every colour in the prismatic spectrum. Finally he makes an investigation into the relative sensitiveness to light of various points in the retina, and shows that there are "iso-lumes," or fields of equal sensitiveness, which appear to be of the same form as the colour fields.

He points out that there are difficulties in reconciling these results with either the Young or Hering theory of colour vision, and suggests a modification in the accepted theory of light and colour which may explain the connection between the two.

"On the Nature of the Contagium of Rinderpest." By Alexander Edington, M.B., F.R.S.E., Director Colonial Bacteriological Institute, Cape Colony.

In the following paper it is proposed to communicate to the Royal Society the results of experiments made in South Africa on the infectivity of the blood of animals affected with rinderpest. The experiments were all made on cattle kept under conditions in which accidental spontaneous infection could with certainty be excluded. These experiments had been concluded in 1896, before the arrival of Dr. R. Koch in South Africa, and their results had been communicated to him on his arrival.

(1) The blood of an animal ill with rinderpest, when taken during the febrile stage or previous to death, and injected subcutaneously or intravenously into healthy cattle, produces the typical disease—rinderpest, provided the blood is prevented from coagulating.

(2) The onset of coagulation and actual coagulation of the blood exerts a marked destructive influence on the virulence of such blood.

(3) The best method of obtaining virulent blood is to draw it aseptically from the jugular vein of an animal ill with rinderpest, and to mix it immediately with a 1 per cent. solution of citrate of potash, the latter previously well sterilised, in the proportion of 2-3 parts of blood to 1 part of citrate of potash solution. Such blood, as has been shown, remains fluid.

(4) This citrate of potash mixture of blood proves virulent in the first few days, generally not exceeding six days; after six days' keeping the virulence becomes rapidly weakened, so that after nine days the blood mixture is altogether inert.

(5) Admixture of glycerine to citrate blood does not *cæteris paribus* interfere with the virulence of such blood. Glycerine added to fresh blood does interfere with the virulence of the latter on account of the coagulation of the blood.

(6) The nasal mucus of an infected animal when used fresh and rubbed into the nostrils of normal cattle, produced in all instances typical rinderpest. We have never had a single failure in attempting to produce the disease by this means. By keeping the nasal mucus, even for a few hours, its virulence becomes markedly less.

(7) The condition of marked swelling of the lymphatic glands is one of, if not indeed the most evident pathognomic feature of the disease. The contagium exists as a primary infection in the lymphatic glands.

(8) A very mild attack of rinderpest, such as is produced by injection of blood of greatly decreased virulence, does not convey absolute immunity, this latter being produced in proportion to the severity of the attack through which the animal had passed primarily. An animal seemingly affected may have a relapse of the disease, which may go on to fatal issue or be mild in type, leading to recovery. Animals in the latter case always acquire immunity of a high degree.

Physical Society, June 11.—Mr. Shelford Bidwell, President, in the chair.—A mathematical paper was read by Mr. C. S. Whitehead, on the effect of sea-water on induction telegraphy. If a secondary circuit containing a telephone is rightly placed with respect to the field of a primary circuit traversed by an alternating current, signals may be transmitted over considerable distances. The author investigates the effect of filling the intervening space with sea-water; and, generally, the effect of a spherical conducting shell on the induction, at a point in a dielectric, due to an alternating current in a circular circuit, when the axis of the conductor passes through the centre of the shell. In the mathematical treatment, two cases are considered. (1) To find the normal magnetic induction at any point in the dielectric outside the shell when a circular circuit carrying an alternating current is placed in the dielectric inside a spherical conducting shell. (2) To find the normal magnetic induction at any point on the remote side of an infinite conducting plate, due to a circular circuit parallel to the plate. In both cases the following result is arrived at:

$$\frac{v_0}{u_0} = e^{-q\eta}$$

where v_0 is the maximum value of the normal magnetic induction at any point outside; w_0 the maximum normal magnetic induction due to the current in the primary, supposing the conducting shell or plate absent, at the same point; η the thickness of the shell or plate; and

$$q = \left(\frac{2\pi\mu p}{\sigma}\right)^{\frac{1}{2}}$$

where μ is the permeability of the conducting shell or plate; σ its specific resistance, $p = 2\pi$ times the frequency. If the frequency is 300, $p = 1885$. For sea-water, σ is taken as 2×10^{10} C.G.S. units; and $\mu = 1$. The sea-depth at the North Sand Head corresponds to $\eta = 2000$ cms. Hence, in this case, $\frac{v_0}{u_0} = \cdot 21$, or 79 per cent. is lost. Similarly, when

$\eta = 1000$, the loss is 54 per cent. The method employed in the investigation is that suggested by Lamb and Niven; the author adds an expression for Ω, the solid angle subtended by the circuit at any point, in terms of Bessel's functions. Mr. Evershed referred to some experiments of his own, from which he concluded that the author's formula gave too low an estimate of the attenuation; the discrepancy indicated that some term had been neglected. Mr. Yule doubted whether the equations given by the author were quite applicable to sea-water. There was need, apparently, of a term involving the polarisation of the medium. Mr. Heaviside communicated a criticism of the paper. It was not necessary to investigate the problem for any particular form of circuit from which the waves proceed. The attenuating factor for plane waves, due to Maxwell, was sufficient. Taking the best-known value for the conductivity of sea-water, there was no reason why the conductivity should interfere with signalling. A considerably greater conductivity must be proved for sea-water before it could be accepted that the failure of experiments on telegraphic communication with light-ships from the sea-bottom was due to that factor. It was unlikely theoretically; and Mr. Stevenson had contradicted it from a practical standpoint. For some reason, the account of the light-ship experiments had not been published, so that there was no means of finding the real cause of failure.—Mr. T. H. Blakesley read a paper on a new definition of focal length, and an instrument for determining it. The author asserts the principle that the focal length of a lens-combination is an abstract quantity, not necessarily the distance between two particular points. It is a quantity best defined in terms of some function of the two distances of object and image from their appropriate focal centres. Such a function is the magnification factor, m, the linear ratio of image to object, positive if the image is erect with regard to the object. Consider a particular pair of conjugate foci on the axis of a lens-system. Let one of these foci be at distance v from some fixed point on the axis, measured positively, in the direction of the rays. Then $\frac{dv}{dm}$ is constant, and is the focal length, f. If v_0 is the value of v when $m = 0$, $v - v_0 = f.m$. Let u be the position of the other focus, and u_0 its value when $m = \infty$. Then $u - u_0 = f.m^{-1}$; and $\frac{v - v_0}{u - u_0} = m^2$. The last expression, m^2, may be called the "areal magnification"; it is important in determining photographic exposure. The author describes an optical bank which enables $\frac{dv}{dm}$ to be measured by a very simple operation; it gives also a record, on a paper strip, of the magnification-factor corresponding to various relative positions of object and image. Dr. S. P. Thompson said the paper was the most important contribution to geometrical optics that had appeared for many years. The introduction of the magnification function was a most useful device leading to exceedingly simple results. The important thing to measure was not so much the focal length as the reciprocal of that quantity. Dr. Chree said the photographic method at present used at Kew for determinations of focal length gave greater security than any more direct method. The colour of the light had to be taken into account. Mr. Blakesley, in replying, called attention to the use of his strip diagrams of magnification, for enlarging purposes in photography. When the magnification along some definite line was known, the focussing-cloth might almost be dispensed with.—Dr. J. A. Fleming read a paper on a method of determining magnetic hysteresis loss in straight iron strips. The author's process is based upon the use of the bifilar reflecting watt-meter. The samples of iron, large or small, in the form of straight strips are inserted in a long solenoid. The solenoid is traversed by an alternating current, and the square-roots of the mean-square values of the current are determined by a Kelvin balance. A flat bobbin of fine wire may be slid along the strip; an electrostatic voltmeter connected to the ends of this exploring coil gives the square-roots of the mean-square values of the electromotive force in that coil. From these measurements and the known dimensions of the solenoid and coil, the induction density, B, can be found at any point of the length of the strip. From these results a curve is drawn, coordinating the values of B to corresponding distances along the half-length of the strip. Assuming the hysteresis loss per cycle, per c.c. of iron, to vary as the 1·6th power of the maximum induction density, and then raising all the B ordinates to the 1·6th power, and plotting a new curve over the first, another curve is obtained which represents the variation of hysteresis loss per c.c. of iron from point to point along the half-length of strip. Now, at some point along the half-length of strip there must be a section where the induction density is B, such that the true *mean* hysteresis loss for the *whole* bar is proportional to $B_1^{1·6}$. Let this value of the induction density be called the "*effective value*," and the corresponding point in the strip the "*effective point*." Let $M·B^{1·6}$ stand for the mean ordinate of the curve representing the varying values of $B^{1·6}$ all along the half-length. Then, evidently,

$$B_1 = \sqrt[1·6]{M·B^{1·6}}$$

The following curious experimental result is found. Whatever may be the length or section of the iron strip, the point at which the actual induction density has a value equal to the "effective" value, always comes at the same proportional distance from the centre of the strip. This distance is very exactly equal to 0·56 of the half-length, as measured from the middle; or 0·22 of the whole length from one end. If, therefore, the secondary coil is placed at that spot, and the secondary voltage then observed is used to calculate the induction density, the value so obtained corresponds to the true mean value of the varying hysteresis loss per c.c. all along the strip. Mr. Carter asked whether roots other than the 1·6th gave a similar constant value of the induction density. Dr. Fleming said it seemed to be the result of accident that the 1·6th root gave a constant value for iron.—The President proposed a vote of thanks to the authors, and the meeting adjourned until June 25.

Geological Society, May 26.—Dr. Henry Hicks, F.R.S., President, in the chair.—On augite-diorites with micropegmatite in Southern India, by Thomas H. Holland, Officiating Superintendent, Geological Survey of India. This paper dealt with a series of basic dykes intersecting the pyroxene-granulites and gneisses of the Madras Presidency, and believed to be of the same age as the lava-flows of the Cuddipah system. These dykes consist essentially of augite (near hedenbergite) and a plagioclase-felspar (near labradorite), between which we find masses of micropegmatitic intergrowths of felspar and quartz, with a micro-miarolitic structure. Around the patches of micropegmatite, chemical changes have frequently taken place in the minerals of the rock. After discussing the chemical constitution of the rock, and of its various constituents, and the relation between the micropegmatite and the surrounding minerals, the author pointed out that three methods for the formation of the micropegmatite may be conceived of: (α) during the primary consolidation of the magma; (β) by secondary changes induced in the rock; (γ) by subsequent intrusion of granophyric material into the augite-plagioclase rock. In opposition to (γ), the author pointed out the entire absence of granitic intrusions in the neighbourhood. He regarded the absence of all proofs of subaerial hydration, and the remarkable freshness of the rocks as precluding the possibility of the micropegmatite having been formed by secondary change. The primary origin of the micropegmatite he believed to be proved by (1) the crystallographic continuity of its felspar with that of the normal plagioclase of the rock; (2) the mode of occurrence of the micropegmatite, filling in the angles and spaces between the augite and the plagioclase; and (3) its variation in coarseness of grain agreeing with that of the remaining two constituents of the rock. An interesting discussion took place upon the question of the primary or secondary origin of the micropegmatite in basic rocks.—The laccolites of Cutch and their relations to the other igneous masses of the district, by the Rev. J. F. Blake. The author has observed thirty-two domes of various kinds in Cutch, distributed as follows: (i.) those connected with the northern islands; (ii.) those of Wagir; and (iii.) those along the northern edge of the mainland. They are divisible into four classes: (*a*) those which are so elongated on the line joining adjacent ones that they seem to be mere modifications of anticlinals, though the supposed anticline is not really continuous; (*b*) those which lie in a line, but are not elongated in that direction, and often in no other; (*c*) those which are related to a fault, which cuts them in half; and (*d*) those which are not in any particular relation to each other, or to any other stratigraphical feature. The domes varied in degree of perfection: some were irregular, while some had the strata running in concentric circles, the outer and newer strata dipping away from the inner and older. In no less than ten of the thirty-two domes igneous bosses were found occupying the centre, and these were distributed amongst all of the above classes. The author gave reasons for maintaining that the domes were the results of intrusion of igneous rocks in the form of laccolites, and were not anticlinal folds which have afterwards been affected by cross-folds. The domes were contrasted with igneous peaks which occurred in abundance in a different part of the area, usually at a higher horizon of the strata and at a higher level above sea. These were probably volcanic pipes through which the lava was forced and extruded at the surface. The author compared the rocks of the bosses with those of the dykes and flows. Both were principally perfectly fresh dolerites, but the former were distinguished by the presence of intergrowths of micropegmatite as the last stage of consolidation, as in the "Konga diabases." There was also among them a felsite-breccia with micropegmatite developed in the cracks. He considered that nearly all the igneous rocks of Cutch had been derived from a single magma, which in a solid condition must have contained large crystals of augite, olivine, and ilmenite in a ground-mass of lime-felspars, and have been throughout of a basic character. Such a magma originated in more than one centre.

Zoological Society, June 1.—Dr. Albert Günther, F.R S., Vice-President, in the chair.—A communication was read from Dr. John Anderson, F.R.S., containing a water-colour drawing of the Egyptian weasel (*Mustela subpalmata*), taken from living specimens which he had recently presented to the Society's menagerie. Dr. Anderson also sent some remarks on this rare Egyptian mammal, and others were made by Mr. E. C. Taylor. —A communication was read from Prof. T. W. Bridge, on the morphology of the skull in the Paraguayan Lepidosiren and other Dipnoi.—A paper on the classification of the *Thyrididæ*, a family of the Lepidoptera Phalænæ, by Sir George F. Hampson, Bart., was read. It contained short diagnoses of the twenty-six known genera (of which *Pycnosoma* and *Plagiosella* were described as new) of the group, and a list of the known species of each genus.—A second communication from Sir George Hampson treated of the classification of the *Chrysauginæ*, a subfamily of moths of the family *Pyralidæ*. Like the preceding paper, it contained diagnoses of the known genera, of which seventy-six were enumerated, and a list of the known species of each genus. Of the genera the following were characterised as new:—*Hyalosticta*, *Protrichia*, *Prionidia*, *Microzancla*, *Sarcistis*, *Monoloxis*, *Dilaxis*, *Tetraschistis*, and *Cyclopalpia*.—Dr. A. G Butler read a paper on a collection of Lepidoptera obtained in East Africa in 1894 by Mr. F. Gillett. Fifty-seven species were enumerated, and the dates of the capture of the specimens were recorded.—Dr. C. I. Forsyth Major read a paper on the Malagasy genus of rodents *Brachyuromys*, and entered into the question of the mutual relation of some of the groups of the *Muridæ* (*Hesperomyinæ*, *Microtinæ*, *Murinæ*, and *Spalacidæ*) with each other and with the *Nesomyinæ* of Madagascar. The Malagasy Rodentia were considered as forming a subfamily *Nesomyinæ*, the lowest of *Muridæ*, being forerunners of the American *Hesperomyinæ*, the Old-World *Murinæ* and the *Microtinæ* (*Arvicolinæ*). One of the genera from Madagascar (*Brachyuromys*) was stated to bear close affinities to a genus of the *Spalacidæ*. Reasons were given for regarding the last-named family as only lowly-organised *Muridæ*.

CAMBRIDGE.

Philosophical Society, May 10.—Prof. Liveing, Vice-President, in the chair.—Observations on stomata by a new method, by Mr. Francis Darwin, President. The method consists in the use of "Chinese sensitive leaf," *i.e.* thin sheets of horn treated in a special manner. When a strip of this substance is placed on the stomatal surface of a leaf, it gives evidence of the condition of the stomata by its movement. If they are open, it curves away from the source of moisture; if shut, it remains stationary. By means of a simple apparatus the degree of curvature of the horn is recorded. All the ordinary experiments with stomata can be easily and rapidly shown with a hygroscope of this sort. By taking readings at regular intervals the diurnal course of the stomata can be studied; in this way it has been shown that the nocturnal closure of the stomata is a periodic phenomenon like the "sleep" of leaves. A number of observations were made on the effects of the withering of leaves on the stomata: it was shown that while the stomata of certain species simply close as the leaf withers, in others the first effect is a well-marked opening. This fact is of interest in connection with the mechanism of the stomata, since it indicates the share which the pressure of the surrounding epidermic cells has on the guard cells. It was shown that many plants open their stomata in long-continued darkness; this fact bears on the mode of action of the guard cells, since it shows that they do not (as is often assumed) lose their turgescence when the assimilation of CO_2 is prevented.—Notes on hybrid Cinerarias produced by Mr. Lynch and Miss Pertz, by Mr. Bateson. It is stated by many writers that the garden Cineraria arose as the hybrid offspring of several species of *Senecio* from the Canary Islands. This statement has been questioned by Mr. Thiselton Dyer on various grounds. The author exhibited hybrids raised from *S. cruentus*, *S. multiflorus*, and *S. Heritieri* (= *lanatus*) raised in the Cambridge Botanic Gardens by Mr. Lynch and Miss Pertz, which illustrated the very great variability which appears in the offspring of the various crosses. In particular, specimens of *Heritieri* ♀ × *cruentus* ♂ and of the reciprocal cross were produced, showing excessive variability and proving how greatly the peculiar characters of *Heritieri* may be obscured in the offspring, even of the first cross. Five specimens of *multiflorus* ♀ × *Heritieri* ♂ were exhibited, each of which was exceedingly distinct from the rest. Experiments had entirely confirmed Darwin's observation that Cinerarias are self-sterile in a high degree. They hybridise, on the contrary, with great readiness. An accidental hybrid between *Heritieri* ♀ × garden Cineraria ♂ and the reciprocal were also shown, the two plants being quite unlike each other. One seedling *multiflorus* ♀ × garden Cineraria ♂ had been produced which was almost entirely female, a few anthers only appearing in later inflorescences. These experiments were to be continued; but so far as they had gone, they were entirely consistent with the view that the Cineraria was a hybrid between several species, *cruentus*, *Heritieri* and, probably, *multiflorus* being among them. The two first are named by most writers as probable parents.

PARIS.

Academy of Sciences, June 8.—M. A. Chatin in the chair.—On the periods of double integrals, and the development of the disturbance function, by M. H. Poincaré.—General theory of gradually varied conditions in the friction of liquids with vortices; formulæ of the first approximation, by M. J. Boussinesq.—Action of light upon mixtures of chlorine and hydrogen, by MM. Armand Gautier and H. Hélier. The influence of moisture upon the combination of the two gases under the action of light was first studied. When water is present the velocity with which hydrochloric acid is formed is considerably increased, this effect being probably produced by the lowering of the partial pressure of the hydrogen chloride formed. The effect produced by exposure for different periods to standard artificial light was also studied. If either gas is in excess, the reaction is much accelerated.—Observations on the limitation of chemical reactions, with especial regard to the preceding communication, by M. Berthelot.—Reply of M. Armand Gautier to M. Berthelot.—Note by M. Berthelot accompanying the presentation of his work on "Thermochimie." —A new truffle (*Terfezi aphroditis*) from the Isle of Cyprus, by M. Ad. Chatin. This truffle is characterised by its dark colour, being known locally as the black truffle. It frequently attains a very large size, one weighing 385 grams having been found in 1873.—Micrometric measures of double stars made at St. Petersburg and Domkino by Prof. S. de Glasenapp, Director of the Imperial University of St. Petersburg, by M. Loewy.—Examination of some spectra, by M. Lecoq de Boisbaudran. A reply to some criticisms of Eda and Valenta.—A Committee was appointed to present a list of candidates for the Foreign Associateship, rendered vacant by the death of M. Tchébychef. —Theoretical and practical study of the lung, its functions and diseases. Tuberculosis and its clinical cure, by M. H. Grasset. —On surfaces having the same spherical representation, by M. A. Pellet.—Remarks on a recent note of J. M. Weber, by M. E. Goursat.—On real systems of complex numbers, by M. E. Cartan. —Properties of the simple kathodic rays. Relations with simple electric oscillations, by M. H. Deslandres. An electrified body, interposed in the path of a kathode ray, causes an enlargement of the shadow, the kathode bundle being divided up into several distinct and unequally deviated bundles. These bundles are called simple kathodic rays, and it is shown that they correspond to simple electric oscillations.—On the atomic weight of cerium, by MM. Wyrouboff and A. Verneuil. Having shown in a preceding paper that it is possible to prepare cerium oxide in a state of high purity, this specimen has been utilised to fix the atomic weight of the metal. The sulphate was carefully purified from free sulphuric acid by repeated precipitation with alcohol or by careful ignition, and the atomic weight determined by three methods, namely, from the loss of water of the hydrated sulphate at 250° (92·70), from the ratio C_3O_4 : hydrated salt (92·83), and from the ratio C_3O_4 : dry salt (92·87), the mean result being about 92·7.—On the heat disengaged by the addition of bromine to some unsaturated substances, by MM. W. Louguinine and Iv. Kablukov. The unsaturated substances, for which results are given, include allyl chloride, ethyl allyl ether, allyl acetate, crotonic aldehyde, mesityl oxide and cinnamic alcohol.—Combinations of phenylhydrazine with metallic bromides, by M. J. Moitessier. Compounds of phenylhydrazine with the bromides of zinc, cadmium and magnesium are described.—On a menthoglycol, by MM. Ph. Barbier and G. Leser.—Chemical study on the culture of *Cattleya*, by MM. Alex. Hébert and G. Truffaut.—The use of aluminium vessels, by M. Balland. A method of treatment is described which permits of the rapid examination of aluminium water-flasks and other vessels used for military purposes.—The bacteria of boghead cannel, by M. B. Renault. The presence in boghead coal of an extremely small micrococcus is proved, to the chief of which the name *Micrococcus petrolei* is given.—Study of the infectious lesions of the bubonic plague, by M. Gustave Nepveu. —Researches on the Ostioles, by M. J. J. Andeer.—On the mechanical impossibility of the geometry of Lobatschewsky, by M. Jules Andrade.

DIARY OF SOCIETIES.

THURSDAY, JUNE 17.

ROYAL SOCIETY, at 4.30.—An Experimental Research upon Cerebro-Cortical Afferent and Efferent Tracts: Prof. Ferrier, F.R.S., and Dr. Turner.—On the Relative Behaviour of the H and K Lines of the Spectrum of Calcium: Dr. and Mrs. Huggins.—(1) Further Observations of Enhanced Lines. (2) The Total Solar Eclipse of August 9, 1896. Report on the Expedition to Kiö Island. (3) On the Classification of the Stars of the δ Cephei Class: J. Norman Lockyer, F.R.S.—On the Action exerted by certain Metals and other Substances on a Photographic Plate: Dr. W. J. Russell, F.R.S.—Stress and other Effects produced in Resin and in a Viscid Compound of Resin and Oil by Electrification: J. W. Swan, F.R.S.—On Lunar and Solar Periodicities of Earthquakes: Prof. A. Schuster, F.R.S.—Kathode Rays and some Analogous Rays: Prof. S. P. Thompson, F.R.S.—And other Papers.

LINNEAN SOCIETY, at 8.—On the Distribution of *Primula elatior*, Jacq.: Miller Christy.—On the Acari collected by Mr. H. Fisher, Naturalist of the Jackson-Harmsworth Polar Expedition, at Cape Flora, Northbrook Island, Franz-Josef Archipelago, in 1896: A. D. Michael.—Further Observations on Stipules: Sir John Lubbock, Bart., F.R.S.—On Minor Tension Lines between Plant Formations: Prof. Conway Macmillan.

CHEMICAL SOCIETY, at 8.—Ballot for the Election of Fellows.—The Reduction of Perthiocyanic Acid: F. D. Chattaway and H. P. Stevens.—Molecular Refraction of Dissolved Salts and Acids, Part II.: Dr. J. H. Gladstone, F.R.S., and W. Hibbert.—On a Space Formula for Benzene: Prof. J. Norman Collie, F.R.S.—On the Production of some Nitro- and Amido-oxypicolines: Dr. A. Lapworth and Prof. J. Norman Collie, F.R.S.—The so-called Hydrates of Iso-propyl Alcohol; Dr. T. E. Thorpe, F.R.S.—The Carbohydrates of the Cereal Straws: C. F. Cross, E. J. Bevan, and C. Smith.—Further Experiments on the Absorption of Moisture by Deliquescent Substances: H. Wilson Hake.

MINERALOGICAL SOCIETY, at 8.—On Blödite from the Punjab: F. R. Mallet.—On Monazite and Xenolime in European Rocks: Orville A. Derby.—On the Identity of Sundtite and Webnerite: G. T. Prior and L. J. Spencer.

FRIDAY, JUNE 18.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Sub-Oceanic Changes: Prof. John Milne, F.R.S.

SATURDAY, JUNE 19.

GEOLOGISTS' ASSOCIATION—Excursion to Leighton Buzzard. Director: A. C. G. Cameron. Leave Euston, 9.10 a.m.; arrive Leighton, 10.47 a.m.

MONDAY, JUNE 21.

VICTORIA INSTITUTE, at 4.30.

TUESDAY, JUNE 22.

ROYAL STATISTICAL SOCIETY, at 5.—Annual General Meeting.

WEDNESDAY, JUNE 23.

GEOLOGICAL SOCIETY, at 8.

FRIDAY, JUNE 25.

PHYSICAL SOCIETY, at 5.—A New Theory of the Earth's Magnetism; Mr. Sutherland.—Experiments in Critical Phenomena; Dr. Kuenen.—On the Attenuation of Electric Waves in Wires: Dr. Barton.—On the Steady Motion of an Electrified Ellipsoid: G. F. C. Searle.

SATURDAY, JUNE 26.

GEOLOGISTS' ASSOCIATION.—Excursion to Red Hill and Merstham (New Railway). Directors: Dr. G. J. Hinde, F.R.S., and W. Whitaker, F.R.S. Leave Cannon Street Station (S.E.R.) at 1.35 p.m.; arrive at Red Hill, 2.21 p.m.

LONDON GEOLOGICAL FIELD CLASS.—Excursion—Aylesford to Maidstone. Lower Greensand. Leave Cannon Street, 2.37; arrive Aylesford, 4.9.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—In Garden, Orchard and Spinney, Phil Robinson (Isbister).—The Dolmens of Ireland: W. C. Borlase, 3 Vols. (Chapman).—The Woodland Life: E. Thomas (Blackwood).—The Collected Mathematical Papers of Arthur Cayley, Vol. xii. (Cambridge University Press).—Électro-Métallurgie: A. Minet (Paris, Gauthier-Villars).—Grundprobleme der Naturwissenschaft: Dr. A. Wagner (Berlin, Gebrüder Borntraeger).—Introduction to Philosophy: Prof. O. Külpe, translated by W. B. Pillsbury and E. B. Titchener (Sonnenschein).—The Fertility of the Land: Prof. I. P. Roberts (Macmillan).—Human Embryology: Prof. C. S. Minot (Macmillan).—The Psychology of the Emotions: Prof. Th. Ribot (Scott).—Grundriss der Entwickelungsmechanik: W. Haacke (Leipzig, Georgi).—Nouvelle Étude sur les Tempêtes, &c.: H. Faye (Paris, Gauthier-Villars).—Life in Early Britain: Prof. B. C. A. Windle (Nutt).

PAMPHLETS.—L'Ora Esatta Dappertutto: Dr. M. Rajna (Milano, Hoepli). —On the Origin of the European Fauna: Dr. R. F. Scharff (Dublin, Ponsonby).—Epistolæ quas per Annos a 1596 ad 1601: Tycho Brahe et Oligerus Rosenkrantzius (Havniae).

SERIALS.—Proceedings of the Physical Society of London, June (Taylor). —Geographical Journal, June (Stanford).—Journal of the Asiatic Society of Bengal, Vol. lxv. Part 2, Nos. 3 and 4; and Part 3, No. 1 (Calcutta).—American Journal of Science, June (New Haven).—Abhandlungen zur Physiologie der Gesichtsempfindungen aus dem Physiologischen Institut zu Freiburg i. B., Erstes Heft (Hamburg, Voss).—Aeronautical Journal, 1897. No. 3 (Boston, Clarke).—Atti della Fondazione Scientifica Cagnola della sua Istituzione in Poi, Vol. xiv. (Milano).—Memoire del R. Istituto Lombardo di Scienze e Lettere, Vol. xx., xi. sella, serie iii. Fasc. 1-4 (Milano, Hoepli).—Journal of the Chemical Society, June (Gurney).—Bulletin of the American Mathematical Society, May (New York, Macmillan).—Himmel und Erde, June (Berlin, Paetel).—Journal of the Franklin Institute, June (Philadelphia).—American Naturalist, June (Philadelphia).—Transactions of the American Microscopical Society, Vol. xviii. (Buffalo, Brown).—McClure's Magazine, June (New York, McClure).

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