THURSDAY, SEPTEMBER 20, 1894.

THE PRINCIPLES OF PURE MATHEMATICS.

Grundzüge der Geometrie von mehreren Dimensionen und mehreren Arten gradliniger Einheiten in elementarer Form entwickelt. Von Guiseppe Veronese, Professor an der königl. Universität zu Padua. xlvi. + 710 pp. (Leipzig: Teubner, 1894.)

THE work before us is an authorised German translation, by Lieutenant Adolf Schepp, of Wiesbaden, of Prof. Veronese's treatise on the Foundations of Geometry, first published at Padua in 1891; and the translator tells us in his short preface that the author has communicated to him the corrections and improvements of his work that have occurred to him since its publication in Italian. To give such an account of the contents of a book, so important, so original, and, it may be added, so controversial, as would serve to render its purpose and method generally intelligible, and at the same time to subject it to adequate criticism, would require a memoir rather than a review. We shall therefore endeavour only to give such a description as will recommend it to the attention of all who are interested in the logical basis of Pure Mathematics.

The Preface of thirty-four pages gives a general view of the author's system; the Introduction of 222 pages is devoted to the logical establishment of the notions of Number and Continuous Quantity; after that the First Part deals with the Straight Line, the Plane, and Space of Three Dimensions; the Second Part is occupied with the theory of Space of four or *n* Dimensions. The treatise ends with an interesting historical and critical discussion of the most important previous works on the same subject, and some notes elucidatory of special principles. A full table of contents is given, and a list of authors quoted; but it would have added much to the value of the book as a work of reference if a good alphabetical index of subjects had been included. The remainder of the present notice will be confined to the Introduction, the specially geometrical parts of the book being reserved for another occasion.

The thorough revision to which, in this century, the underlying principles of mathematical reasoning have been subjected is not less remarkable than the great advances made in the ulterior developments of these principles. Crelle has said that for those who probe the depths, equally with those who build in the heights of mathematical thought, there ever remain unexplored mysteries. Among those who have probed the depths, the investigators, namely, who have occupied themselves with the notions of number and quantity, the continuum of real numbers, the infinitely great and the infinitely small, there has been much divergence of opinion as to the logical grounding of the subject. Such discussions appear to be foreign to the taste of our English writers. With us Arithmetic is an affair of sums to be done by rules; Algebra is arrived at by noting the laws of operation with the numbers of Arithmetic, and giving to them the power of holding generally. We are too used to the process humorously described by Clifford [1]—"In the science of number while five-sevenths of fourteen has a meaning, namely, ten, five-sevenths of twelve is nonsense. Let us then treat it as if it were sense, and see what comes of it." This method, which Clifford held to be "logically false and educationally mischievous," is not that adopted by continental writers, and in particular it is not the method of Prof. Veronese. For him it is necessary so to define the abstract notions—number, quantity, and so on—that the laws of operation with them may be logically well-grounded upon the definitions. Let us see how he sets about the notion of (positive integral) number.

Readers of Clifford's lecture just now quoted will remember that the *crux* of Arithmetical theory lies in the proof of the statement that the number of things in a group is independent of the order in which they are counted; and the difficulty of proving it is not diminished by the facts, firstly, that everyone is firmly convinced of its truth, and secondly, that the whole system of Arithmetic is the work of the human mind, and therefore the theorem must somehow be implicitly included in the definitions when these are given with sufficient clearness. Prof. Veronese, like Kronecker,[1] appears to regard the ordinal number as logically preceding the cardinal number; in other words, he makes the idea of a group of things arranged in an order more elementary than the idea of the number obtained by counting the things in the group. Kronecker, going out from this notion, rapidly arrived at the required result, but our author is not satisfied with his reasoning. His own process is much more leisurely. He starts from the notions of unity and multiplicity (Einheit and Mehrheit) and explains the operations of uniting (Vereinigung) the objects of a series into a group, and of separation (Zerlegung) of a group into objects by successively taking away (Wegnehmen) object after object from the group. He defines an ordered group, and explains the unique correspondence of elements in two such groups. It is only after all this that he is prepared to define a number as an ordered group of units arranged to correspond uniquely and in the same order to the objects in an ordered group of objects. This definition is found to be a sufficient ground for the definition of counting, for proving the crucial proposition above referred to, and for the establishment of the commutative law of addition and the remaining laws of operation with positive integral numbers.

To establish the notion of Quantity and the extended conception of Number, with which Algebra has made us familiar, it is necessary, as many writers (including Du Bois Reymond) have pointed out, to frame an account of the Fundamental Form, or, as we may call it, the *Locus in quo* of real Quantity. A numerical fraction implies a something divisible into equal parts, and a part of it containing a certain number of these parts. A square root implies an exact measurement of a side of a square which has a given area. These examples show that we do tacitly or expressly assume a *somewhat* capable of exact division into parts in arbitrary ways corresponding to various mathematical ideas. This *somewhat* is the Fundamental Form (Grundform), and it has been frequently figured as a geometrical straight line, as by Du

[1] "Lectures and Essays," vol. i. p. 336.

[1] "Ueber den Zahlbegriff." *Crelle*. Bd. ci. 1887.

Bois Reymond (in his Algemenie Functionentheorie). According to Prof. Veronese it is more proper to give an independent abstract account of the Fundamental Form, partly because the properties of the straight line are afterwards to be determined in accordance with abstract definitions. He therefore takes as a guide the rectilinear continuum of intuition, of whose properties he gives an analysis, and then proceeds in an abstract manner. He defines a Form as anything whose marks are part, whole, order, and kind of position. Thus a line regarded as consisting of segments limited by points in a certain order having positions on the line is a Form, a song regarded as consisting of certain words pronounced in a certain order and each in a certain musical pitch is a Form. He explains how one Form may be determined by other Forms, and how the identity of two Forms may be inferred from the identity of the Forms that severally determine them. To avoid the circular reasoning that must ensue, unless some Forms are known to be identical there arises the necessity for introducing the Fundamental Form as a standard which serves for the determination of all others. He describes successively a system of one dimension as a form given by a series of elements whose order, from a certain element, is a mark of the form, a homogeneous system of one dimension, and a system of one dimension identical in the positions of its parts. Such a form is chosen as Fundamental Form. The operations of uniting segments of the Form and of separating united segments are described, and shown to obey the Laws of Algebra for addition and subtraction. The relations of segments as multiples or factors of other segments lead to the laws of multiplication and division, and to the description of the Scale founded upon any segment as unit. The Range of the Scale (Gebiet der Scala) is the part of the Fundamental Form arrived at by continual repetition of the segment chosen as unit.

The author is now prepared to introduce the conceptions of the infinitely great and the infinitely small. He assumes that there is an element of the Fundamental Form which lies outside the Range of the Scale founded on any segment as unit. This assumption is apparently free from any contradiction. Such an element being chosen, the segment limited by it, and any element within the range of the scale, is infinitely great in reference to the unit of the scale; had this segment been chosen as unit, the original unit would have been infinitely small. From the nature of the Fundamental Form, as a homogeneous system identical in the position of its parts, follows the necessity of assuming any number of orders of infinite segments and any number of orders of infinitesimal segments.

To every segment corresponds a numerical symbol, just as in particular the natural numbers correspond to the segments which are exact multiples of that one chosen as unit. The ordinary Laws of Algebra holding for the segments hold in like manner for the numbers thus introduced. To the infinitely great and infinitely small segments of different orders correspond infinitely great and infinitely small numbers of different orders. It is proved that the numbers thus arrived at are not identical with Cantor's "Transfinite numbers" (*Acta Mathematica*, Bd. II.). After the introduction of these numbers, and the establishment of the laws of operation with them, come the hypotheses of continuity of the Fundamental Form, an idea here treated in a very instructive manner, the proof of the existence of Limits so elaborately discussed by Du Bois Reymond, the notions of commensurable and incommensurable segments, and the theory of Proportion, the last being especially interesting. A chapter is added for the sake of completeness, in which the properties of real, positive and negative, rational and irrational, numbers are established on the basis of principles already discussed.

It is a cardinal feature of the author's account of the theory of Quantity to dispense with the so-called Axiom V of Archimedes, according to which it is inherent in the notion of quantity that when one quantity a is greater than another b, there exists a number n such that nb is greater than a. This axiom has been found by other writers, as Stolz, extremely useful in establishing the properties and relations of finite quantities, but appears to involve difficulties in connection with the infinitely great and the infinitely small. At the expense of greater length of explanation, Prof. Veronese has freed the theory from the axiom and the involved difficulties. His own exposition is generally clear, though his doctrine of "commensurable numbers of the second kind" (pp. 182 and 213) is not without obscurity. Could not an example have been given?

Enough has been said to show that Prof. Veronese's book treats of a great deal besides the Foundations of Geometry—his Introduction might, in fact, well be entitled the Foundations of Mathematics. He tells us that although some parts of it will be useful in Geometry, much has been worked out simply for its own sake. We may well be grateful to him for the patience and trouble that he has expended in clearing up the Logic of the operations that most of us, without a thought of underlying difficulties, cheerfully perform with confidence and success. He has none of the charm of style to be found in the writings of Clifford or Kronecker. Rigorous he is, thoroughly common-sense, careful almost to tediousness, and extremely leisurely. For the elucidation of the very difficult subject he has chosen, these qualities are perhaps the greatest of merits, yet we fear that they will not render his writings acceptable to readers unprepared for a considerable sacrifice of time. A. E. H. L.

TEXT-BOOKS ON ORGANIC CHEMISTRY.

Organic Chemistry. Part I. By W. H. Perkin, jun., Ph.D., F.R.S., and F. Stanley Kipping, Ph.D., D.Sc. (London: W. and R. Chambers, 1894.)

Lessons in Organic Chemistry. Part I. Elementary. By G. S. Turpin, M.A. (Camb.), D.Sc. (Lond.) (London: Macmillan, 1894.)

IT is not surprising that "organic" chemistry should have received less attention in this country than on the continent, considering that the professors in nearly all the chief British universities have been notoriously neglectful of this department of the science, and that the highest degrees in connection with chemical science have been until recent years generally attainable without a practical acquaintance with the subject, and without evidence of capacity for research.

The influences which in Germany have led to so widespread and successful prosecution of research in organic chemistry are traceable partly to the university system, which demands the production of a piece of original work, and partly to the wonderful development in that country of the colour industry, which is now practically a German monopoly. We have, however, British chemists who have successfully devoted themselves to "organic" chemistry, and among them the names of Perkin (son as well as father) and Kipping stand out in honourable prominence. Hence a text-book issued in these conjoint names would naturally excite attention and interest.

"Our original intention," say the authors in their preface, "was to write a small text-book on organic chemistry, based on the syllabus drawn up by the Science and Art Department." Such a plan, however, was not worthy of the reputation of the writers, and they are to be congratulated upon having enlarged the scope of their work beyond this rather narrow limit.

This volume, Part I., deals with the fatty compounds, and "contains in the first place a general account of the methods most frequently employed in the separation, purification, and analysis of organic compounds, and in the determination of molecular weight. The preparation and properties of typical compounds are then described, attention being directed to those changes which come under the heading of general reactions rather than to isolated facts regarding particular [substances. Questions of constitution are also discussed at some length, and in the case of the most typical compounds, the facts on which the given constitutional formula is based are specifically mentioned." From this outline it will be seen that the arrangement of the book is not essentially novel. The best feature is the discussion of the structure or constitution as expressed by the formulæ of the more important compounds, and, notwithstanding one or two statements which look rather dogmatic, this is the feature which gives it some superiority over other text-books of about the same dimensions. No reference is made in this volume to ideas of geometrical isomerism, which are prudently reserved for the second part. It is to be regretted that the authors should have allowed themselves to drop, in print, into the slovenly phraseology which is too common among all classes of chemists. For example, p. 99, cane sugar is said to be converted into "equal molecules" of dextrose and levulose. It is true that this expression is employed by writers of bigger books, but that is no justification for the continuance of a phrase which is absolutely unmeaning. On p. 204, triethylamine is said to be "a stronger base" than diethylamine; while on the opposite page, 205, tetrethylammonium hydroxide is stated to be "a stronger base" than potash or soda. If eminent chemists occupying the position of university professors are so lax, it is not to be wondered at that the poor South Kensington teacher and his pupils should be sometimes found wanting when called upon for definitions.

Chapter xiii., p. 218, opens with this statement:—

"It may be assumed as a general rule that the changes which any particular group of atoms is capable of undergoing are independent of the nature of the groups with which it is combined."

This requires for its justification something more than the example which follows, for organic chemistry is full of instances of the influence which neighbouring atoms and groups have upon the character of a given atom or group; and at the top of the very same page the authors draw attention to one of these, namely: "The influence of alkyl groups in increasing the basic character of an element." Mercury is here referred to, and the meaning is obvious to the instructed chemical reader, though the reference to the basic character of the element, coupled with the succeeding statement that mercuric oxide is a feeble base, is well calculated to confuse the mind of a learner.

Dr. Turpin's book is one of the series of science class-books adapted to the elementary stage of the South Kensington syllabus, and issued by Macmillan. Here again the arrangement runs upon well-established lines, beginning with processes of analysis, methods of estimating molecular weight, and then plunging into the successive series of hydrocarbons, alcohols, ethers, acids, and so forth. Detailed directions are given for the performance of a selection of instructive experiments, the number of which, however, being no more than twenty in the whole book, ought to be considerably increased. At the end of each chapter are some questions which will doubtless be suggestive to both pupil and teacher. These are good and useful features of the book, which it must be remembered is labelled elementary; but, oh! Dr. Turpin, where in the whole range of stereo-chemical literature did you find the "valuable hypothesis" that "the carbon atom is regarded as being similar in shape to a regular tetrahedron"? (p. 31). We certainly feel justified in protesting against the author's treatment of the "tetrahedral theory of the carbon atom," which is disposed of in about twenty lines with three shaded diagrams. It is more than doubtful whether this hypothesis should appear in an elementary book at all, but to thrust it in without reference to the sort of fact which it is intended to explain, and to state it in this crude form, cannot be too strongly condemned.

Both these little books have their good points, and both will undoubtedly be found useful by many young students; but the perusal of them and others leaves the impression that the text-book which will meet all the difficulties and provide fully for the needs of the student entering upon this ever-widening subject of organic chemistry, has yet to be written. Organic chemistry is not begun till the student has some acquaintance with inorganic and general chemistry, and if properly taught previously he ought not to require to be told how to deduce a formula from the results of analysis, or how to determine a molecular weight. The practice of reserving these matters as an introduction to organic chemistry belongs to a bygone time, and it has the disadvantage of leading many students to think that vapour density and other methods are applicable only to organic compounds. The arrangement of carbon compounds in homologous series from the outset is also confusing to the beginner, because each succeeding term of such a series is derived from distinct materials which have no apparent connection with either those which go before or those which follow after. A better plan, adopted in some of the older books, now out of date, is first to study the transformations of some one substance, such as alcohol, which lends itself to many changes, which are easily traced experimentally, and subsequently to deal with series. This leads naturally and easily to the great object of the detailed study of carbon compounds. Apart from their practical utility and the application of knowledge gained by this detailed study to the purposes of the vegetable and animal physiologist, the great aim of the organic chemist is surely to trace the relation of chemical constitution to physical properties, and so to shed light upon the wider question of the constitution of matter generally; but this is just the aspect of the study which, in most of the text-books, is kept in the background. W. A. T.

PRACTICAL PHYSICS.

Physikalisches Prakticum, mit besonderer Berücksichtigung der physikalisch-chemischen Methoden. Von Eilhard Wiedemann und Hermann Ebert. Zweite verbesserte und vermehrte Auflage. Pp. xxiv. 455. 279 Woodcuts. (Braunschweig, Viewig, 1893.)

RECENT years have seen a great development in the teaching of practical physics, and a great increase in the number of laboratories in which instruction in the elementary parts of the subject can be given to large classes of students. So much has this been the case, that now practical physics is taught in a good many of our schools, and forms one of the subjects in numerous examinations. Those who have been largely concerned in the establishment of classes for practical instruction in physics, and have had some experience in actual teaching, have often felt the need of a suitable book to put into the hands of their students, and have endeavoured, each for himself, to supply this want. This is the origin of several books on practical physics, such as Glazebrook and Shaw's manual (to take an English example), and the work before us. The authors of such books are able to employ the MS. or the proof-sheets in the instruction of their students, and thus are able to obtain a practical test of their work before sending it forth to the public, with the result that the books are generally very satisfactory for the purposes for which they are designed. The only drawback is that each book is apt to appeal only to a particular type of students, and to give descriptions of the apparatus in a particular laboratory.

The "Practical Physics" of Wiedemann and Ebert has been designed for a special class of students, viz. those who are chiefly interested in acquiring a knowledge of chemistry. Particular attention has therefore been devoted to those parts of physics which are of most use in a study of chemistry, while several parts of the subject of great interest to physicists have been either omitted or only very briefly dealt with. Thus experiments on rigid dynamics and on the magnetic properties of iron and steel are completely passed over.

The authors have not attempted to give an account of the methods of precision which may be employed in the experiments selected by them, and consequently have taken no notice of the small corrections which become of so great importance in an accurate research. In those cases where it seemed desirable that some source of error should be brought prominently before the student's notice, the experiment is so arranged that the correction shall not be too small.

To each section there is an introduction wherein the general laws to be employed are stated, and the quantities to be measured are sometimes defined; but, as a rule, no account whatever is given of the reasoning by which the formulæ are arrived at. This is bound to be unsatisfactory, and must lead the student to be continually asking for explanations of the formulæ, unless indeed he be a person of little mental vigour, when he will accept formulæ without a murmur. In many instances no explanation or definition whatever of the quantity to be measured is vouchsafed to the student. For example, he is informed that the coefficient of viscosity of a liquid can be determined by the formula

$$\eta = \frac{\pi p r^4 t}{8 V l}$$

where V is the volume of liquid which is driven through a fine tube of radius r and length l in time t by a pressure p, but there is absolutely no definition of the coefficient of viscosity, although it might have been given in a few lines. The same complaint may be made about several other sections. The authors are surely mistaken in their idea that by their method the use of books on "the higher mathematics" may be dispensed with, and the "Prakticum" become a self-contained treatise on practical physics, wherein the student may find all he requires without the trouble of searching through special text-books. Besides, it is in every way better that the student should endeavour to acquaint himself with the methods by which the formulæ have been deduced. He gains in this way a grasp of the principles of the subject which is hardly attainable in any other manner; and if he does learn a little mathematics, he may hope that it will not seriously injure his ability for chemistry.

Before dealing with the contents of the book, it may be well to mention some points in which the book is far less satisfactory than the authors were capable of making it. The first complaint is that the results of the sample experiments are frequently set down without any statement of the units in which they are expressed. For instance, the modulus of rigidity of brass is found by an experiment to be 4770 *somethings*, but what the *somethings* are is not stated. The student who happened to express the linear magnitudes in centimetres instead of millimetres, would doubtless be much perplexed when he found by his experiment the value 477,000 instead of the result in the book. If, on the other hand, the value of the modulus had been expressed as 4770 kilogrammes per square millimetre, all the difficulty would have been avoided. The student should be so trained to state precisely the units in which his results are expressed, that the bare statement that the modulus of rigidity is 4770 should produce an unsatisfied feeling, in his mind, much the same as is called up by the conundrum, Why is a house? In some instances where units are given, they are given wrongly, as when the velocity of sound is found to be 331·5 *metres*, and the average velocity of hydrogen molecules is stated to be 1698 *metres*.

A minor defect is that one system of units is not adhered to throughout. Sometimes centimetres are employed, and sometimes millimetres. This is of no consequence, except so far as it tends to keep alive and propagate the state of confusion from which the C.G.S. system might have been expected to deliver the scientific world.

The first part of the book deals with the mechanics of solids, liquids, and gases. The usual methods of measuring lengths, &c., are described, and an account is given of experiments on the balance, on the laws of the pendulum, on elasticity, and on acoustics. The greater portion of the space is devoted to experiments with liquids and gases. The full account which is given of the methods of making measurements of a mechanical nature upon matter in these two states, should be very useful to the students for which the book is designed.

The second division, which is devoted to heat, is excellent. A large number of experiments are described, most of them of great importance to the modern chemist. In this connection may be mentioned specially the sections dealing with melting points, the effect of dissolved substances on the freezing and boiling points of liquids, and the amount of heat evolved in solution and chemical combination. A section is devoted to the determination of the mechanical equivalent of heat by the aid of what is practically a model of Joule's apparatus.

Optical measurements and observations occupy the next portion. Some simple experiments with reflecting surfaces, lenses, and prisms are given, so as to form an introduction to the subject. A few simple experiments with combinations of lenses with lenses or mirrors would have been of much use here, for students generally find difficulty with such experiments, and require some little experience before they can deal practically with the real or virtual images which are seen in mid-space, and not down the tube of a telescope. A large part of the section is devoted to spectrum analysis, and there are some excellent plates of emission and absorption spectra. A short account of the phenomena of polarisation leads up to a chapter on the rotation of the plane of polarisation by various substances, and the use of this property for saccharimetry and other purposes.

The last division of the book, which is devoted to electricity and magnetism, is somewhat abbreviated, only those parts of the subject being included which are supposed to be of interest to the chemist. Voltaic electricity practically takes up the whole of the space. The same omission of definitions, which has been already noticed, shows itself strongly here, no definition being given of either the ampere, the volt, or the ohm, while the enunciation of Ohm's Law is just what a schoolboy might be expected to put down. Although a tangent galvanometer is described, no hint is given that it is possible to calculate its "reduction factor" if the value of "H" is known, and, in fact, the electromagnetic definitions of the units seem quite kept out of sight. From a physical point of view, this division compares quite unfavourably with the three other divisions.

The volume is brought to a conclusion by a useful collection of numerical tables, physical and mathematical.

In spite of the defects which have seemed to call for notice, the book is undoubtedly a useful one, the defects being such as the teacher can very easily remove. If a third edition is called for, it is to be hoped that the authors may see their way themselves to remove them.

The book will often be of service to those teachers who are engaged in the task of conducting classes in practical physics, for it will often suggest fresh experiments to be added to those forming the regular course of the laboratory. But it must be remembered that although a demonstrator in the course of a few years may acquire a knowledge of a large number of experimental methods, yet the students who come under his care for a year or so have only time to acquire a very limited acquaintance with the subject, so that if a new experiment is added to the course, it practically displaces some old one. The course of experiments which is most suitable for students of a particular type working for a particular end, very soon settles itself by a process of selection, and then must remain practically unchanged, although there may be a gradual evolution in the employment of improved methods.

G. F. C. SEARLE.

OUR BOOK SHELF.

Object Lessons in Elementary Science. By Vincent T. Murché. Three volumes. (London: Macmillan and Co., 1894.)

WHEN a child is shown any object, he usually asks "What is it?" and then "What does it do?" If these questions are sensibly answered the child learns much about the properties of common things while he is very young, and, what is more, his faculty of observation is developed. Evidently, then, an excellent grounding for a scientific education can be obtained from object lessons. Simple objects are brought under the children's notice, and their peculiarities observed. For instance, liquids such as water, oil, wine, milk, and quicksilver are taken and used to show that they flow, break up into drops, have no shape of their own, and keep a level surface. Physical properties of solids can then be treated; but whatever the subject of the object lesson, the aim of the teacher must be to let the class come to their own conclusions upon the points illustrated. This principle of sound instruction is well exemplified by the lesson on hard and soft bodies in the first of the three volumes before us. The aim of the lesson is to enable a child to express clearly (1) what he understands by "hard" and "soft"; (2) that hardness and softness are merely relative terms; (3) how to test the hardness of a body. Such objects as an apple, a turnip, a potato, cork, chalk, wood, lead, iron, flint, steel and glass are taken, and children are asked to scratch them with the finger-nail. It is then found that some of the objects can be scratched easily, others not so easily; a third class can only be scratched with difficulty, and a fourth cannot be marked at all with the finger-nail. The experiments are afterwards repeated with a knife, and then the objects are rubbed against one another, and the results noticed. By these means the pupils learn that there are many degrees of hardness, some bodies which are commonly called hard being really soft when compared with others; *e.g.* lead is hard when compared with wood, but soft when compared with iron, and so on. To our minds, this method of teaching elementary science is admirable. It must not be supposed however, that Mr. Murché only deals with physical conditions. His excellent little volumes are also concerned with the chemistry of common things, with the mechanics of every-day life, with zoology, botany, and physiology, and with various arts and manufactures. The volumes follow a scheme of object teaching in elementary science issued by the London School Board some years ago. The author adopted this scheme for use in his school as soon as it was issued, and the experience gained since then has enabled him to produce a thoroughly practical work. We know no better work for teaching elementary science to young children. Though designed for Standards I. to VI. of Board and National schools, most of our private, and many of our public, schools would gain by introducing these object lessons into their curricula.

Précis de Météorologie Endogène. By F. Canu. (Paris: Gauthier-Villars et Fils, 1894.)

LA MÉTÉOROLOGIE ENDOGÈNE is, according to the author's definition, concerned with (1) all acoustic and dynamic phenomena produced more or less directly by variations of atmospheric pressure within the earth's crust; (2) internal manifestations of electricity and magnetism. Ritter gave this branch of knowledge its name, but it was De Rossi who reduced it to a system. M. Canu's volume is an elementary description of phenomena belonging to the physics of the earth. Among the subjects dealt with are the aurora and its connection with the sun; earth currents; subterranean noises, and circumstances affecting them; terrestrial magnetism; earthquakes and earth tremors; and causes producing the escape of fire-damp. All these phenomena are first treated descriptively, and then in relation to other phenomena. Thus, after descriptions of the height, spectroscopic features, acoustic properties, electric character, and geographical distribution of auroræ, we find brief statements of all the causes believed to influence the phenomena. This plan is followed in each chapter, and though the correlation between the phenomena described is sometimes very doubtful, in general the observations quoted deserve consideration. "Pour propager une science," says the author, "il faut avant tout la vulgariser." To accomplish this object the book has been made easily understandable to a French-reading public.

Sach- und Orts-Verzeichnis zu den mineralogischen und geologischen Arbeiten von Gerhard vom Rath. Im Auftrage der Frau vom Rath bearbeitet von W. Bruhns und K. Busz. Pp. 197. (Leipzig: Engelmann, 1893.)

THIS book is a tribute by the widow of Prof. vom Rath, of Bonn, to the memory of her late husband. It had been her wish to republish his numerous memoirs in a collected edition, but the expense of reproduction of the elaborate crystal drawings with which his researches have been illustrated was found to be prohibitory; hence the tribute has taken the form of a detailed Index to his works. The plan adopted for the Index is identical with that of the useful Repertorium of the "Zeitschrift für Krystallographie und Mineralogie von P. Groth." There are two alphabetically arranged lists, the one a subject-index, the other a locality-index. The crystallographical and mineralogical part is the work of Dr. Busz, while for the petrographical and geological part Dr. Bruhns is responsible. The Index gives striking evidence of the vast range of Prof. vom Rath's studies and observations, while the high standard of excellence which characterised his work is known to all who have occasion to refer to his memoirs. By reason of the diversity of the species and subjects discussed by him, this Index will be of great advantage to students of mineralogy.

Elementi di Fisica. Vols. I. and II. By Antonio Ròiti. (Florence: Successori Le Monnier, 1891 and 1894.)

THE first volume of the third edition of this work was published in 1891, but the second volume, revised and enlarged, has only recently appeared. The two constitute an admirably-arranged work on general physics, similar in structure to Ganot's "Natural Philosophy." After an introduction on the properties of matter, Prof. Ròiti passes to the mechanics of solids, and then to the mechanics of fluids. The next section is devoted to acoustics, after which come chapters on heat and energy. These conclude the first volume; the second being concerned with radiant energy, and electricity and magnetism. There are nearly nine hundred illustrations in the complete work, but the majority of them are old friends. However, scientific judgment has been used in making the compilation, and the only matter for complaint is the absence of an index—a common defect of continental publications. In a work of science having the scope of that under review, such an omission is unpardonable.

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.*]

Latitude by Ex-Meridian.

THE problem under consideration is that of finding latitude by an altitude of a heavenly body taken near the meridian, commonly called the "Ex-Meridian." The method most frequently employed by navigators is that in which a reduction is applied to the observed altitude in order to reduce it to the meridian, this reduction being either found by calculation or taken by inspection from special tables such as the "Ex-Meridian Altitude Tables," by Messrs. Brent, Walter, and Williams. In the following it is proposed to show how this reduction may be effected by the use of the Azimuth and Traverse Tables.

If l be the latitude, d the declination, and h the hour angle, the formula of reduction is

$$x = Ch^2 \quad \ldots\ldots\ldots (1)$$

where

$$C = \frac{\cos l \cos d}{2 \sin (l-d)} \left(\frac{\sin^2 15'}{\sin 1''} \right) \text{(Godfray's "Astronomy").}$$

Now since C may be considered constant

$$dx \text{ or } dl = 2\, Chdh \quad \ldots\ldots\ldots (2)$$

Again from the fundamental relation

$$\cos d \cos l \cos h = \cos z - \sin d \sin l$$

it is easily found that

$$dl = dh \cos l \tan A \quad \ldots\ldots\ldots (3)$$

where A is the azimuth, and eliminating C between (1) (2) and (3) the formula is obtained in the simple form

$$x = \tfrac{1}{2} h \cos l \tan A$$

which expresses the reduction in minutes of arc, h being the number of minutes of arc in the hour angle.

As an example of the use of this formula, take the observation given at the beginning of the Brent Tables.

Date, November 18, D.R. latitude 51° north, hour angle 0h. 24m. 54s., declination 19° 20′ 43″ south, and altitude 19° 29′ 18″. Required the true latitude.

From Burdwood's Azimuth Tables the bearing is found to be about 6° 15′, and we have

$$x = 186'{\cdot}75 \cos 51^\circ \tan 6^\circ 15' = 12' 48''$$

giving a latitude 50° 57′ 11″ north.

The result found in the book is 50° 57′ 10″ north.

To find the reduction by the Traverse Table we may proceed as follows:—With 187 as distance and 51° as course, we have d lat. 117′·7; with this as d lat. and 6° 15′ as course, we have in the departure column 12′·8, which agrees with the result found above.

A difficulty attending the above method is that the Burdwood Tables do not give the azimuths of bodies having an altitude greater than 60°, and are only calculated for bodies whose declinations do not exceed the maximum declination of the sun. However, this should hardly be sufficient to condemn the method, especially as the sun is the body most frequently observed.

It may be also of interest to notice an additional use of the Brent Tables. These are constructed on formula (1), Table III. giving the value of C for every degree of latitude from 0° to 70°, and of declination from 0° to 60°. Now (2) may be written in the form

$$2h = \frac{1}{C}\frac{dl}{dh}.$$

So that if we wish to find during what time observations may be taken so that an error dh in the estimated longitude will not produce more than an error dl in the latitude, we have, if t be expressed in time,

$$t = \frac{15}{C}\frac{dl}{dh}.$$

Thus in the above example, suppose it were required to find during what time observations should be taken, so that an error of a second of time in the estimated longitude would not produce more than an error of a second of arc in the latitude, we have

$$t = \frac{15}{1 \cdot 23} = 12\text{m. } 11\text{s.}$$

In cases where the latitude and declination are of the same name and do not differ by very much, this time is very small, but when of different names in high latitudes t is considerable.

J. WHITE.

H.M.S. *Hawke*, Mediterranean Squadron.

Magnetism of Rock Pinnacles.

OWING to my absence from home, I have only just seen the letters of the Rev. E. Hill, M.M.S., and James Heelis, in NATURE of August 2 and 9, on the above subject. The writers have apparently overlooked the very interesting report by Profs. Rücker and Thorpe, published in the Brit. Assoc. Report for 1889, p. 586, in which it is shown that "all the principal masses of basalt in the kingdom form centres of magnetic attraction," and that "the Malvern Hills, though composed of diorite in which magnetic polarity can barely be detected, produce deviations of twenty minutes of arc at a distance of one mile from their axis."

The mineral magnetite is an original constituent of basic igneous rocks; and, owing to the action of gravity on this heavy mineral whilst the magma which contained it was still in a fluid or plastic condition, or to some other cause, it has sometimes segregated into masses, or has become more or less concentrated, in certain parts of igneous rocks. Two very interesting papers on gabbros, in which remarkable concentrations of magnetite have been observed, have quite recently been read before the Geological Society—one by Sir Archibald Geikie and Mr. Teall, and the other by Mr. Alfred Harker—in which the concentration observed in these rocks is accounted for in different ways. Rocks in which a local concentration of magnetite has taken place must have a very powerful effect on the magnet even at a distance.

In addition to original magnetite, basic rocks, especially those of igneous origin, contain secondary magnetite, and magnetic pyrites, formed by aqueous and other agents, out of the unstable minerals of which the original rocks were built up. Serpentine, for instance, usually contains secondary magnetite formed out of the mineral olivine, one of the principal constituents of the peridotite from which serpentine was derived.

Owing to the presence of the above original and secondary minerals, small hand-specimens of ordinary igneous rocks—even those in which special segregation of magnetite has not taken place—will generally be found, when examined, to attract a magnet more or less powerfully.

A suitable instrument for testing hand-specimens may be formed by attaching a small horse-shoe magnet to one arm of a chemical balance. After the equilibrium of the balance has been restored, place the hand-specimen under the magnet and raise it carefully. The balance will dip unmistakably towards the specimen if it contains an appreciable amount of magnetite.

20 Nevern Square, S.W. C. A. MCMAHON.

Aurora.

IN Barrhead, Renfrewshire, on Friday (14th), at 9.15 p.m., I witnessed the finest aurora I have observed for years. The luminous arch extended from south-west to north-east, and shortly reached the zenith. The rapid fluctuations in the streamers were remarkable. There were no coloured bands. The moon, nearly full, was shining, rendering the appearance less vivid. In about fifteen minutes the auroral light began to wane.

Tynron, Dumfriesshire, September 18. J. SHAW.

BRIGHT PROJECTIONS ON MARS' TERMINATOR.

THE appearance of bright spots on the surface of Mars has been long familiar to observers of this planet. An idea of the ease with which they may be observed can be gathered from the following words of Schiaparelli, our highest authority on Martian questions.

"It would not be difficult to find a series of hypotheses which would explain satisfactorily the appearance of the polar and other white spots by attributing them in some way to the evaporation of the supposed seas, and to the atmosphere of the planet whose existence is indisputable. But I consider it more useful to point out that these different white spots are, of all the species of appearances on *Mars*, the easiest to observe. They require only an instrument of moderate power and a very persevering attention. The . . . . peculiarities concerning these spots show that they offer a field for the most interesting investigations, whose importance in the study of the physical constitution of Mars is obvious; and in this field useful work could be done by those observers who are not able to decipher the much more difficult details of the canals and their doubling."

Now the appearances of some of these spots in different positions on the planet's disc have been observed at times to undergo rapid changes in brightness, and it was, if we do not err, the distinguished observer just quoted who first pointed out the tendency of some of these bright regions to increase relatively in brightness as the terminator of the planet was approached.

Observations of more recent date than those just referred to, have, however, made us acquainted with other surface phenomena connected, perhaps, in some way with, but of more importance than, the bright spots, and these are the bright prominences or projections at the terminator.

It must be remembered, nevertheless, that bright projections may be of two kinds, optical and real.

The former is an effect of contrast. It may be brought about by the approach of a very bright spot to the terminator where the adjacent darkness tends to give it the appearance of a projection, or, in other words, it is the result of pure irradiation. As a somewhat parallel example may be mentioned the "drop" seen at the transits of Venus. That numbers of such spots have been seen at various times, can easily be shown by a brief examination of the records. Terby, for instance, in 1888, on several nights watched three such points, which, as they approached the western edge of the disc, became very bright, and before passing behind the planet, projected beyond the edge of the disc, as was the case with the polar cap. At Mount Hamilton, also, numerous similar observations at various times have been made.

The second kind of bright projection is that due to the physical peculiarities at the surface of the Martian globe itself, and may correspond to elevated highly illuminated regions. These were first observed at the Lick Observatory in 1890, at the Observatory at Nice, and at the Arequipa Observatory in 1892. The first prominences observed this year were seen on June 26 at Mount Hamilton, and since then have been more or less constantly watched.

To give the reader an idea of what actually is seen at the telescope when such a projection is under observation, an instance or two may not be out of place.

On July 5, 1890, at 10h. Pacific standard time, a sketch by Prof. J. E. Keeler, with the 36-inch, showed a narrow, elliptical, white spot from 1″·5 to 2″·0 long, projecting northward at a slight angle with the line of the terminator. Half an hour later the spot was within the disc, but still visible as an oval white patch on a darker background. The following day (8h. 3m.) Prof. Holden saw a projecting spot curved upwards and nearly meeting, and the smaller projecting spot some 2″ farther towards the south. The lower spot changed very considerably its shape during the time of observation, about an hour, and was observed to be always situated at the end of a long bright stripe of the surface of the planet which lies north of Deuteronilus.

A second case may be taken from the observations of Prof. Hussey and Campbell, made at the opposition of 1892, on July 11, with the Lick instrument. They record that a most striking one (prominence) was visible when the observations began at 12h. 15m., and remained constantly in view for about two hours. Its shape changed a great deal during that time. At 13h. 25m. it was unusually prominent, and its outer extremity was perceptibly bent upward toward the south polar cap. On July 13 these observations were duplicated; the southern one of the two projections presented the hooked or bent appearance most strongly at 14h. 35m., just as it was seen two nights earlier at 13h. 25m. Allowing for the longer rotation period of *Mars*, the same point on the planet was under observation on the two nights.

A somewhat indirect reference to these bright projections made by the Arequipa observers is included in the statement made by Prof. W. H. Pickering, that "clouds have on several occasions been observed to project beyond the terminator and also beyond the limit, thus confirming the observations made at the Lick Observatory."

Besides the above-mentioned observations, inserted to serve as samples of what has been seen, many more, by different observers, might be given, but they are all of the same type, and undoubtedly describe the same phenomena. One principal fact about them seems to be that although their shapes undergo distortions of all kinds, due to the different directions of the illuminating source, their mean positions seem to be at all times more or less constant.

As they appear beyond the terminator, not too far from it and within the limb, and are brilliantly illuminated, the natural conclusion to draw from these is that they must either be the tops of high mountains lighted up by the sun, or clouds at a high altitude in the Martian atmosphere, rendered bright by the same source. The latter suggestion, which, in the face of the most recent facts, does not seem to have much weight, was put forward by Prof. W. H. Pickering, and their height above the surface of Mars was measured to be at least twenty miles: more recent measures indicate that these estimates are far too high. That they may be, and most probably are, mountain tops, is the most general explanation; and Prof. Campbell,[1] whose opinion coincides with our own, says they are "due to mountain chains lying *across* the terminator of the planet, possibly covered with snow in some cases, and in others not necessarily so."

The reasoning he adopts may be summed up as follows: On July 11, 1892, the Earth was approximately 39,000,000 miles distant. With powers of 350 to 520 the equivalent distances were reduced to 110,000 and 75,000 miles respectively, distances equal to one-half and one-third of that of our Moon from us. Now if, with the *naked eye*, one can see at the terminator of our satellite bright projections at a distance of 240,000, surely projections, if any, at much lesser distances should be visible on the Martian disc.

If they be due to mountains, a small calculation has shown that they need be only of a moderate height, entirely comparable with those on the Earth and Moon. The figures computed to represent the height of the hills, satisfying the July observations, represented an altitude a little more than 1·89 miles.

A well-observed fact, which strengthens the mountain theory to a certain extent, is the presence of extremely brilliant star-like points which have appeared both on and off the snow-cap. If these are really mountain-tops, they should be always visible under suitable illumination, for when seen on a background of snow their height should enable them to catch all available light for reflection; and, secondly, when observed on darker surroundings (as when the snow serving as a background has melted), their height would still serve the same purpose, besides preserving for them their snow-capped peaks. The constancy in position of these spots shows that they are rigidly connected with the surface, and not due to the atmosphere, unless they be looked upon as stationary clouds or mists, which does not seem likely in the Martian atmosphere. Mr. Lowell this year has observed and measured some, the positions of which correspond with the measurements made by Green in 1877.

In Prof. Holden's mind the mountain theory seems to be thoroughly conclusive, for at Mount Hamilton, night after night, and even month after month, the prominences on the planet appear in the same longitudes and latitudes, insomuch that a map of some of the chains is in preparation.

The positions of these brilliant spots on the globe of Mars, just referred to, lie much nearer the South Pole than those which have appeared as projections. This shows that we must not look upon the Martian surface as very flat, but as one studded with hills and dales, if we have such indications of unevenness as we are led to believe.

It may be remarked here that at Mount Hamilton and at Nice no bright prominences have been seen outside the limb, the only observations of such a nature of which we are aware being those of Martian clouds at Arequipa, where, Prof. Pickering states, "clouds have on several occasions been observed to project beyond the terminator and also beyond the limb."

In considering the visibility of mountains at the terminator and at the limb, certain important points must, as Prof. Campbell says, be taken into account.

In the first place, to obtain the greatest "seeing effect" at the terminator, it is not so much the height of the mountain in question, but the length of its chain that is the chief function. On the other hand, a mountain at the limb is seen simply by virtue of its *height* above the general surface, the *length* of the chain in this case being entirely eliminated. It must not be forgotten, however, that we view Mars from the earth, and not from the sun. This fact, combined with the different positions of the planet's axis at the times of opposition periods, accounts for the innumerable ways under which mountain chains can be illuminated, rendering them sometimes visible and sometimes invisible, according to the conditions in vogue. For instance, in 1890 the mountainous part observed was in the region a little to the north of Tempe (lat. 40° N., long. 45°). In 1892 the projections were chiefly observed about the region of Noachis (lat. 30° to 50° S.), two small ones being remarked at 25° S. lat. At Nice projections were noticed in approximately the same position, and in addition at 30° S. lat. and 220° long. to the south of Hesperia.

Such, then, are some of the facts and deductions to which a discussion of the observations of these prominences, made up till now, has led us. There is, no

[1] "An Explanation of the Bright Projections observed on the Terminator of Mars," by W. W. Campbell. *P. Astronomical Society of the Pacific*, vol. vi. No. 35, p. 103.

doubt, much to be learnt before we can say with certainty that we are dealing with mountain ranges pure and simple; but, as Prof. Campbell says, this hypothesis is a good one to work upon. The explanation, which assumes the presence of clouds, does not, as previously hinted at, seem to be any longer tenable, for would not permanent clouds (as these must necessarily be) at a considerable height mean land at a high altitude, and therefore mountains?

Those making measures of the positions of projections on the Martian terminator may find the following method of procedure, recommended by Prof. Campbell, serviceable:—"Marth's valuable ephemeris of Mars gives the 'position angle of the greatest defect of illumination.' With the micrometer wires set to that position angle, place the fixed wire tangent to the upper limb and bisect the projection with the movable wire. Again, place the fixed wire tangent to the lower limb, and bisect the projection with the movable wire. The diameter of the planet should also be measured, without changing the position angle of the wires. Irradiation caused by the bright polar cap is liable to increase some of the distances measured, especially with small telescopes."

Before concluding this brief summary, a few words may be added with respect to a recent note which appeared in these columns (p. 319), entitled "A Strange Light on Mars." The note in question was based on a telegram issued by the International Bureau, and referred to an observation made at the Nice Observatory. The "strange light" alluded to was regarded by the writer as referring to something quite exceptional, and *not* to the well-known prominences which during 1892 were so often seen, and which during this present period of opposition have been observed and measured several weeks before the telegram was dispatched.

W. J. S. LOCKYER.

NOTES.

THE funeral of Prof. von Helmholtz took place on September 13, at Charlottenburg. Among the numerous tributes of admiration were magnificent wreaths from the German Emperor and the Empress Frederick, both of whom were represented at the ceremony. Most of the learned societies of the capital and many of the Universities and scientific bodies in other parts of the Empire also sent representatives. Among those present at the funeral were Baron von Marschall, the Secretary of State for Foreign Affairs, Count Eulenburg, Dr. Miquel, Dr. von Bötticher, Herr von Schelling, and Herr Thielen.

WE are glad to learn that the Technical Education Board have made a grant of £500 to Bedford College (for Women), to aid in the full equipment of the laboratories of that institution.

THE *Lancet* states that the trustees of the late Mr. Richard Berridge have, with the consent of the Attorney-General, now handed to the British Institute of Preventive Medicine the residue of the legacy, amounting to over £20,000, for the purpose of building and endowing a laboratory for the chemical and bacteriological examination of water-supply and the investigation of processes of sewage purification. The permanent laboratory is now in course of erection on the site secured by the Institute at Chelsea, but, pending its completion, a temporary laboratory has been fitted up in order that the work may be at once proceeded with. Mr. Joseph Lunt, formerly assistant to Sir Henry Roscoe, has been appointed by the Institute to carry on this work under the director's supervision. The Institute is now, the *Lancet* understands, prepared to undertake the bacteriological and chemical examination of any samples of water which may be submitted. In addition to this, the Institute will give expert assistance in the bacteriological or pathological diagnosis of any pathological material. The demand for this kind of work has greatly increased, so much so that, although Dr. Ruffer will still retain charge of this department, a specially trained bacteriologist has been appointed to work under his direction. Particulars may be obtained by writing to the director at the temporary offices of the Institute, 101 Great Russell Street, London, W.C.

ACCORDING to the *British Medical Journal*, a Clinical Research Association has been formed, under the patronage of Sir James Paget, Dr. Wilks, Mr. Jonathan Hutchinson, Sir W. H. Broadbent, Sir George Humphrey, Dr. Clifford Allbutt, and others, with the object of assisting medical practitioners in the investigation and treatment of disease by furnishing trustworthy reports upon excretions, tumours, and other morbid products. A laboratory has been fitted up, and will be under the direction of Dr. J. Galloway and Messrs. J. H. Targett and F. G. Hopkins. Further particulars of the Association can be obtained from the secretary, Mr. C. H. Wells, 5 Denman Street, S.E.

A MEDICAL School for Women is to be established by the Russian Government at St. Petersburg. This step, which is said to be due to the influence of Prince Wolkowski, acquires additional importance from the fact that only a few years ago the Ministry of Instruction was strongly opposed to every movement favourable to the higher education of women. The fate of the new institution will, we hope, be happier than that of the one established by Prof. Gerie, which was closed in 1884.

AN international Congress of Chemistry and Microscopy will be held in Vienna during the last week of the present month. Dr. E. Ludwig is the president of the committee of arrangements, and the secretary is Dr. Hans Heger, I. Kolowrating, Pestalozzigasse 6, Vienna.

WE notice that in the Universal Exhibition to be held in Paris in 1900, there are to be sections devoted to hygiene, military and naval hygiene, and medicine and surgery.

INFORMATION has been received respecting an Exhibition of Industry which is to be held at Kioto from April 1 to July 31, 1895. The exhibition is the fourth of the kind organised by the Japanese Government, and will be divided into classes under the following heads:—Manufactures, Fine Arts, Agriculture, Waste Products, Education, Mines and Mining, and Machinery.

WE have on several occasions referred to the great landslip at Gohna, and on July 5 printed an illustrated abstract of the report upon it by Mr. T. H. Holland. The dam, as readers of our notes for August 30 are aware, burst on August 26, and, as a consequence, very considerable destruction of property ensued. Further information respecting the occurrence has now reached England, and the *Times* of Saturday last published the following interesting details received from a correspondent:—"On August 24, at 8 o'clock in the morning, an automatic bell, placed within a foot of the top of the dam, sounded the first note of alarm. The warning was communicated throughout the whole of the threatened territory almost instantaneously by means of telegraphic messages, bonfires, rockets, the beating of drums, and other signals, and the people immediately fled, with all their cattle and personal belongings, into the hills. In this way ample warning was given and the apprehended loss of life averted. Three hours after the first signal the water reached the lowest point of the ridge, and the officials thought it expedient to block the passage through which the torrent would first escape, so that the lake should not overflow before 7 o'clock on the morning of the 25th. Warning telegrams were despatched along the valley. The weather was very unfavourable for observation, a heavy mist obscuring the landscape. Signs of collapse were visible at 8 o'clock in the evening, and shortly before midnight the dam burst. A flood 30 feet high, sweeping onward with irresistible force, reached Chamoli, half-way between Gohna and Srinagar, at half-past 12 on the 26th. At 1 in the morning there was another tremendous rush of water, which descended with an awful roar; but nothing was visible owing to the constantly thickening mist. The flood travelled at an average rate of twenty-four miles an hour all down the valley, rising in places to a height of 200 feet. At Chamoli it rose to a height of 160 feet, destroying the bazaars and the hospital. At Srinagar the devastation was even more widespread. The flood reached Hardwar at 9 o'clock on Sunday, and by noon the river had risen 12 feet. It presented a magnificent spectacle, and the view from the surrounding heights was at once grand and terrible. At Hardwar all Government buildings, with the exception of the telegraph office, were destroyed. The whole lake was discharged in about two hours."

AT the August meeting of the Calcutta Microscopical Society, the retirement of Dr. William King from the Geological Survey of India was referred to, and a brief notice of his work in India, and especially in connection with the Society, was read. We take the following information from a report in the *Englishman*:—Dr. King joined the Geological Survey in Calcutta under its first Director, Dr. T. Oldham, in March 1857. In May of that year, a memorable month in Indian history for its connection with the mutiny of the Native Army, he went to Madras with the first survey party for that Presidency, under Mr. H. F. Blanford. Dr. King continued in Southern India for over twenty-five years, with only occasional visits to headquarters in Calcutta; and during that period he took part in the surveys of, or himself surveyed, the districts of the Coromandel and part of the Northern Sircars, working chiefly at the Crystalline, Transition, Vindhian, Gondwana, and Cretaceous formations of Peninsular India. In 1870 he became Superintendent of the Madras Survey Party, and the latter years of his work in Madras were spent in connecting the coastal Gondwanas of Nellore and the Godaveri District with the coal-bearing division of the series in the Central Provinces, by the Godaveri Valley and Western Hyderabad. After this Dr. King's labours lay in the Central Provinces, where in his progress over the Mandla and Bhundara districts, and eventually over the whole of Chattisgarh, he connected most of the rock formations of Southern India with those of the Central Provinces and Central India, up to the western frontiers of Chota Nagpur. In 1887 he became Director of the Geological Survey of India. During the period of his directorship the geology of the north-west frontier (particularly in Beluchistan and in the Salt Range) and of Burma, was considerably advanced in respect to the extent of area mapped, and its correlation with European and Europo-Asian geology. The mineral development of those regions in the way of coal, oil, and tin was also greatly advanced during the same period. Dr. King is the author of four memoirs on the geology of districts in the Madras Presidency, and of more than twenty reviews on the geology, or mineral condition, of other tracts. Dr. Simpson has been appointed President of the Microscopical Society of Calcutta, in the place of Dr. King.

THE Pilot Chart of the North Atlantic Ocean for September shows the remarkable drift of the derelict *Fannie E. Wolston*. On October 16, 1891, the vessel became a derelict not far distant from Cape Hatteras, and on June 13, 1892, was reported in 39° west longitude, from which position, after a number of irregular gyrations, she drifted back to about longitude 75° west by the end of January last, and on August 6 was again sighted in latitude 34° N. and 67° W. This vessel has thus been a derelict for over 1000 days, during which time she has drifted about 8600 miles. The American Hydrographer points out that the dangerous character of these derelicts is illustrated by the fact that during a period of seven years there have been forty-five collisions with them, which caused the total loss of nine vessels. The United States Government has employed the steamship *San Francisco* in destroying these obstructions, and during the above period sixty-nine have been burnt, and one blown up by torpedoes. The efficacy of destroying derelicts by fire is thus illustrated.

THE Italian Meteorological Office has published part 1 of its *Annali* for the year 1893, showing the work done in various departments of the service. Special studies of the behaviour of thunderstorms are carried on in the interest of agriculture, with the view of establishing for each province, and for each week of the year, the mean number of storms, distinguishing those which were accompanied with rain or hail, attention also being paid to the size of the hailstones. A list of all hailstorms which have occurred during a period of fifteen years is being prepared. The volume contains several discussions of earthquake shocks, especially those which occurred in Zante, in 1893. A new seismograph has been erected at the Collegio Romano, provided with a long and heavy pendulum, which registers shocks that occur at great distances. This instrument, which was devised by Dr. Agamennone, has worked so well that others are to be established in various parts of the kingdom. The department of terrestrial magnetism has been occupied with the preparation of a series of magnetic charts, and an account is given of some modifications and improvements made in a small portable magnetometer, for the study of local magnetic disturbances.

AN interesting paper on the temperature variation in the electrical resistance of some organic bodies (esters of the fatty acids), by Prof. A. Bartoli, is published in the *Proceedings* of the Reale Istituto Lombardo di Scienze e Lettere. The liquids examined were in most cases obtained from Kahlbaum, and the author gives their boiling point. The conclusions to which the author has come are as follows:—(1) In a series o esters derived from a given alcoholic radicle with different acids of the fatty series the conductivity, both at ordinary temperatures and at the boiling point, decreases with increase in the complexity of the constitution of the body. In addition, the alcoholic radicle affects the conductivity, which diminishes with increased complexity; thus, while methyl valerate conducts to a fair extent, amyl valerate is an insulator. (2) In general the conductivity of these esters increases with increase of temperature, the rate of change with temperature being smaller for those having a more complex composition than for those with a simpler formula. Thus, while the rate of change is considerable for amyl valerate, amyl butyrate, and isobutyl valerate, it is small in the case of methyl formate, methyl acetate, and ethyl formate. (3) Of the sixty different bodies experimented upon, one sample of ethyl acetate had a conductivity which decreased with increase of temperature; another sample of the same body, however, which the author considers to be purer, gave an increasing conductivity. A sample of isobutyl acetate also gave a negative rate of variation with temperature. These anomalous results the author considers to be due to the presence in the samples of a small quantity of one of the alcohols. (4) The addition of from 1 to 20 per cent. of any alcohol to any of the esters experimented upon, gives a solution of which the variation of the conductivity with temperature is negative, while the addition of a phenol, a ketone, an aniline, or a paraldehyde of any acid, gives a solution whose resistance increases with rise of temperature.

IN a paper contributed to the *Archives Néerlandaises*, M.P. Zeeman gives an account of the observations he has made of the Kerr phenomenon on the reflection from surfaces of iron, cobalt, and nickel in a magnetic field. The author has continued the experiments commenced by M. Sissingh, using a slightly modified form of apparatus. He finds that the difference between the observed and calculated phases (obtained from Lorentz's formulæ) is practically constant for radiation of all wave-lengths, and is equal to 80° in the case of iron. Similar results were obtained with nickel and cobalt. In the case of these two metals the author, after attempting to obtain suitable mirrors by the deposit of the metal on polished iron, or by electrolysis, was obliged to have plane faces cut on blocks of the pure metal, which when polished formed good mirrors.

THE specific heat of gases at constant pressure has been investigated by Dr. Silvio Lussana, by means of a new and ingenious apparatus. The contrivance, as described in the *Nuovo Cimento*, is intended to overcome the difficulty of providing a sufficient quantity of gas to experiment upon. With the resources of an ordinary physical laboratory it is difficult to obtain a pure gas in sufficient quantity to make an impression upon the calorimeter, so Dr. Lussana decided to use the same quantity over and over again. Two substantial iron tubes were placed vertically, and communicated at the bottom by means of an india-rubber tube strengthened with five layers of canvas. They were partly filled with mercury, and by elevating or lowering one of them the mercury could be made to completely fill the one or the other. When one tube was full of mercury, the other was filled with the gas to be investigated, and the amount of gas which filled the tube could be driven out and through the calorimeter by lowering the tube. The gas was then made to pass through an india-rubber tube leading to a brass worm immersed in a heating bath, and another immersed in water, which constituted the calorimeter. It then passed through a small subsidiary worm, to test whether it had lost all the heat acquired, and finally entered the other iron tube which was being emptied of mercury. By means of a short circuit provided with a valve, the gas and the mercury in the two iron tubes could be exchanged, and the same process repeated. The water equivalent of the calorimeter was determined experimentally by sending a measured quantity of hot water through it. To ensure constancy of pressure, the level of the mercury was always adjusted to the same fiducial mark on a short length of glass tubing introduced in the india-rubber tube. The gas was introduced by a Natterer compression pump. Seeing that pressures were employed up to forty atmospheres, special care had to be bestowed upon stop-cocks and junctions, some of which were constructed in a novel manner. The results of the measurements, which promise to be of great interest, will shortly be published.

THE May number of the *Transactions of the North of England Institute of Technical Brewing*, a copy of which has been sent to us, contains an interesting and very useful paper by Mr. Fellowes, on "Some of the micro-organisms causing the diseases of beer." Mention is made of the important services rendered by Pasteur, Hansen, Van Laer, Lindner and others to this subject, and we are introduced to quite a number of microbic foes with all of which the brewer has to wage war. The cause of viscosity in beers has recently been elaborately studied by Van Laer, who has isolated certain micro-organisms which he has classed together under the name of *Bacillus viscosus*. When these organisms are introduced into sterilised wort along with pure yeast, the liquid is rendered more or less ropy, the degree of viscosity depending upon the proportion in which the disease organism is introduced. Curiously, however, although the *Bacillus viscosus* behaves in this characteristic manner in the case of Belgian beers, so far, similar results have not been obtained with it when subjected to the English system of fermentation. Mr. Fellowes has himself isolated various organisms present in samples of viscid beer, but has not been able to obtain with such pure cultures or individual varieties a viscosity equal to that of the sample from which they were originally derived. He suggests that the cause of this failure may be sought in the probable modifications induced in the physiological character of the micro-organisms during the process of isolation by means of gelatine cultures. In support of this supposition he refers to Prof. Percy Frankland's investigations on the fermentation of calcium citrate by means of a particular bacillus, which although in the habit of fermenting this substance, for years past absolutely refused to do so when introduced into calcium citrate solutions direct from gelatine cultures. Mr. Fellowes is of opinion that the viscosity in English beers may be due to the associated action of various micro-organisms present, their activity depending not only on the particular varieties, but also on the relative numerical strength in which they are present. It is obvious that to obtain such particular conditions artificially is by no means an easy task, but there can be no doubt that a wide field for research on the question of symbiotic fermentation, or the associated life of micro-organisms, remains yet to be explored.

The *Berichte der Deutschen Botanischen Gesellschaft*, vol. xii. part 5, contains a paper, by J. E. Humphrey, on nucleoli and centrosomes. The author favours the theory that the nucleolus is not a definite organ of the nucleus, but regards it, with Strasburger and Guignard, as a reserve material of the nucleus. In this connection he examined the nuclei of the sporangia of *Psilotum triquetrum*, in which Karsten considers that the centrosomes of the dividing nuclei arise from the nucleoli, and after division are re-included in the daughter nuclei. His observations, however, lead him to the conclusion that the nucleoli and centrosomes are completely distinct from one another, and that the latter are altogether extra-nuclear. Another interesting result, which he obtained in the course of his observations, is that the body, which is often found in connection with the nuclei of the pollen-sac, and which has been called the "paranucleolus," is probably not a natural structure, but is formed during the process of fixing the material in which it is found, as it was seen regularly on that side of the nuclei which was the last to be reached by the fixing fluid.

NATURALISTS may sometimes have wondered that a region so classical in the annals of marine biology as the neighbourhood of St. Vaast-la-Hougue was not earlier made the site of one of those marine laboratories which our neighbours across the Channel conduct with such efficiency and economy. For some years past, however, the Museum of Natural History of Paris has been engaged in altering and refitting the extensive buildings of an ancient *lazaret* on the island of Tatihou to this end, and at the first September meeting of the Academy of Sciences M. Edmond Perrier was able to report the practical completion of the laboratory. A circulation of sea-water has been fitted up throughout the laboratories and tank-rooms, and marine animals of all kinds live perfectly within the aquaria. M. Malard-Duméril, the naturalist in charge, and his staff reside permanently upon the spot, and there is full accommodation for eighteen additional naturalists. The work of the new laboratory is not, however, to be limited to the promotion of pure scientific research, but, if the hopes of its founders are realised, will also include operations on a practical scale in marine pisciculture.

ON the title-page to the second edition of the "Manual of the Geology of India," recently noticed in NATURE, the name of the author of that edition alone appears. The Government of India, on this circumstance being brought to their notice, have ordered the title-page in question to be cancelled, and a revised title-page, with the names of the original authors of the work inserted, to be substituted.

WE are informed that Mr. J. Nisbet, some of whose books on Forestry were recently reviewed in these columns, has undertaken to contribute a series of short articles on "Birds in Relation to Forestry" to the Natural History Department of the *Yorkshire Weekly Post*.

THE syllabus of the Manchester Municipal Technical School and Municipal School of Art, for the session 1894–5, has just been issued, and may be obtained from the director and secretary, or the Guardian Printing Works, Manchester. Attention is drawn to several new subjects and courses of instruction, among which we may mention—honours classes in theoretical mechanics, applied mechanics and steam, a course of lectures in hygiene, and special courses in magnetism and electricity for telegraph employés.

THE fifth annual report of the Missouri Botanical Garden, covering the year 1893, has just come to hand, and forms a handsome volume. The year under review seems to have been a very satisfactory one for the garden, both from a financial and scientific standpoint. In addition to the reports of the officers of the Board and of the director, the volume contains several scientific papers, some of which are illustrated; there are also several well-executed process illustrations of objects of interest in the garden.

WE learn from the abstract of the *Proceedings* of the Linnean Society of New York for the year ending March 27, 1894, that at the annual meeting, held on the date mentioned, there were 136 resident and 35 corresponding members. At the beginning of the year the society had on its roll 37 resident and 37 corresponding members. During the year 29 papers were read, and 214 publications were added to the library.

MESSRS. J. AND A. CHURCHILL have sent us the new edition —the third—of the translation, by T. H. Waller and H. R. Procter, of Kohlrausch's "An Introduction to Physical Measurements." The present edition is translated from the seventh German edition, and contains nearly four times the number of pages than the first German edition, which appeared in 1869. The tables have been corrected to the present state of knowledge, and a good deal of new matter has been embodied in them.

A MAGAZINE entitled the *American Historical Register* has been started this month in Philadelphia, the special mission of which is to form the medium of inquiry and communication between the members of various American patriotic associations, to chronicle their proceedings, and to preserve in its pages matters of historical value and of personal interest to their members; it bears, therefore, the sub-title of "Monthly Gazette of the Patriotic-Hereditary Societies of the United States of America." The magazine is tastefully printed on good paper, and several successful process illustrations grace its pages.

THE *Journal* of the Royal Horticultural Society dated August has just reached us, and contains, in addition to the usual extracts from the *Proceedings* of the Society, the following papers:—"The Cedar of Goa," by Dr. M. T. Masters, F.R.S.; "The Deciduous Trees and Shrubs of Japan," by James H Veitch; "Rare Trees and Shrubs in the Arnold Arboretum," by Maurice de Vilmorin; "Hybrid Narcissi," by the Rev. G. H. Englehear.; "Botanical Exploration in Borneo," by F. W. Burbidge; "Flowering Trees and Shrubs," by George Nicholson.

MESSRS. DULAU AND CO. have issued part xxxiv. of their catalogue of zoological and palæontological works, containing descriptions of the books on mammalia offered for sale by them.

WE have received from Dr. F. Krantz, Rhenish Mineral Office, Bonn-on-the-Rhine, a catalogue of minerals, and plates of minerals for exhibiting optical phenomena, which he has for sale.

THE additions to the Zoological Society's Gardens during the past week include a Common Marmoset (*Hapale jacchus*) from South-east Brazil, presented by Mr. J. C. Alleyne; a Boschbok (*Tragelaphus sylvaticus*, ♀) from South Africa, presented by Mr. J. E. Matcham; a Silver Pheasant (*Euplocamus nycthemerus*, ♀) from China, presented by Mr. Thomas Harris; a Larger Hill-Mynah (*Gracula intermedia*) from India, presented by Mr. Charles E. Brooke; a Cape Bucephalus (*Bucephalus capensis*) from South Africa, presented by Mr. A. W. Arrowsmith; a Common Chameleon (*Chamæleon vulgaris*) from North Africa, presented by Mr. G. T. Elphick; a Slowworm (*Anguis fragilis*), British, presented by Mr. G. H. Morton Middleton; a Malbrouck Monkey (*Cercopithecus cynosurus*, ♀) from West Africa, a Blue-fronted Amazon (*Chrysotis æstiva*), from South America, twenty Painted Terrapins (*Clemmys picta*) five Stink-pot Terrapins (*Aromochelys odorata*), an American Box Tortoise (*Terrapene carinata*) from North America, deposited; a —— Hedgehog (*Erinaceus*, sp. inc.) from India, a Mitred Guinea Fowl (*Numida mitrata*) from Madagascar, a Bull Frog (*Rana catesbiana*) from North America, purchased.

OUR ASTRONOMICAL COLUMN.

THE SEMI-ANNUAL VARIATION OF METEORS.—"It is a saying of Arago," wrote Prof. A. S. Herschel thirty years ago, "founded upon observation and confirmed by constant experience in later years, that the Earth encounters more shooting stars in going from aphelion to perihelion than in going from perihelion to aphelion." The fact of this semi-annual variation in the number of meteors has since been confirmed by many observers, and has also furnished a subject for much discussion. Mr. G. C. Bompas summarises the state of knowledge on the matter in the current number of the *Monthly Notices* of the R.A.S., and criticises the explanation believed to account for the facts of observation. The theory accepted by most observers is that the semi-annual variation referred to is due to the planetary motion of the Earth, just as the horary variation is due to the Earth's rotation. It will at once be seen that observations in the southern hemisphere supply a test of the validity of this explanation; for the greater number of meteors should appear in the southern hemisphere from January to June in each year—that is, when that hemisphere is in front of the Earth's orbital motion. From June to December, when the northern hemisphere is in front, we encounter a larger number of meteors than during the first half of the year. There can be no doubt that the change in the position of the Earth's axis relatively to her motion does really tend to increase the number of shooting stars seen in the second half of the year in the northern hemisphere, but Mr. Bompas thinks that this cause is insufficient to account for the very large increase observed, viz. from two to three times the number observed in the first half of the year. He has examined the meteor observations made by Dr. Neumayer at the Melbourne Observatory from 1858 to 1863, and he finds that the variation is not reversed, but follows the same law as in the northern hemisphere, the hourly number of meteors seen in the second half of the year exceeding the number seen in the first half. It seems, therefore, that some cause further than that hitherto assigned must help in producing the semi-annual variation of meteors. The whole discussion leads Mr. Bompas to submit: (1) That the explanation hitherto adopted of the semi-annual variation of meteors is inadequate; (2) that the variation is connected with and mainly due to the cosmical motion of the solar system; (3) that it renders highly probable the cosmical origin and motion of meteors.

GEOLOGIES AND DELUGES.[1]

IN the days when geology was young, now some two hundred years ago, it found a careful foster-mother in theology, who watched over its early growth with anxious solicitude, and stored its receptive mind with the most beautiful stories, which the young science never tired of transforming into curious fancies of its own, which it usually styled "theories of the earth."

Of these, one of the most famous in its day and generation was that of Thomas Burnett, published in 1684, in a work of great learning and eloquence. Samuel Pepys, of diary-fame, is said to have found great delight in it, and it is still possible to turn to it with interest when jaded with the more romantic fiction of our own day.

It was the fashion to commence these theories with chaos, and chaos, according to Burnett, was a disorderly mixture of particles of earth, air, and water, floating in space; it was without form, yet not without a centre, a centre indeed of gravity, towards which the scattered particles began to fall, but the grosser, on account of "their more lumpish nature," fell more quickly than the rest, and reaching the centre first accumulated about it in a growing heap, a heap, as we might now express it, of fallen meteorites; the lighter particles, which form fluids, followed the heavier in their descent, and collected around the solid kernel to form a deep ocean. This was at first a kind of emulsion, like milk, formed of oily and watery particles commingled, and just as in the case of milk, there separated on standing, a thick creamy upper layer, which floated on the "skim-milk" below. That this really happened, the good Burnett bravely remarks, "we cannot doubt." The finest dust of chaos was the last to fall, and it did not descend till the cream had risen; with which it mingled to form, under the heat of the sun, the earth's first crust, an excellent but fragile pastry, consisting of fine earth mixed with a benign juice, which formed a fertile nidus for the origin of living things. Outside nothing now was left, but the lightest and most active particles of all, and these "flying ever on the wing, play in the open spaces" about the earth, and constitute the atmosphere of air.

Such was the earth when first it formed the abode of unfallen man—perfect in form and beauty, for it was a true sphere, smooth as an egg; undisfigured by mountains, and unwasted by the sea. It was unfortunately but too like an egg, since its fragile shell rested on the treacherous waters of the interior abyss, "the waters under the earth," and the sun over-roasting, finally cracked and burst it; the broken fragments of the ruined world fell downwards into the abyss, and the subterranean waters rushed out in a mighty flood to remain as our present seas and oceans, from which the broken crust protrudes as continents and islands. As might naturally be anticipated, the bursting out of the abyss corresponds to the Noachian deluge, which we thus perceive to have been profounder in its origin and wider reaching in its effects than we might previously have supposed. This, for distinction, we may call Burnett's deluge; of his geology we may say that it is cosmological, since it endeavours to trace the history of the earth backwards to its origin in chaos; that it is catastrophic, because it attempts to account for all the great features of the earth by a single event which occurred suddenly and with violence; and that it is theologic, since it owes its inspiration to Holy Writ.

As geology grew older it went to school: what was the name of the school is not quite certain; some have called it "Science falsely so called," others, more briefly, "Inductive Science." However this may be, the immediate effect on the manners of young geology was very distressing. It grew contradictory, and was frank in the expression of obnoxious opinions. One of its most irritating remarks was that the world was not made in a week, and it would appear that at this time the relations of child and foster-parent became not a little strained. Still geology proved an apt scholar, and its progress was rapid. One of the most important lessons it learnt was that if we want to know how the world was made, the first essential is to study the earth itself, to investigate with patient drudgery every detail that it presents, and particularly the structures that can be seen in river-banks, sea-cliffs, quarries, pits, and mines. Thus it discovered that the solid land beneath our feet is to a large extent composed of layers of sediment which were once deposited more or less quietly at the bottom of ancient seas, and certain curious bodies known as fossils, it concluded to be the remains of plants and animals, sea-shells and the like, which were once the living denizens of these seas.

It discovered that these deposits lie so regularly one upon another, that it compared them to a pile of books, or to a slanting row of books lying cover to cover; and that in some cases, at least, the simile was not strained, will appear if we trace the structure of England from Oxford westwards towards Bristol. We then find that the thick bed of clay upon which Oxford stands, lies evenly on a series of gently sloping beds known as the lower Oolites; these in like manner repose on those thin seams of limestone and clay called the Lias, and these in their turn upon the red beds of the Trias. It might perhaps have been expected that this uniform arrangement would continue through the whole thickness of the stratified rocks, but it was discovered, and the importance of the discovery was recognised so early as 1670 by Bishop Steno, a man of great genius, that the regularity of the succession is liable to interruption at intervals. Thus as we approach Bristol, we encounter those beds of limestone which are associated with our coal-bearing strata, and which are consequently called "carboniferous"; but these are by no means related to the beds we have just passed over in the same manner as they are to one another—we do not find the highest bed of the carboniferous series offering its upper surface as a gently sloping platform on which the trias may rest; on the contrary, the carboniferous beds are seen to lie in great rolling folds, with the tops of the rising folds absent, as it were sliced off, and it is on the edges not on the surface of these beds that the red trias layers are seen to be spread out. This sudden change in disposition may well be called a break in the succession of the rocks, and, as if to emphasise it and compel attention to it, we find it accompanied by a complete change in the character of the fossils, those occurring in the carboniferous rocks being of entirely different kinds to those which are found in the overlying beds.

Evidently the carboniferous beds could not have been laid down in the sea in the steeply folded form they now present, at first they must have been spread out in nearly horizontal layers, and the folded form must have been subsequently impressed upon them, no doubt by the action of some stupendously powerful force. Subsequent also must have been the removal of the upper parts of the folds and the general planing down which they appear to have undergone.

To the young geology all this might seem perfectly clear, but in its impulsive explanations it assumed that nature must have frequently acted in a great and terrible hurry: thus the folding of the rocks was supposed to have been produced suddenly and violently by a single mighty convulsion, which simultaneously changed sea-floors into mountain chains, split open the land in wide gaping chasms—our present river valleys—and with the same blow destroyed every living inhabitant in the world.

But the discordance between two sets of rocks is met with not once only, but several times, in the stratified rocks of the earth's crust, and for every discordance there must have occurred a corresponding catastrophe.

These catastrophes were as wonderful as Burnett's, and there were more of them, so that at this stage of its existence geology was appropriately designated "catastrophic." It had completely severed the apron-strings, and ceased to be theologic, but it still to its credit remained cosmologic. It traced the earth from chaos up to a stage when islands and continents rose out of a primeval ocean, the waters of which were boiling; saw it peopled with strange and various forms of life, and watched it run its course, rejoicing in the sun, "chearfull, fresh, and full of joyaunce glad," then pictured it overtaken with disasters, shaken with earthquakes, overwhelmed by floods, and agonising in the labours of a new birth. Calm followed after storm, and life rejoiced afresh in a remade world to be again destroyed. Thus, through alternations of peace and strife, the earth moved on its changeful way, to the crowning creation of man, who was himself a living witness of the last great catastrophe of all, the Noachian deluge. Its waters covered the whole earth, to the tops of the highest mountains under heaven, and on their retreat they left behind, as a standing witness to their extension, great sheets of sediment, supposed to be spread out over the entire surface of the globe, and appropriately named the "diluvium." The diluvium may be seen in most parts of the British Isles, except in the south of England; it consists of clays and sands, containing vast numbers of curiously scratched stones.

[1] British Association Address to working men, by Prof. Sollas, F.R.S.

As the powers of geology matured it became increasingly able to dispense with catastrophes. The very diluvium itself was shown to be local in its distribution, and glacial in its origin; masses of moving ice, like that which buries the greater part of Greenland out of sight, covered a large part of the temperate regions, and this it was that produced the curious scratched stones and the deposits containing them, which are consequently no longer called "diluvial" but "glacial." More important yet, land could be shown to be still actually rising from the sea, and mountains growing into the air, but so slowly that the fact was not established without much dispute, which is hardly yet over. Valleys could be shown to result, not from any bodily fracturing of the land, but from the slow wearing action of the rivers which flow through them, and the waves of the sea were shown to be capable of cutting down cliffs and of reducing the land to a plain.

From these facts the discordance in the succession of stratified rocks found an easy solution. Recurring to the instance of the carboniferous rocks and their relations to the trias, we no longer need suppose that the stupendous force which folded the carboniferous rocks and raised them into the air, acted suddenly or even very rapidly; judging from the rate at which mountains rise now, their upheaval may have proceeded slowly; a few feet in a century would suffice. If we allow but one foot in a century, it would only require two millions of years to produce a mountain range 20,000 feet in height. The movement might naturally be expected to be accompanied by earthquakes, but there is nothing to lead us to suppose that these would be on a much grander scale than those of the present. During its slow elevation, the mountain range would be exposed to wind and weather, rain and rivers would carve it out into ridges and valleys, and frost would splinter its peaks into spires and pinnacles. Subsequently it would sink beneath the sea, and the waves of the sea, as they battered down its cliffs, would remove the last remnants which had escaped the rain and rivers, and roll over an unbroken plain. On this plain, as it continued slowly to subside beneath the sea, the immense deposits of the trias, lias, lower oolites, and Oxford clay would be piled up.

If the rise of the sea-floor into the Bristol Alps took place slowly, and involved a great lapse of time, so equally did the sinking of the land to form the sea-floor afresh, and in this long interval time was afforded for great changes in the organic world; and thus we reach an explanation of the great and striking differences which distinguish the fossils of the carboniferous rocks from those of later date.

There is no insuperable difficulty in this explanation; its great merit lies in its accordance with the course of nature as we observe it at the present day; and henceforward it became the motto of geology that the processes of the present furnish the key to the interpretation of the past. The changes in which the life of the earth is manifest are not only slow and gradual now, but they have ever been the same. The earthquakes, which in ancient times shook the land, were no more violent than those of which we have lately read in the daily newspapers; the ancient volcanoes were not more terrible in their outbursts than Krakatoa; floods were not more appalling than those which still from time to time sweep away tens or even hundreds of thousands of human beings from the Ganges Plain, and the earth, instead of falling into convulsions every now and then, proceeds on the even tenour of her way, without haste and without rest, preserving a uniformity in her progress which impresses us with its solemn grandeur, but which sometimes seems a trifle monotonous. From its belief that an unbroken uniformity in the operations of nature extends from the present into the most remote past, geology now came to be called "uniformitarian." It was no longer theologic, no longer catastrophic, and, I am sorry to add, no longer cosmologic. It persistently refused to inquire into the early history of our planet, and restricting its study to the accessible parts of the earth's crust, it abdicated its regal position as the science of the earth, and became as it were a mere petty chieftain, dealing only with rocks and the fossils they contain; the fossils, by the way, not rightly belonging to its province at all. And it was because it passed from being a science of the earth to become a mere study of rocks and fossils, that Hutton was able to make his famous declaration that as a result of his inquiries into the system of nature he could discover "no vestige of a beginning, no prospect of an end." Apart from this, however, and in its self-limited career, geology pursued a luminous advance, and as it did so the Noachian deluge began to sink into an oblivion which it might be thought to have scarcely merited. For if the biblical account is to be taken literally, it furnishes us with a catastrophe of the first order, and since it is said to have occurred comparatively recently, or at least in historic time, the uniformitarian, by his own principles, would have been compelled to infer, as the catastrophist had done, that such deluges form a part of the orderly scheme of the world. The universality of the deluge had, however, for various reasons, been denied, not only by geologists, but by writers of other schools of thought, and towards the middle of the century, belief in it amongst the learned was gradually expiring; such a number and variety of convincing arguments as converged against it could indeed but lead to that result; and that the deluge, so far from being universal, was a local, and very local phenomenon, became an article of belief, so settled amongst all good geologists—and I think I may add theologists—that it may be said to have finally fallen into the deep slumber of a decided opinion, from which I for one have no desire to arouse it.

Thus the deluge, so far from shaking the uniformitarian position, was rather itself submerged by uniformitarian views, and growing geology was in danger of taking the uniformitarian formula for an infallible dogma. It was saved from this by physics, a clever brother of its own, which had now discovered the famous principle of the "conservation of energy," and another equally famous, "the dissipation of energy." From these it was deducible that the duration of the earth as a living planet must be strictly limited in time. It must have had a beginning, and at the beginning was furnished with a store of energy, which it has ever since been spending. In this spending of energy its life consists, and when the store is at length exhausted its life will cease, and it will become numbered amongst the dead planets.

A good deal of this uniformitarian geology might perhaps itself have guessed, had it extended its views beyond rocks and fossils to the stars and other shining bodies which people the vast realms of space. The present then, strange to say, will still afford a key to the past. We have but to turn to the sun, our nearest luminary, though still more than ninety millions of miles away from us, and in that great orb we find much to suggest the state of our planet some ninety millions of years ago or more. It is scarcely necessary to remind you of the fact that the sun is a body so hot that the most refractory substances known to us on the earth exist in it in a state of gas or vapour; tongues of glowing gas shoot from it like flames; the clouds which emit its brilliant light are probably clouds of carbon or silicon, which have momentarily condensed from a gaseous state; and rain, if rain ever occurs, must be a rain of molten metals, such as iron, which will be dissipated in gas before it has fallen very far.

If we proceed to the more remote nebulæ, largely composed of glowing masses of gas, we find a suggestion of a stage more embryonic still, when the earth had as yet no separate existence, but formed, with its sister planets and the sun, a single shining cloud. On the other hand, if we turn our gaze on our nearest relative—offspring possibly—that dead planet, the moon, we may read in its pallid disc the sad reminder, "Such as I am, you, too, some day will be."

But this was not all that was contained in the admonition of physics; it showed not only that the earth is mortal, but that its span of life, as measured in years, or millions of years, is brief compared to the almost unlimited periods which geology had been in the habit of postulating. If catastrophic geology had at times pushed nature to almost indecent extremes of haste, uniformitarian geology, on the other hand, had erred in the opposite direction, and pictured nature when she was "young and wantoned in her prime," as moving with the tame sedateness of advanced middle age. It became necessary, therefore, as Dr. Haughton expresses it, "to hurry up the phenomena."

With its uniformitarianism thus moderated, geology has again become cosmologic, and neglecting no study that can throw light on any question connected with our planet, has regained its position as the science of the earth: it is henceforth known as evolutional geology.

The change has not taken place without occasional relapses into catastrophism. Some indications of this can, I fancy, be perceived in the writings of that eminently great geologist Suess, who, amongst other suggestions savouring of heresy, has lately recalled attention to the "Deluge," and endeavoured to show that though certainly local, and indeed confined to the

Mesopotamian valley, it was on a grander scale than we had been accustomed to suppose, or, in plain language, a genuine historic catastrophe.

A local flood must have had a locality, and the clue to this is furnished by Genesis itself, which informs us that Abraham, the founder of the Hebrew race, left his ancestral city, "Ur of the Chaldees," at a time long subsequent to the flood; it is, therefore, rather in the land of the Chaldees than in Palestine, that we should be led to seek the scene of this momentous tragedy.

This land is no other than the famous and once beautiful valley of Mesopotamia, through which the great Euphrates and arrow-swift Tigris flow to empty themselves into the Persian Gulf. Almost lost sight of for awhile, interest in it was re-awakened some seventy years ago by the investigations commenced by Mr. Rich, and followed up with such wonderful results by Botta, Place, Layard, George Smith, and others. Their discoveries have revealed to us in unexpected fulness the details of a complex and advanced civilisation almost, if not quite, as ancient as the Egyptian, and far more profoundly interesting, for the ancient nations of Mesopotamia are the intellectual forefathers of the modern world. The learning of the Chaldees was the heritage of the Jews and Greeks, from these the torch was handed on to the Romans, and Jew and Greek and Roman inspired, and still inspire, for good and evil, the civilisation of the nineteenth century. There is much more of the Chaldean in every one of us than we are given to imagine.

The people whom we find in possession at the dawn of history were Semites, the parent stock from which the Jews subsequently branched off; and one has but to glance at their faces and forms, as portrayed in their statues and pictures, to recognise the strong family likeness, while the emphasis with which muscular development is expressed in parts of the human figure suggests that the remarkable assertion, "The pride of a young man is in his legs," was a Semitic opinion long before the time of Solomon.

Just as Egypt is the gift of the Nile, so is Mesopotamia equally the gift of the Tigris and Euphrates, for it is built up of the mud brought down from the mountains by these two streams into the Persian Gulf, which is thus in process of obliteration. So long as the two great rivers were not regulated, they produced terrible floods in the wet season; and one of the earliest works of the Chaldeans was to control their flow by great dams, and by diverting a part of their water into canals. These canals covered the country like a network, and served not merely to ease the rivers, but also to irrigate the land, which thus richly supplied by water, became, under the hot sun, so fat and fruitful, that corn is said to have borne 300-fold. Groves of palms, orchards, with grapes and many other luscious fruits, were cultivated, while the pastures supported abundant flocks and herds. It was a true garden of Eden, and differed chiefly from the biblical paradise, which Delitsch thinks was actually situated within this garden, in the fact that even here man had still to earn his bread in the sweat of his brow. This the Turks, who now possess the country, have no inclination to do, and consequently it is rapidly returning to its primitive desolation. Were England as enterprising as she was in the time of Elizabeth, we should rent this land from the Porte, run a railway through it, and thus shorten our route to India by a thousand miles, farm it, and thus provide ourselves with one of the richest granaries in the world.

In a land so favoured, it is nothing wonderful that the inhabitants teemed in millions, villages were everywhere dotted about, and in their midst great and flourishing cities arose—Ur, the City of the Moon-good; Erech, the City of Books; Nippur, and, most famous of all, proud Babylon, "the Gate of God," which stood on the left bank of the Euphrates, some 280 miles above its present mouth. In early times, probably about 2300 B.C., the Jews left this beautiful land for some unknown reason, and after various vicissitudes settled in Palestine. Another branch of the Chaldean stock migrated in later times to the northern part of the Tigris valley, where they built many mighty cities, and founded the warlike kingdom of Assyria. Of their cities it is sufficient to mention Assur, which gave its name to the kingdom, and Nineveh, which afterwards became the capital.

The Mesopotamian plain, owing to the way in which it has been produced, is an almost dead flat, and offers no natural elevations for building; the Chaldees, therefore, to raise the foundations of their palaces, temples, and houses above the reach of floods and fever, and for better defence against their enemies, constructed, with incredible labour, great mounds, by piling together quantities of sun-dried bricks and rubbish, and building round this a thick wall of burnt bricks, well cemented together. Some of these mounds, as that of Kojundjik at Nineveh, are as much as 60 feet in height, and it has been computed that this mound alone would have required the labour of 20,000 men for six years in its construction. But there was never any difficulty in obtaining all the labour that was wanted. Prisoners of war were compelled to work under the stick, and the building of mounds was one of the wholesome occupations to which the Jews were set during their captivity in Assyria.

On the mound of Kojundjik stood two great palaces, one of them that of King Assurbanipal. It was evidently not merely a royal residence, for one of its chambers at least was devoted to public purposes; this was the king's library, to which the citizens, who were taught in their early years to read and write, had free access. Whether any of the books were written on papyrus is uncertain; all that have survived the conflagration, in which the palace was destroyed, are on tablets of kiln-made brick. Of such tablets many thousands have been recovered, not only from Nineveh, but from other towns, and many of them are now preserved in the British Museum. Thus within the last fifty years modern Europe has obtained a glimpse, and more than a glimpse, into the literature of a civilisation that perished just as the Roman was coming into existence; for, as Sir Walter Raleigh puts it, "In Alexander's time learning and greatness had not travelled so far west as Rome, Alexander esteeming of Italy but as a barbarous country, and of Rome as but a village. But it was Babylon that stood in his eyes, and the fame of the east pierced his ears."

The recovered literature covers a vast field of human interest, in science, as in astronomy and mathematics, particularly in astronomy, for the Chaldeans were famous star-watchers, and had already named the stars and constellations, associating them with the deeds and mighty works of their heroes and demigods, so that the star-lit sky became a pictured dome, and the zodiac a frieze to the Assyrian, reminding him of history or fable, like the sculptures and paintings which adorned the king's palaces; in religion and poetry, and in commerce, many of the tablets recording business contracts, and revealing a system of mortgage and banking, money being frequently lent at from 13 to 20 per cent., which was moderate; for the advantages of cent. per cent. were already known and appreciated by these simple Semitic folk.

It was amongst the tablets from King Assurbanipal's library at Nineveh, that George Smith, now over twenty years ago, made a famous discovery. He found a fragment of a tablet, bearing words, which he deciphered as follows:—"On the Mount Nizir the ship stood still. Then I took a dove, and let her fly. The dove flew hither and thither, but finding no resting-place, returned to the ship." Every Englishman who knows his Bible would have guessed, as George Smith immediately did, that he had before him a piece out of a Chaldean account of the deluge. He searched for more fragments, and found them. He went out to Assyria, visited the King's palace, and found still more tablets and pieces of tablets, some of them just those he required to fill up missing gaps in the story. Since its first translation by its discoverer it has been again translated and retranslated by some of the acutest scholars in Europe, so that we now possess a fairly complete knowledge of it; a few missing words or even lines, and occasional obscurities occur, but these are of no great importance. In a town which has the privilege to number the distinguished Assyriologist, Prof. Sayce, among its residents, there will be no necessity to present the story more than briefly. It runs as follows:—Sitnapistim, the Chaldean Noah, is warned by Ea, the god of wisdom and the sea, that the gods of Surippak, a city on the Euphrates, even then extremely old, had decided in council to destroy mankind by a flood. Sitnapistim is told to build a ship in which to save himself, his family, household, and belongings. Anticipating the curiosity of his neighbours, since he had never before built a boat, he asks what answer he is to make when questioned as to his unusual proceedings. Ea, who as the god of wisdom is naturally a master of evasion, provides him with a subterfuge, and Sitnapistim sets about building his boat. He forms it of timber and reeds, and makes it water-tight by filling up the crevices with pitch, which he poured over it both within and without. It is of great interest, as showing the local colouring of the legend and the survival of an ancient custom, to observe that this practice of paying the native boats of the Euphrates with pitch has persisted in Mesopotamia down to the present day, natural pitch being used, which occurs at various localities in the valley, but particularly near the town of Hit. Sitnapistim's method of procedure, both in building and paying his boat, may still be witnessed at Hit as a matter of almost every-day occurrence.

Sitnapistim having provisioned the vessel, and brought into it all his goods and chattels, received an intimation of the immediate approach of the catastrophe; he went on board with his family and friends, closed the roof, and prudently entrusted the helm to the sailor—Buzar-sadi-rabi. Heavy rain fell during an anxious night, and as soon as daybreak appeared—

"There arose from the foundation of heaven, a dark cloud,
The storm-god Ramân thundered in its midst and
Nebo and Merodach went in front.
As leaders they passed over mountain and plain
Ninib went therein, and the storm behind him followed.
The Anunnaki raised high their torches,
With their radiant brightness the land glittered,
The turmoil of Ramân reached to heaven,
All that was light was turned to darkness.

* * * * * *

In the earth men perished. . . .
Brother beheld not his brother, men knew not one another. In the heaven
The gods were terrified by the deluge, and
Hastened to ascend to the heaven of Anu.
The gods were like a dog—sat down cowering on the ring wall of heaven.
Ishtar cried like one filled with anger.
Cried the mistress of the gods—the sweet-voiced—
'The former generation is turned to clay. . . .
What I have borne, where is it?
Like fish spawn it fills the sea.'"

For six days the flood lasted and ceased on the seventh, and then Sitnapistim is made to say—

"I looked on the sea and called aloud,
But the whole of mankind was turned to clay.
I opened the air-hole, and the light fell on my face:
I bowed low, sat down, and wept,
Over my face flowed my tears."

Sitnapistim then beheld the land, Mount Nizir, on which the ship grounded. It remained swinging there for seven days; on the seventh day Sitnapistim sent out a dove, which returned, then a swallow, which flew to and fro, but also returned, and finally a raven:—"The raven went, saw the going down of the waters, came croaking nearer, but did not come back." Sitnapistim then left the ship with his people, built an altar on the summit of the mountain, and offered sacrifice. The poem then runs—

"The gods smelt the savour, the gods smelt the sweet savour,
The gods gathered like flies over the sacrificer.
The mistress of the gods, Ishtar, lifted up the (bow?) which Anu had made according to her wish."

A discussion then takes place among the gods, who all through are very human, and in its course Ea suggests to Bel, who seems to have been the prime mover in all the mischief, that he should for the future destroy mankind in a less undiscriminating manner—by wild beasts, pestilence, and famine. The scene ends happily with the apotheosis of Sitnapistim and his wife.

The surprising resemblance of the story to the biblical narrative, extending into identity of words, as in the case of the "gods smelt the sweet savour," points to direct derivation or borrowing, and there can be very little doubt in deciding on which side the borrowing lay. The biblical narrative is indeed a Jahvistic or Monotheistic edition of the Chaldean. To this conclusion the most distinguished Assyrian scholars have been led. I need only mention here Prof. Sayce, whose opinion is expressed on page 119 of his work on "The Higher Criticism and the Monuments," published by the Society for Promoting Christian Knowledge, during the current year.

The Chaldean story certainly reduces the flood to much smaller dimensions, and so far brings it nearer the range of probability; the rain lasted only seven days, and the waters have subsided sufficiently at the end of a fortnight for Sitnapistim to land. They do not cover all the high mountains, and the stranding of the ship on Mount Nizir when the flood was at its climax, gives us a maximum height, which it cannot have exceeded; for if this mountain had been deeply submerged, it could not have arrested the passage of the ship. The height of the Nizir mountains is about 1000 feet above the sea-level, which still leaves room for a very respectable flood.

The scepticism which prevailed in the middle of this century with regard to legends seems to have given place to an almost equally great credulity. The older argument seemed to be that the presence of some obviously unveracious statements in a legend condemned the rest, want of faith in some was want of faith in all; while the more modern view would appear to be that since so many discredited legends have been found to enshrine some important truth, all are to be assumed trustworthy till they are proved otherwise.

It may be in this spirit that Suess has elaborately discussed the Chaldean legend as though it presented us with a trustworthy account of the Mesopotamian deluge.

Reasoning from the facts as it records them, Suess lays great stress on the course taken by the ship from Surippak, supposed to have been situated near the mouth of the Euphrates, to the land of Nizir, a distance of about 240 miles up stream. Had the flood been produced solely by heavy rainfall and a consequent overflowing of the swollen rivers, the ship instead of being carried inland would have been drifted out to sea, *i.e.* southwards into the Persian Gulf. Suess therefore suggests that a great wave was produced in the Persian Gulf, partly by a cyclone and partly by an earthquake. This wave of twofold origin then rolled in upon the low-lying land of Mesopotamia, and drove its floods of water up the valley till they washed the foot of the Nizir Hills.

Of all catastrophes none are more terrible, none more disastrous than those thus produced. When the shock of an earthquake occurs beneath the sea, and affects the adjacent land, a trembling of the ground is first felt, then the sea retires and leaves the beach bare, only to return in a long mighty wave which breaks with violence on the shore. Thus on October 28, 1746, Callao in Peru, after being shaken by an earthquake, was overwhelmed by a sea-wave and utterly destroyed; of its 5000 inhabitants only 200 survived the flood. Still more destructive was the famous earthquake of Lisbon, November 1, 1755, when the inhabitants, without a warning, were destroyed in the falling city, and in six minutes 60,000 persons perished. The sea in this case, as in others, retired first, and then rose 50 feet or more above its usual level, swamping the boats in the harbour; at Cadiz the wave is said to have reached a height of 60 feet, and it was felt over the greater part of the North Atlantic Ocean, arriving even on our own shores, as at Kinsale in Ireland, where it rushed into the harbour and poured into the market-place.

That a great sea-wave so produced might have thus arisen in the Persian Gulf is quite within the bounds of possibility, particularly as a zone of the earth's crust, very liable to earthquakes, stretches across the mouth of the Gulf near the Ormus Mountains.

But if we are to follow the legend, we must follow it faithfully, and as a result of the most recent investigations it turns out that all the passages which were supposed to refer to an earthquake have been mistranslated. The earthquake is thus put out of court, and we are left with what help we can get from the hurricane, a kind of disturbance which often vies with the earthquake in the destructive nature of the sea-waves to which it gives rise.

The Andaman Islands of the East Indies are a centre which give birth to some of the most terrific hurricanes in the world. Travelling more or less westwards and northwards, these whirlwinds sweep over the waters of the Bay of Bengal and raise the sea into waves mountains high, which every now and again rush over the low-lying lands of the Ganges delta, overwhelming the unfortunate inhabitants by myriads. Thus on the night of October 14, 1737, one of these waves, estimated at 40 feet in height, suddenly overtook the dwellers by the Ganges and destroyed them to the number of 100,000, or, as some say, 300,000 souls. These storms do not, as a rule, travel towards the Persian Gulf, and the North Arabian Sea is singularly free from them; but Suess, tracing the course of the storm of October 24, 1842, suggests that for once, in the case of the deluge, an East Indian storm may have lost its way and blundered, as it were, into the Persian Gulf. The track of this storm of 1842 was as follows:—At 5 o'clock on October 24 it reached Pondicherry; it then slightly altered its direction and veered more to the south-west, and on the 25th at midday it crossed the western Ghats, and then divided into two parts; the south centre need not concern us. The northern centre travelled north-eastwards towards the Persian Gulf, and was felt from the Gulf of Aden to Cap Guardafui, wrecking in this tract a number of vessels.

The greatest estimated height of storm-waves is from 40 to 45 feet, and, as Suess points out, it must have needed a much greater wave than this to drown out all Mesopotamia up to the Nizir Hills. How much greater, is a question we are fortunately able to answer positively, thanks to the accurate measurements made by the engineer Czernik during a survey for a projected railway. The Tigris rises very slowly from its mouth inland, but at Bagdad it is already 154 feet above the sea-level, and at Mansurijah, the lowest point where its tributary Diala Tschai emerges from the Hamrin Mountains, the height is given as 285 feet; but the land of Nizir lies even still more to the north than this, and the Lower Zab, which cuts through it, cannot have a less elevation than 600 or 700 feet. No storm wave of which we have any record, no recorded earthquake wave, nor any combination of the two, approaches even remotely the height that would be required to carry the sea even to Bagdad; while as for the Nizir Mountains, the Valiant Pherson, who "nearly spoilt the flood," might have drank up all the sea-water which came there without any assistance from Glenlivat. If we admit that the Tigris valley was ever submerged up to this point and restored to its original condition in the course of fourteen days, we are confronted with a catastrophe not only stupendous in degree, but of a nature beyond our present powers of explanation.

But are we compelled to admit anything of the sort, and would it not be well before doing so to inquire a little more closely into the credentials and character of the Chaldean story? We have seen that the tablets on which it occurs were found in King Assurbanipal's library, and it is fairly certain that they were copied from others much older preserved in the ancient city of Erech, the city of books. It is indeed probable that the tablets in Erech may date from the time of King Khammarubi, or from about 2350 B.C. The tablets present themselves therefore with good recommendations, and we proceed to the character of the story itself. It does not occur alone, but as one chapter out of twelve in a long poem of about 3000 lines, concerning the adventures of a mythical hero named Izdubar or Gizdubar, perhaps the same as Nimrod, that "mighty hunter before the Lord" of biblical story, and plainly the prototype of the Greek Heracles.

The first tablet, containing the first chapter, is incomplete. So far as can be made out, it sets forth the misfortunes of the city of Erech, probably under the oppression of its Elamite enemies, who were so terrible in battle that poor Ishtar, its protecting goddess, "could not lift up her head against the foe."

The second and third introduce Gizdubar, already famous as a hunter, as the hero, who was looked for to deliver the city. His rivals induce Ururu, the mother of the gods, to fashion a strange being, Eabani, half man and half bull, to fight with Gizdubar. This monster comes to Erech, bringing with him a powerful lion, desert-bred, to fight Gizdubar; but the hero succeeds in slaying the lion, and so wins the friendship and esteem of Eabani. In the fourth and fifth tablets the friends encounter and overcome the terrible tyrant Humbaba, whose voice was as "the roaring of the storm, his mouth wickedness, and his breath poison." The sixth tablet, which is well preserved, tells how the hero was beloved of Ishtar. "Be my husband," she says, "and I will be thy wife. I will make thee to ride in a chariot of gold and precious stones, with golden wheels and diamond horns. When thou enterest our house under the pleasant fragrance of the cedar, men shall kiss thy feet. Kings, princes, and lords shall bow down before thee, and bring tribute." Gizdubar, however, is not to be seduced; he repels the advances of the goddess, who then presents herself as a naturally angry woman before her father Anu, and persuades him to frame a divine bull which is to destroy Gizdubar. He and Eabani together slay this bull, however, and the goddess, now terribly incensed, pronounces a terrible curse upon Gizdubar. The seventh tablet is unfortunately missing. The eighth, ninth, and tenth narrate how Gizdubar, suffering under the divine anger, loses his friend Eabani, and is smitten with a grievous illness. He journeys to the river's mouth to consult his divine ancestor Sitnapistim. On his way he crosses a desert where "scorpion men" guard the dark path to the "waters of the dead," which separate him from his quest. On the shore of this sea he finds a park of the gods, with wonderful trees bearing precious stones for fruit. After waiting here a long time a ferryman takes him over to the fields of the blessed, where he meets Sitnapistim. He tells his sorrowful tale, and the heart of Sitnapistim is filled with pity; but, alas! neither gods nor men can give him help. In the eleventh tablet Gizdubar inquires of Sitnapistim how he became immortal, and receives in answer the story of the deluge. After its recital Sitnapistim heals Gizdubar of his disease, and gives him the plant of life, its name being "Altho'-â-grey-beard-the-man-becomes-young-again." Unfortunately an evil demon robs him of this on the way home. In the twelfth and last tablet Gizdubar returns to Erech, and utters a lament over his lost friend Eabani, whose ghost subsequently appears and recounts the doings of the dead in Hades.

Thus the deluge story is a myth within a myth, containing statements plainly unveracious; and how we are to distinguish in this mass of fiction the true from the false passes the wit of man to conceive. If we say of the deluge-part of it that it is a gross exaggeration, the judgment will sound mild, but this is all that is requisite to reduce the catastrophe to commonplace proportions.

Whether Gizdubar ever existed in the flesh or not has been doubted; it is certainly remarkable that each of the chapters of the poem corresponds to one of the signs of the zodiac, and they are arranged in the same order as the signs of the zodiac. A fanciful correspondence is thus drawn between the succession of events in the life of Gizdubar and the yearly course of the sun through the heavens, and it has consequently been maintained that Gizdubar is no other than the sun himself personified. The stages in the life of man find, however, so ready an analogy in the course of the sun, that this conclusion is by no means forced upon us, and we may turn to another identification of more significance in our inquiry. It is that of the Greek story of Heracles with the legend of Gizdubar. Heracles himself is no other than a Greek Gizdubar, the Chaldean Eabani corresponds to the centaur Cheiron, the tyrant Humbaba to the tyrant Geryon, the divine bull to the bull of Crete, the park of the gods to the garden of the Hesperides, the lion slain by Gizdubar to the lion of Nemea which Hercules slew, and finally, just as Gizdubar is ferried across the waters of the dead, so Hercules is taken by Helios in the golden boat of the sun across the ocean.

As the Greeks have borrowed so much of the legend it would be surprising if they had not taken the rest, including the story of the deluge, and accordingly we find the Greeks provided with a legend of the flood, or with more than one, as they appear to have had more than one Heracles; but that which most closely accords with the Chaldean, is the flood of Deukalion.

On the other hand the Egyptians, who had sun-stories of their own, did not borrow the legend of Gizdubar, and are silent as to a deluge; a fact of extreme importance when we consider that the Egyptian civilisation was contemporaneous with the Chaldean, if not indeed older. The Nile is gentler in its overflowing than the Tigris, so that Egypt did not suffer under the scourge of unexpected floods.

If, finally, we turn to China, also possessed of very ancient historic records, and liable to the destructive deluges of the Yellow River, which have earned for it the designation "The Curse of China," we discover a deluge story of great importance, to which Suess has already called attention. In the third Schû of the Canon of Yao, a monarch who reigned, it is supposed, somewhere about 2357 B.C., and therefore contemporaneous with Khammurabi, we read:—The Tî said, "Prince of the Four Mountains, destructive in their overflowings are the waters of the flood. In their wide extension they inclose the mountains and cover the great heights, threatening the heaven with their floods, so that the lower people is unruly and murmur. Where is a capable man whom I can employ this evil to overcome?" Khwan was engaged, but for nine years he laboured in vain; a fresh engineer, named Yû, was therefore called in; within eight years he completed great works: he thinned the woods, regulated the streams, dammed them, and opened their mouths, provided the people with food, and acted as a great benefactor to the State.

It is refreshing thus to pass from the ornate deceptions of legend to the sober truth of history; and if the facts on which the Gizdubar legend of the deluge is founded could be expressed in the same simple language, we should probably find it narrating similar events, or events as little calculated to surprise us as those of the straightforward Chinese Schû.

History then fails to furnish evidence of any phenomenon which can be called catastrophic in the geologic sense of the word, and geology has no need to return to the catastrophism of its youth; in becoming evolutional it does not cease to remain essentially uniformitarian.

And the careful foster-mother? She too, as it appears to me, has widened her studies, and must, I should think, recognise with pride the stalwart growth of her early friend. May they be drawn nearer together, and feel the warm glow which is produced by the sympathy of a common love for truth.

THE INTERNATIONAL GEOLOGICAL CONGRESS AT ZURICH.

THE sixth meeting of the International Geological Congress was held at Zürich from Wednesday, August 29, to Monday, September 3, and was highly representative. Over 220 members were present, including leading geologists from all parts of Europe. Swiss and German members were in the majority. We may mention the names of MM. Renevier, Heim, Golliez, Forel, Schardt among the Swiss representatives, and Baron Richthofen, MM. Beyrich, Hauchecorne, Zittel, Credner, Groth, Gümbel among the German. From Austria there were present, among others, MM. Suess, Mojsisovics, Tietze, Penck; from France, Prince Roland Bonaparte, MM. Gaudry, de Lapparent, Michel Levy, Bertrand, de Margérie; from Britain, Sir A. Geikie, Sir J. Lubbock, Prof. Hughes, Prof. Sollas, Mr. W. Topley; from Scandinavia, Prof. Brögger; from Belgium, Prof. Dewalque; from Italy, Prof. Capellini, MM. Pellati, de Gregorio; from Russia, MM. Karpinsky, Nikitin, Pavlov, von Toll; from Roumania, M. Stefanescu; from the United States, Profs. R. Pompelly, Lester Ward, van Hise. Prof. Haeckel, of Jena, was also present at several meetings.

Prof. Capellini opened the Congress, and called Prof. Renevier to the presidential chair for the meeting at Zürich. The new President intimated in his address that, according to a decision of council, the official language of the Congress should remain as before, French; at the same time communications made in German would be accepted, and would be reported in the same language. Communications written in other languages had to be translated into French.

Without doubt the most important feature of the Congress was the new international geological map, which has been under course of preparation in Berlin since the Congress meeting of 1881, and is now exhibited for the first time. A report on its progress was read by Dr. Hauchecorne, of Berlin. The topographical groundwork has been prepared by Kilpert, to scale 1 : 1,500,000; the system of geological colouring followed has been most successful, and the Congress has certainly every reason to be satisfied with the result of the co-operation of the various surveys and societies to produce an international map. The whole map will contain 49 sheets; only six are now ready for issue, including the north-west part of Europe, Northern Germany, with parts of France, Belgium, Poland, &c. The next part, to be issued within a year, will contain ten sheets, and will include the British Isles, France, Spain and Portugal, Italy, and Switzerland. Some difficulty has arisen in regard to the older Palæozoic rocks of various districts, and also as to the method of showing the Quaternary beds. It is now settled that solid rocks, where their distribution is known, will be shown by thin bands of colour over the general colour for Quaternary beds. (We reserve a fuller notice of this important work until the sheets are published.)

The subscription for the entire map is £4, but this can be paid in instalments as the various parts are published. The proportion for the first part will be 10s. Subscriptions must be sent to Dietrich Reimer, Berlin, before the end of December 1894; after that the subscription price will be raised.

On three days of the Congress meeting, communications were delivered to a general assembly of members; on one day, sections were formed, and a large number of papers in this way read. Unabated interest made itself felt throughout. At the general assembly on August 29, Prof. Suess gave an address "On the Southern and the Northern Alps," in which he distinguished two main directions of movement in the Alps. The Northern zone and the Central chain of the Alps formed a region of "zufluss" (flow towards the North Pole); the Southern zone, continued into the Dinarian Alps, was a region of "abfluss" (flow away from the North Pole). In the former case the relations were in harmony with those of general European movements; in the latter, the relations were associated with those of Asiatic chains.

Prof. Heim described the "Geology of the neighbourhood of Zürich," and made it most clear by reference to a splendid set of original maps and models. During the course of the Congress Prof. Heim also organised several excursions on the lake and on its banks, demonstrating that post-glacial movements of old fluvial terraces are in direct connection with the origin of the Lake of Zürich. As might have been expected, animated discussions were held among the members on the points at issue—the origin of the lake-basin, proofs of interglacial periods, mountain-movement which had affected glacial deposits, original and ultimate direction of the valleys, &c.

On August 31, the general assembly was addressed by M. Michel Levy and Prof. von Zittel. Michel Levy's subject was "The principles to be followed in a universal classification of the rocks." He regretted the confusion which threatened petrography with regard to its classification and nomenclature. Every day the number of names derived from particular localities increased, and useless synonyms were added. He proposed that some general system of classification should be agreed upon by petrographers, and suggested it might be founded (1) on the *texture*—affording the great divisions; (2) on the essential *constituent minerals*, to give the names of the smaller groups. In compliance with M. Michel Levy's desire, a Congress commission was appointed to consider and revise the nomenclature.

Prof. von Zittel spoke on "Phylogeny, Ontogeny, and systematic arrangement." He gave a word of warning against the assumption that Darwin's Theory of Descent had been actually demonstrated by palæontology. In his experience its application to palæontology had been in but few cases successful. Great breaks occurred between the various classes of fossil animals for which there was still no sufficient explanation. Again, Ernst Haeckel's law, that the development of one individual repeats the development of the whole family, had been confirmed in few classes of palæontological forms. The tendency of recent research had been becoming more and more subjective; even young investigators freely constructed new species, new genera, a new system of classification or line of descent. Others as freely questioned the validity of the new names and families, until a kind of anarchy prevailed in some of the groups of the plant and animal kingdom. Solid facts and experiences must be carefully studied, while theory, even the most brilliant, must be held at its mere theoretical value.

At the general sitting on Saturday, September 1, Sir Archibald Geikie and M. Marcel Bertrand spoke. Sir A. Geikie's paper, delivered in French, was on the "Banded Structure of oldest Gneisses and Tertiary Gabbros." Intrusive basic rocks of Tertiary age in which no mechanical deformation had taken place, had assumed a banded structure during their crystallisation from the original magma, the bands being occasionally plicated. The structure exactly resembled what is observed in many old banded gneisses, and arguing from analogy, these gneisses might have acquired their banding during their original consolidation, and not as the result of subsequent dynamo-metamorphism. A series of photographs admirably illustrated this suggestion.

M. Bertrand treated the "Structure of the French Alps and the recurrence of certain facies." After describing the metamorphism of various sedimentary formations into the condition of gneiss as the result of great dynamic changes, he pointed out that in different countries and in quite different formations certain facies followed each other in the same order of succession. These were a deep-sea facies, a "Flysch" facies formed during uprise, followed by an archipelago and river facies. In the French Alps, for example, the deep-sea facies was represented by the Devonian gneiss, the period of movement by the carboniferous deposits, the shallow water by the later red sandstones. Taking the Swiss Alps, the same facies recurred in younger formations; one might distinguish gneiss of Permian age, Flysch—(1) fine and schistose of Triassic and Jurassic age; (2) the coarser deposits of Cretaceous and Eocene age—and ultimately the archipelago facies of molasse and nagelflue in young Tertiary and Glacial time.

M. de Margérie read the report of the Commission of Bibliography. In accordance with the council, the Commission offers to furnish gratuitously a copy of the Catalogue of Geological Bibliographies, at present in the press, not only to all the members of the preceding Congress, as had been agreed upon at Washington, but also to those of the Congress of Zürich. The sectional meetings on Thursday, August 30, were of a special character. At the General Geology Section, with Prof. de Lapparent as president, most of the papers related to glacial questions. The Congress, acting upon proposals of

Prof. F. A. Forel and Captain Marshall Hall, has appointed a committee to investigate the variations of glaciers. Representatives of various countries are appointed. Prof. Forel and Dr. L. du Pasquier will have charge of this committee, the expenses of which will be defrayed by Prince Roland Bonaparte, the representative of France on the committee.

Dr. A. Rothpletz spoke on "Overthrusts and their methodical investigation"; M. Steinmann gave a note on the "Extent of the Indo-Pacific Cretaceous region." The Section of Stratigraphy and Palæontology, presided over by M. Gaudry, heard papers by Prof. Hull, by MM. Sacco, Fallot, Mayer-Eymar, Depéret; on "Tertiary strata and their classification," by Profs. Steinmann and Boehm, and by M. Pavlov on "Cretaceous strata"; by M. Kilian, on "the limit of the Jurassic and Cretaceous systems"; and by M. Stephanescu, on the "Fossil camel in Roumania." The other sections were Mineralogy and Petrography, M. Michel Levy presiding; and Applied Geology, Dr. Hauchecorne presiding. At the Mineralogy and Petrography Section several papers were read; among others, one on the petrography of Attica, by Prof. Lepsius, on grorudites and tingnaites, by Prof. Brögger. Prof. Groth showed a simple apparatus for demonstrating the direction of the vibrations in biaxial crystals.

An interesting interlude was formed at the meeting on August 31, by the presentation to Geheimrath Beyrich of a magnificent wreath of Alpine flowers made in the name of the assembled geologists. The day was the eightieth anniversary of Beyrich's birth, and Prof. Heim expressed the feelings of all present in the warm words of congratulation and appreciation which he addressed to the veteran geologist. Not less touching was the reply of the Geheimrath to the graceful token of love and respect from his colleagues of all European nations.

Space will not permit a description of the excellent exhibition of maps, photographs, models, and specimens in connection with the Congress. Exhibits had been sent from all countries. Also the great collection of the Zürich museums was an attraction in itself, and Prof. Heim was untiring in his efforts that all the guests should see all and even more than all which they had hoped to observe. The new geological map of Switzerland, scale 1 : 500,000, prepared by Heim and Schmidt, won the admiration of all, and together with the geological guide-book of the excursions published by the organisation committee, will remain as a valuable, lasting witness of the enterprise and energy displayed by Switzerland and her professors on the occasion of the sixth Congress.

It is rather unfortunate that the weather, which had been the best of summer weather during the excursions in the Jura Mountains previous to the meeting, and throughout the meeting itself, should have broken just as the excursions into the Alps began. Rain and mist undoubtedly bid fair to mar the enjoyment and lessen the benefits. From September 17 to 23 an excursion will be conducted by Profs. Penck, Brückner, and du Pasquier, for the study of glacial appearances in the Alps. A special paper has been published by these three geologists, more especially with a view to this excursion, but also of general interest, entitled "The Glacial System of the Alps."

The seventh meeting of the International Geological Congress will be held in 1897 at St. Petersburg. The geological tours proposed were shown in a map of Russia exhibited during the Congress. An excursion across Russia and the Ural Mountains will precede the St. Petersburg meeting, and one is arranged to be undertaken to the Caucasus and the Caspian Sea at the close of the meeting. The Czar, it is said, has invited the Congress to St. Petersburg, and has already subscribed 30,000 roubles to defray in part the expenses of the Congress.

THE INTERNATIONAL CONGRESS OF HYGIENE.

THE International Congress of Hygiene and Demography, recently held at Budapest, does not appear to have been very successful from a scientific point of view. The medical journals say that serious work was impossible at the Congress, owing to the numerous social amusements and entertainments provided for the members. This opinion is borne out in a report in the *Times*, to which we are indebted for the following notice.

Our contemporary remarks that unless some sweeping reforms are introduced into the procedure of the Congress the same loss of prestige which has reduced other similar institutions to impotence or extinction seems certain to overtake it. The Congress appears to have ended in a chaotic confusion for which the word fiasco is none too strong, and the principal reasons for this unfortunate state of things are said to be (1) an overwhelming development of what may be called the picnic element; (2) an abuse of the system of passing sectional resolutions; (3) the superabundance of papers.

But, in spite of the confusion and turmoil resulting from the foregoing defects of procedure, an abundance of valuable material was brought forward at the Congress, some of which might, under more favourable circumstances, have been focussed into a shape which would exercise a real influence on practical questions of public health and social economy. Much sound and useful work, for instance, was done upon such questions as the housing of the working classes, the influence of dwellings and occupations upon health, the movements of population, and especially the townward migration, upon the condition of the insane, upon school hygiene, practical sanitation, and many others. The real scientific life of the Congress, however, lay in the department dealing with infectious disease and bacteriology. Here three crowded meetings took place on three successive days to discuss the following questions:—(1) Immunity from infectious disease; (2) diphtheria; (3) cholera.

The first of these is of great practical importance, because the future of medicine, from the present bacteriological point of view, lies in solving the problem of immunity. According to one school immunity is effected by certain cells (leucocytes) which eat up the germs, and are therefore called phagocytes. This fascinating theory was introduced a few years ago by M. Metchnikoff, the eminent chief of the Pasteur Institute in Paris; but the balance of opinion seems to be turning against it in favour of the theory that the germs are mainly destroyed by certain chemical substances contained in the watery part of the blood. Prof. Buchner, of Munich, is a prominent supporter of this theory, and his paper, read at the Congress, summarises the latest views on the subject. "The natural capacity for resistance to infection (the so-called natural immunity) rests on essentially different conditions and causes from the artificial or acquired immunity. The former rests on the one side upon the bactericidal activity of a substance called Alexine, which is secreted by the organism, on the other by a natural insusceptibility of the cells and tissues of the body to particular bacterial poisons. The leucocytes play an important part in the natural protection of the organism, not, however, as phagocytes, but through the action of substances secreted by them. Acquired immunity, upon the other hand, rests on the presence of modified bacterial products, the so-called Antitoxine, either in the blood or in the tissues of the body." M. Metchnikoff defended his theory of phagocytosis with great vivacity, but the other leading bacteriologists present, including Prof. Roux, of Paris, were on the other side. The debate marks a step in the advance of knowledge, though not a very decided one.

The morning devoted to diphtheria was the central point of the Congress. An overflowing and animated audience attended the meeting. This fearful disease is the most burning question in the medical world at the present time, partly because of its alarming increase, and more recently because of the hopes entertained of the new method of treatment, derived from bacteriological research. Prof. Löffler, the eminent discoverer of the diphtheria bacillus, opened the proceedings by reading the German report, which recommended "immediate bacteriological examination of all suspected cases; notification to the police of all bacteriologically determined cases and of all doubtful ones; isolation of every case; protective inoculation with serum of persons about the invalid, particularly children; extension of this principle as far as possible in families and schools; disinfection, keeping of convalescents apart until the bacillus has disappeared."

Similar drastic measures were recommended in the French report. The English report did not suggest any practical measures for dealing with the evil, but pleaded for more careful study, and more accurate knowledge of its causes and conditions. The Danish, Hungarian, Swedish, and Swiss reports also pleaded for further investigation. It is much to be regretted that the Congress could not find time to formulate some, and carefully-weighed, conclusions on this important matter.

In a debate on cholera, which followed in the same section, Prof. Max Gruber said, at the commencement of his address, that the bacteriology of the disease is by no means so simple as was once supposed; "the deeper investigation goes the greater the difficulties that rise up before us." Continuing, the *Times* reports him as remarking that the result of his own investigations had brought him to doubt the specific character of the cholera bacillus. "The question," he said, "is in this strange position—that, while we know with certainty that the vibrios which appear in cholera are the cause of the symptoms of the disease, we do not know for certain that these vibrios are of a distinct species. We cannot say for certain whether in all cases of true cholera they belong to a single species or to several, whether they are distinct from our own native vibrios or not." He was inclined to think they were not distinct, and propounded a quite new theory to the effect that these native and harmless vibrios take on an injurious character and give rise to cholera when some other at present undiscovered germ is introduced; for it is certain that cholera is introduced, and yet apparently the germs are here all the time. M. Metchnikoff, on the other hand, defended the specific character of the cholera vibrio, but admitted that it was not everything. It is frequently present, and yet does no harm. To explain this he has invented yet another theory, very curious and rich in appalling possibilities. The cholera germ, he thinks, is only powerful for evil when the native bacilli of the human interior, the *flora* of the stomach and intestines, as he quaintly calls them, are favourable to its growth. It is pointed out by our contemporary that these utterances are interesting as marking a distinct change of front and a distinct advance in knowledge. Bacteriologists, as the result of their own investigations, are beginning to come into line with the position long maintained by other observers, who reached their conclusions by the old method of studying the facts of epidemic disease. The germ is, no doubt, the cause of the disease, but it alone will not suffice. Its effects depend upon the conditions in which it is placed, upon its environment; it must have a favourable soil in which to grow, or it changes into a harmless variety. And this bacteriological doctrine has an important bearing on the encouragement of hygiene, for it helps us to understand more precisely how hygienic measures work in rendering the soil unfavourable to the growth of the injurious micro-organisms.

SCIENCE IN THE MEDICAL SCHOOLS.

THE students' number of the *Lancet* furnishes some interesting information upon the curricula of the medical schools of Great Britain. With the idea of seeing how far science instruction in subjects not purely medical is provided in these schools, we have prepared the subjoined table, from lists given in our contemporary, of classes to be held during the session

	Physiology.	Biology or Zoology.	Botany.	Chemistry.	Practical Chemistry.	Natural Philosophy or Physics.	Practical Physics.	Bacteriology.	Hygiene or Public Health.	Natural History.
METROPOLITAN MEDICAL SCHOOLS.										
St. Bartholomew's Hospital	×	×	×	×	×	×	×	...	×	...
Charing Cross Hospital and College	×	×	×	×	×	×	×	×	×	...
St. George's Hospital	×	...	...	×	×	...	...	...	...	...
Guy's Hospital	×	×	×	×	×	×	...	×	×	...
King's College Hospital	×	×	×	×	×	×	...	×	×	...
London Hospital	×	×	×	×	×	×	×	×	×	...
St. Mary's Hospital	×	...	...	×	×	...	...	...	...	...
Middlesex Hospital	×	×	...	×	×	...	...	...	×	...
St. Thomas's Hospital and School	×	×	×	×	×	×	...	×	×	...
University College and Hospital	×	×	×	×	×	×	...	×	×	...
Westminster Hospital	×	×	...	×	×	×	...	...	×	...
PROVINCIAL MEDICAL SCHOOLS.										
University of Durham College of Medicine	×	×	×	×	×	×	×	×	×	...
University College, Liverpool	×	×	×	×	×	×	×	...	×	...
Owens College School of Medicine	×	×	×	×	×	×	×	...	×	...
Sheffield School of Medicine	×	...	×	×	×	×	×	...	×	...
Mason College	×	×	×	×	×	×	...	...	×	...
University College, Bristol	×	×	...	×	×	...	...	×	×	...
Cambridge University	×	×	×	×	×	×	...	...	×	...
Oxford University	×	×	×	×	×	×	...	...	×	...
Yorkshire College, Leeds	×	×	×	×	×	×	...	...	×	...
University College, Cardiff	×	×	×	×	×	×	...	...	...	...
MEDICAL SCHOOLS OF SCOTLAND.										
Aberdeen University	×	...	×	×	×	×	...	...	×	×
St. Andrews University	×	×	×	×	×	×	...	...	...	×
Edinburgh University	×	×	×	×	×	×	...	...	×	×
Glasgow University	×	×	×	×	×	×	...	...	×	×
St. Mungo's College and School of Medicine ...	×	×	×	×	×	×	...	×	×	×
Anderson's College, Glasgow	×	×	×	×	×	×	...	...	×	×
School of Medicine, Edinburgh	×	×	×	×	×	×	...	...	×	×
University College, Dundee	×	×	×	×	×	×	...	...	...	...
MEDICAL SCHOOLS OF IRELAND.										
Dublin University	...	×	×	×	×	×	...	...	×	...
Dublin Royal College of Surgeons	×	×	×	×	×	×	...	...	×	...
Catholic University, Dublin	×	×	×	×	×	×	...	...	×	...
Queen's College, Belfast	×	×	×	×	×	×	...	...	...	...
Queen's College, Cork	×	×	×	×	×	×	...	...	×	...
Queen's College, Galway	×	×	×	×	×	×	...	...	...	...

1894-95, which begins next month. The table does not pretend to be complete; nevertheless, it will serve to show the kind of science subjects on which lectures are given to medical students outside medical technology. The courses advertised are indicated by crosses.

It has not been considered necessary to tabulate courses only given in two or three medical schools. Organic chemistry, for instance, is only down as a specific subject in the lists of lectures at the London Hospital and the University College Hospital. Probably the reason for this is that, at many colleges, the lectures on chemistry embrace the organic and the inorganic branches. Chemical physics is down in the medical curricula of the University College, Mason College, Cambridge University, and Yorkshire College, and physiological chemistry is among the courses at St. George's Hospital and Oxford University. Though psychological medicine is taught in a number of colleges, psychology only appears as the subject of lectures at St. Bartholomew's Hospital, Charing Cross Hospital, Edinburgh School of Medicine, and Queen's College, Cork. In the first two of these institutions, and also at Oxford University, pharmacology is treated distinct from practical pharmacy. It will be seen from the table that, in Scottish medical schools, the students are instructed in natural history, whereas this subject does not appear in the lists of lectures in the medical schools of England and Ireland.

Courses of lectures on bacteriology are advertised to take place at nine medical schools, but it must not be supposed that they are the only schools having facilities for carrying on this study. The *Lancet* has something to say on bacteriology and the medical curriculum. Our contemporary points out that "it is now almost imperative that those who are engaged in the teaching and study of medicine should consider the position of bacteriology in medical education with regard (*a*) to students proper, and (*b*) to those students of more mature years known as post-graduates. We think that the time has nearly come when it will be insisted upon that every medical student should receive not only some systematic instruction in the principles of bacteriology, but, more important still, should be put through a thorough, if short, course of practical laboratory instruction, in which the theories propounded in the class-room may be clearly illustrated. . . . Many of the medical schools have already recognised this fact, and in London alone there are now several well-equipped bacteriological laboratories where a thorough course of instruction can be obtained by the medical student. Guy's Hospital, University College Hospital, St. Bartholomew's Hospital, for example, have all acquired special facilities for carrying on the work; but there is still much room for the more general teaching of the subject. In the large university medical schools, especially in Oxford, Cambridge, Victoria, Durham, Edinburgh, Aberdeen, and Glasgow, the subject is more or less thoroughly taught, but not in all cases as practically as is desirable."

FORTHCOMING SCIENTIFIC BOOKS.

THE following scientific books are reported as being in preparation for the forthcoming publishing season. The list, though not so lengthy as the one we printed a year ago, is still a representative one, and lovers of each and every branch of science appear to be well catered for:—

Messrs. Macmillan and Co. announce:—"A Treatise on Bessel Functions," by Profs. G. B. Matthews and A. Gray; "Elementary Treatise on the Theory of Functions," by James Harkness and Frank Morley; "Elliptic Functions," by A. C. Dixon; "Practical Plane Geometry," by J. Humphrey Spanton; "An Introductory Account of Certain Modern Ideas and Methods in Plane Analytical Geometry," by Dr. Charlotte Angas Scott; "Integral Calculus and Differential Equations for Beginners," by Joseph Edwards; "Geometrical Conic Sections," by Charles Smith; "Elementary Mensuration, with Exercises on the Mensuration of Plane and Solid Figures," by F. H. Stevens; "The Theory of Light," by Thomas Preston, second edition, thoroughly revised; "Magnetism and Electricity," by Prof. Andrew Gray, illustrated; "Steam and the Marine Steam Engine," by John Yeo, with illustrations; "Pumping Machinery," by Dr. Julius Weisbach; "A Laboratory Manual of Physics and Applied Electricity," arranged and edited by Edward L. Nichols, vol. ii. Senior Course and Outline of Advanced Work, by George S. Moler, Frederick Bedell, Homer J. Hotchkiss, Charles P. Matthews, and the Editor, illustrated; "Theoretical Chemistry," by Prof. Nernst, translated by Prof. Charles Skeele Palmer; "Manual of Physico-Chemical Measurements," by Prof. Wilhelm Ostwald, translated, with the author's sanction, by Dr. James Walker, illustrated; "Lassar Cohn's Organic Chemistry," translated by Alexander Smith; "The Rise and Development of Organic Chemistry," by the late C. Schorlemmer, F.R.S., translated and edited by Prof. Smithells; "Chemical Analysis of Oils, Fats, Waxes, and their Commercial Products," by Prof. R. Benedikt, translated, edited, and enlarged by Dr. J. Lewkowitsch; "The Planet Earth, an Astronomical Introduction to Geography," by R. A. Gregory, illustrated; "Papers on Geology," by Joseph Prestwich, F.R.S.; "The Cambridge Natural History," edited by J. W. Clark, S. F. Harmer, and A. E. Shipley; vol. iii. "Molluscs," by Rev. A. H. Cooke; "Aquatic Insects," by Prof. L. C. Miall, F.R.S., illustrated; "Text-book of the Diseases of Trees," by Prof. R. Hartig, translated by Dr. W. Somerville, with a Preface by Prof. H. Marshall Ward, F.R.S., with numerous illustrations; "Timber and Timber Trees, Native and Foreign," by Thomas Laslett, new edition, revised by Prof. H. Marshall Ward, F.R.S.; "A Text-book of Comparative Anatomy," by Dr. Arnold Lang, translated into English by Henry M. Bernard and Matilda Bernard, vol. ii.; "Human Anatomy," by Prof. Wiedersheim, translated from the last German edition by H. M. Bernard, revised and annotated by Prof. G. B. Howes, illustrated; "A Text-book of Pathology, Systematic and Practical," by Prof. D. J. Hamilton, vol. ii.; "Lessons in Practical Bacteriology," by Dr. A. A. Kanthack and J. H. Drysdale; "Mental Development in the Child and the Race," by Prof. J. Baldwin; "A Course of Experimental Psychology," by Dr. J. McKeen Cattell; Leibnitz's "Nouveaux Essais," translated by A. G. Langley; "The Right to the Whole Produce of Labour: the Origin and Development of the Theory of Labour's Claim to the Whole Product of Industry," by Prof. Menger, translated by Mary E. Tanner; "Elementary Course of Practical Science," part ii., by Hugh Gordon; "Short Studies in Earth Knowledge," by William Gee, with illustrations; "Physiography for Beginners," by J. E. Marr, F.R.S., and Alfred Harker; "Physiology for Beginners," by Dr. Michael Foster, F.R.S., and Dr. L. E. Shore; "Agriculture, Practical and Scientific," by Prof. James Muir; "Horse-Breeding for Farmers," by A. E. Pease; "Garden Plants and Flowers: a Primer for Amateurs," by J. Wright; "Greenhouse and Window Plants, a Primer for Amateurs," edited by J. Wright; "Vegetables and their Cultivation, a Primer for Amateurs, Cottage Gardeners, and Allotment Holders," by A. Dean, edited by J. Wright; "The Mechanism of Weaving," by Thomas William Fox; "Boot and Shoe Manufacture," by C. W. B. Burdett, with numerous illustrations; "Facts about Processes, Pigments, and Vehicles: a Manual for Art Students," by A. P. Laurie, illustrated.

Messrs. Sampson Low and Co. will issue:—"Instruction in Photography," "Photography with Emulsions," "Negative Making," "Colour Vision" (being the Tyndall Lectures delivered before the Royal Institution during the present year), all by Captain Abney, C.B., F.R.S.; "Art and Practice of Silver Printing," written by Captain Abney in conjunction with H. P. Robinson; "Pictorial Effect in Photography," "The Studio, and what to do in it," "Letters on Landscape Photography," by H. P. Robinson; "Specifications, for the use of Surveyors, Architects, Engineers, and Builders," by J. Leaning; "Sweet-scented Flowers and Fragrant Leaves: interesting Associations gathered from many Sources, with Notes on their History and Utility," by Donald McDonald, with sixteen coloured plates; "A Text-book of Mechanics and Hydrostatics, by Herbert Hancock, with over 400 diagrams; "Thermodynamics: treated with Elementary Mathematics, and containing applications to Animal and Vegetable Life, Tidal Friction and Electricity," by J. Parker, with numerous diagrams; "The Theory and Practice of Handwriting: a Practical Manual for the Guidance of Inspectors, School Boards, Teachers, and Students," with diagrams and illustrations, by John Jackson, second edition, greatly enlarged with two additional chapters, two extra appendices, and several pages of facsimile illustrations.

Messrs. Swan Sonnenschein and Co. will publish:—"A

Student's Text-book of Botany," by Dr. Sidney H. Vines, F.R.S., second half, completing the work; also the complete work in one volume; "Text-book of Embryology: Invertebrates," by Drs. Korschelt and Heider, translated and edited by Dr. E. L. Mark and Dr. W. L. Woodworth; part i., fully illustrated; "The Cell: its Anatomy and Physiology," by Dr. Oscar Hertwig, translated and edited by Dr. H. J. Campbell, fully illustrated; "Text-book of Palæontology for Zoological Students," by Theodore T. Groom, fully illustrated, forming a supplement to Claus and Sedgwick's "Text-Book of Zoology"; "Lectures on Human and Animal Psychology," by Prof. Wilhelm Wundt, translated and edited by James Edward Creighton and Edward Bradford Titchener; "Handbook on Systematic Botany," by Dr. E. Warming, translated and edited by Prof. M. C. Potter, fully illustrated; "Introduction to Physiological Psychology," by Dr. Theodor Ziehen, with 21 illustrations, a new and revised edition; "Zoology: Introduction to the Study of," by B. Lindsay, illustrated; "Fishes," by the Rev. H. A. Macpherson. "Flowering Plants," by James Britten; "Grasses," by W. Hutchinson; "Mammalia," by the Rev. H. A. Macpherson; "Pond Life," by E. A. Butler; "English Coins," by Llewellynn Jewitt, new edition; "Rainmaking and Sunshine," by John Collinson.

Mr. Murray's list contains:—"The Life and Correspondence of William Buckland, D.D., F.R.S.," sometime Dean of Westminster, twice President of the Geological Society, and first President of the British Association, by his daughter, Mrs. Gordon, with portraits and illustrations; "The Life of Prof. Owen, based on his Correspondence, his Diaries, and those of his Wife," by his grandson, the Rev. Richard Owen, with a chapter by the Right Hon. T. H. Huxley, with portraits and illustrations, 2 vols.; "The Scientific Papers and Addresses of Werner von Siemens," volume ii., including the following subjects: induction writing telegraph, magneto-electric quick type-writer, electric water-level indicator, mine exploder, alcohol meter, the universal galvanometer, automatically-steered torpedoes, automatic electric lamp, electric plough, electric elevator, electricity meter, energy meter, &c., with illustrations; "Handbook of Ancient Roman Marbles, consisting of a History and Description of all Ancient Columns and Surface Marbles still existing in Rome, with a List of the Buildings in which they are found," by the Rev. H. W. Pullen; "An Introduction to Physical Science," by Prof. John Cox; "The History of Astronomy," by Arthur Berry.

Messrs. Longmans and Co. have in the press, or in preparation:—A new edition, in four volumes, of Prof. Max Müller's "Chips from a German Workshop." The first volume will contain "Recent Essays," the second "Biographical Essays," the third "Essays on Language and Literature," and the fourth "Essays on the Sciences of Language, of Thought, and of Mythology"; "Butterflies and Moths (British)," by W. Furneaux, with twelve coloured plates and a large number of illustrations in the text; "Studies of Nature on the Coast of Arran," by George Milner, with illustrations; "From Edinburgh to the Antarctic," by W. G. Burn Murdoch; profusely illustrated by the author; supplemented by the Science Notes of the naturalists of the expedition, W. S. Bruce, J. J. W. Campbell, and C. W. Donald; "A Primer of Evolution: being a popular abridged edition of 'The Story of Creation,'" by Edward Clodd, with illustrations; "The Teaching of Physical Exercises," by F. J. Harvey; "Jacquard Weaving and Designing," by F. T. Bell; "The Magnetic Circuit in Theory and Practice," by Dr. H. Du Bois, translated from the Serman.

Mr. Edward Stanford's forthcoming works include:—"Cloudland," a study of the nature and forms of clouds, by the Rev. W. Clement Ley, with a number of coloured illustrations and reproductions from photographs; a third edition of Prof. James Geikie's "The Great Ice Age," almost entirely rewritten and with a new chapter on "The Glacial Phenomena of North America," by Prof. T. C. Chamberlin, also some new maps and diagrams; an addition, by Dr. Guillemard, on "Malaysia and the Pacific Archipelagoes," to Stanford's "Compendium of Geography and Travel," with numerous new illustrations and maps; and in the same series, volumes on "Africa" and "Asia," by A. H. Keane; a second edition of J. Scott Keltie's "The Partition of Africa," brought up to the most recent changes, and with some new maps.

In Messrs. Blackie and Son's list we notice:—"A Text-book of Organic Chemistry," by Dr. A. Bernthsen; translated by Dr. George M'Gowan, new edition, thoroughly revised and much enlarged by author and translator; "Elements of Metallurgy," by W. Jerome Harrison and William J. Harrison, jun., fully illustrated; "The Natural History of Plants: their Forms, Growth, Reproduction, and Distribution," from the German of Prof. Anton Kerner von Marilaun, translated by Prof. F. W. Oliver, with assistance of Marian Busk and Mary Ewart, with about 1000 original woodcut illustrations and sixteen plates in colours, issued in sixteen parts, also in four half-volumes, at intervals of four months.

Messrs. Whittaker and Co. will shortly issue a new edition, mostly rewritten, of Gisbert Kapp's "Electric Transmission of Energy;" "Model Engine Construction," by J. Alexander, with working drawings; "Steel Works Analysis," by Prof. J. O. Arnold; "Steam Power and Mill Work," by G. W. Sutcliffe; "The Manufacture of Modern Explosives," by Oscar Guttmann; the third and fourth (concluding) parts of C. Gordon Brodie's "Dissections Illustrated"—they will include the head, neck, and thorax, and the abdomen, respectively.

Messrs. Crosby Lockwood and Son have nearly ready for publication:—D. K. Clark's new volume on "Tramways, their Construction and Working," in which will be given a comprehensive history of the earlier forms, as well as the latest developments of tramways in this country and abroad, including the various modes of traction; a popular handbook on "Fertilisers and Feeding Stuffs, their Properties and Uses," by Dr. Bernard Dyer, with Notes on the Fertilisers and Feeding Stuffs Acts of 1893, by Mr. A. J. David.

Mr. T. Fisher Unwin is preparing:—"Travels and Studies in the Far East," by Henry Norman, illustrated; the volume supplementary to "Climbing and Exploration in the Karakoram Himalayas," by Prof. W. M. Conway, containing the scientific memoranda of the expedition by the author and various specialists; "In the Guiana Forest," by James Rodway, illustrated; "The Mountains of California," by John Muir, illustrated; and "The Story of Australian Exploration," by R. Thynne, illustrated.

The Clarendon Press will publish shortly:—"A Glossary of Greek Birds," by D'Arcy W. Thompson; "Index Kewensis," compiled at the expense of the late C. R. Darwin, under the direction of Sir Joseph D. Hooker, by B. Daydon Jackson, part iii.; "A Monograph on the Oligochæta," by Frank E. Beddard, F.R.S.; "A Manual of Crystallography," by M. H. N. Story-Maskelyne, F.R.S. (This work, which has been so long announced, is on the point of publication.)

Messrs. W. and R. Chambers have in the press, or in preparation:—"Chambers's Concise Gazetteer of the World," topographical, statistical, and historical, with pronunciation of the more difficult names of places and information regarding the derivation of names; "Elementary Science," by S. R. Todd; "Organic Chemistry," part ii., by Prof. Perkin and S. Kipping.

Messrs. Chapman and Hall announce:—"The Progress of Science: its Origin, Course, Promoters, and Results," by V. Marmery; "Naval Architecture and Shipbuilding," by G. V. C. Holmes, illustrated: "Machine Construction: a Key to the Examinations of the Science and Art Department," by Hy. Adams; "A Text-book of Mechanical Engineering," by Wilfrid J. Lineham; "Practical Plane and Solid Geometry," by Henry Angel; "The Nests and Eggs of Non-Indigenous British Birds," by Charles Dixon.

Messrs. A. and C. Black's arrangements include:—"Monism; or, the Confession of Faith of a Man of Science," by Prof. Ernst Haeckel, translated from the German by J. D. F. Gilchrist; "The Senile Heart: its Symptoms, Sequelæ, and Treatment," by Dr. George William Balfour; the last part of the "Dictionary of Birds," by Prof. Newton.

Messrs. Cassell and Co. have in hand:—"The Electric Current, how Produced and how Used," by R. Mullineux Walmsley; a new edition of "Electricity in the Service of Man," revised by Dr. Walmsley; "The Year-Book of Treatment for 1895."

Messrs. G. Bell and Sons promise:—"Arithmetic for the Standards," by Charles Pendlebury and W. S. Beard; "Cotton Weaving," by R. Marsden, illustrated; an authorised abridgment of "Webster's International Dictionary," entitled "Webster's Brief International Dictionary."

Messrs. Methuen and Co. will publish in their University

Extension Series:—"Insect Life," by F. W. Theobald, illustrated.

In Mr. Edward Arnold's list we find:—"Psychology for Teachers," by Prof. C. Lloyd Morgan; "Systematic Science Teaching," by Edward G. Howe

The S.P.C.K. announce:—"Edible and Poisonous Mushrooms: what to eat and what to avoid," by Dr. M. C. Cooke, with eighteen coloured plates illustrating forty-eight species.

Messrs. G. P. Putnam's Sons will issue:—"Diagnosis, Differential Diagnosis, and Treatment of Diseases of the Eye," by Dr. A. E. Adams.

Messrs. W. B. Whittingham and Co. give notice of a book entitled "What is Heat?—a Peep into Nature's most Hidden Secrets," by Frederick Hovenden.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MAJOR CRAIGIE, the Director of the Statistical Department of the Board of Agriculture, has presented a report on the distribution of grants for agricultural education in Great Britain in the financial year 1893–94. From a summary in the *Times*, it appears that out of the total vote of £8000 entrusted to the Board of Agriculture for educational purposes the necessary provision had been made for the cost of inspection, and the sum of £7450, which remained available, had been applied in the form of specific grants, a small sum being devoted to the reproduction of the records of the Rothamsted experiments for the past fifty years. The Board had been confirmed by further experience in their estimate of the value of establishing fully-equipped agricultural departments in collegiate institutions capable of aiding the work of distinct groups of local authorities charged with the provision of technical education. The collegiate centres established by the several University colleges at Bangor, Leeds, Newcastle, and Aberystwyth had continued to develop and to extend their usefulness as centres of educational energy for the surrounding counties. Further centres had been fully equipped and new agricultural teaching organisations definitely set on foot, on lines more or less similar, at Cambridge, Nottingham, and Reading. In Scotland, where the institution of definite centres was being more slowly developed than in England, several of the south-western counties had continued to make use of the facilities for agricultural instruction offered by the central classes provided, and by the itinerant lecturers supplied for local work by the Glasgow and West of Scotland Technical College. Besides assisting institutions such as the Durham College of Science and the Glasgow Technical College, where lectures on certain forestry subjects were included in the general curriculum, the Board had again been able to repeat the grant towards the cost of the special forestry class established in the University of Edinburgh. An endeavour had been made to continue, although necessarily on a reduced scale, the assistance given to experimental work, and provision had also been made for experiment stations or demonstration plots at each of the Welsh colleges. A beginning in the same direction had been made at Reading. The grants awarded by the Board during the year range from £800, given to the University College of North Wales, at Bangor, the Yorkshire College, Leeds, and the Durham College of Science, Newcastle-on-Tyne, to £25 given to the Dounby Science School, Orkney. In all there were twenty grants, eight being for work in collegiate centres, five for agricultural experiments, three for dairy instruction, one for special cheese research and agricultural experiments, one for forestry work, and two for special classes.

SCIENTIFIC SERIALS.

American Journal of Science, September.—The effect of glaciation and of the glacial period on the present fauna of North America, by Samuel H. Scudder. Statistics of the number of genera and species found in the areas formerly covered by the ice-sheet and the driftless areas respectively, and of the number common to both, would indicate whether the northern fauna had recovered from the effects of glaciation. Tables are given showing this for the Coleoptera, as the best known among insects, which are very sensitive to climatic changes. The conclusion arrived at is that, on the whole, the fauna has nearly or quite recovered from its enforced removal from the Northern States and Canada.—Tertiary and later history of the island of Cuba, by Robert T. Hill. No positive evidences of subsidence after the beginning of Tertiary time could be discovered. Nowhere do the rivers show any revival or other evidence of subsidence below the sea-level, but all have continuous downward cutting sections. On the other hand, some of these streams are now forming delta deposits in places outside their mouths, which is more indicative of present elevation than of subsidence. Since the old folding or orogenic movements occupied at least a small portion of post-Tertiary time, we may reasonably conclude that the periods of uniform uplifting must have taken place at least since the beginning of the Pleistocene. In other words, they are comparatively modern in geologic time—some of them absolutely recent.—Thermoelectric heights of antimony and bismuth alloys, by C. C. Hutchins. The best combination for a thermo-junction from these alloys is, for one element, bismuth with from 2 to 5 per cent antimony; and for the other, bismuth with from 5 to 10 per cent. tin. They may be cast into thin leaves as follows: Two pieces of plate glass are smoked slightly, or are very finely ground, and rubbed with plumbago. The metal being melted upon charcoal or under fused sodium chloride, a little pool is formed upon one plate, and the other is applied to it as quickly as possible. Leaves thus obtained can be worked with a fine file as thin as 0·03 mm. and are sufficiently tough to stand ordinary treatment.—On the nitrogen content of California bitumen, by S. F. Peckham. Oils from the tunnels in Wheeler's cañon on the south side of the Sulphur Mountain yielded 1·1095 per cent. of nitrogen. These and other oils of this region issue from strata protected from infiltration of rain-water and accompanying oxygen by overlying formations.

Quarterly Journal of Microscopical Science, vol. xxxvi. part 3.—Prof. A. G. Bourne gives an exhaustive account of the structure of *Moniligaster grandis*; and adds a revision of the genus, including diagnoses of some new species. Some good coloured figures of the different species accompany Prof. Bourne's memoir.—Mr. E. W. Macbride has a review of Spengel's monograph on Balanoglossus, and criticises that author's views on the affinities of the Enteropneusta.—Under the name *Monocystis herculea*, Mr. W. C. Bosanquet gives a number of observations on the structure and life-history of a large Gregarine found in the earth-worm *Lumbricus herculeus*.

Wiedemann's Annalen der Physik und Chemie, No. 9.—On refractive power and density of dilute solutions, by W. Hallwachs. The increase in the difference of molecular refraction previously observed with increasing dilution is completely explained by the peculiar behaviour of the density. The constitutive influences analogous to dissociation, which find their most characteristic expression in the changes of electric conductivity, have no effect upon the refractive power.—On the motion of dielectric bodies in the homogeneous electrostatic field, by L. Graetz and L. Fomm. Mascart and Joubert, in their development of Poisson's original theory, assume that small bodies placed in a dielectric do not exert any forces upon each other. This is contradicted by experiments upon small bars and plates of dielectric materials introduced into homogeneous fields, which tend to turn their axes and planes respectively into a direction parallel to the lines of force. When the condenser plates are statically charged, the rotations depend upon the sign of the charge, but in the case of oscillations they are always in the same direction and proportional to the square of the difference of potential. A small disc, made of sulphur or paraffin, suspended between the plates may be used as a "dielectric voltmeter."—On electric oscillations of long duration and their effects, by H. Ebert. The author investigates the conditions of obtaining the best luminous effects of the type of those produced by Tesla. He points out that the secondary circuit must be tuned to the primary, and that the condensers must have the least possible capacity. He describes a "luminescence lamp" made of a glass globe containing a piece of luminous paint. Oscillations are conducted to tinfoil armatures on the globe, and produce vivid luminescence. The light effects were about one-thirtieth or one-fortieth of the amyl-acetate standard. The energy consumed counted by millionths of a watt, so that the economy of the new lamp is very striking, consuming as it does only about a two-thousandth of the energy consumed by the acetate lamp. The difficulty involved in the fact that the high frequency currents employed could not be conducted any distance without encountering enormous inductive resistances, could be got over by effecting the transformation in the immediate neighbourhood of the lamp. Since only condensers of small capacity and inductance are required, a transformer might be attached to the lamp itself.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 21.—"On the Evolution of the Vertebral Column of Fishes." By Dr. H. Gadow, F.R.S., and Miss E. C. Abbott.

The following are a few of the more important points in the paper:—Each skleromere lies within the influence or range of action of two successive myomeres. Taken as a whole, the skleromere is "interprotovertebral," more correctly bi-protovertebral, because it is composed of two successive sklerotomes, namely, the ventral half of one and the dorsal half of a second.

Consequently, the "resegmentation" or "neugliederung" is brought about in a manner fundamentally different to that hitherto supposed to have taken place. If A and B mean two successive sklerotomes, a and b their dorsal, α and β their respective ventral halves, then the new skleromere is composed of $b+\alpha$ and not of $\frac{A+B}{2}$.

The formation of a skleromere by the combination of alternating dorsal and ventral halves of sklerotomes explains also the presence of eight (four pairs) cartilaginous pieces, namely, basalia (so-called dorsal and ventral arches) and interbasalia (so-called intercalary pieces) for each complete segment.

Concerning the formation of centra or bodies of the vertebræ, we distinguish:—

I. *Chorda-centra, i.e.* centra cut out of the full of the chordal sheath, which itself has been strengthened by invasion of cartilaginous cells from the skeletogenous layer. Chorda-centra are possessed by all Elasmobranchs, potentially by Dipnoi and Holocephali.

II. *Arch-centra, i.e.* centra formed by the skeletogenous mass which remains entirely on the outside of the chordal sheath, which latter takes no share in their formation: osseous Ganoids and Teleostei.

Chorda-centra and arch-centra represent two different modes of development, each starting from an acentrous condition. This can be expressed as follows:—

Chordal sheath remaining entirely chordagenous.	Chordal sheath strengthened by invasion of skeletogenous cells, therefore with possibility of chorda-centra.
Cyclostomata.	
Cartilaginous Ganoids.	Dipnoi and Holocephali.
Formation of Centra.	
Osseous Ganoids, Teleostei.	Elasmobranchs.
ARCH-CENTRA.	CHORDA-CENTRA.

The formation of chorda-centra being independent of the arcualia explains how and why the number of "centra" does not necessarily agree either with that of the arcualia or with that of the trunk-segments, *e.g.* Hexanchus and tail of most other Elasmobranchs.

In *Amia calva*, the *postcentrum, i e.* the posterior, archless disk of a complete tail-vertebra, is formed by the interdorsalia and interventralia of the same sklerotome, while the *precentrum, i.e.* the arch-bearing disk or anterior half is formed by the basidorsals of the same sklerotome and the basiventrals of the next previous sklerotome. The intermuscular septum runs obliquely across the precentrum, or, in other words, the precentra are bi-protovertebral or bi-myomeric, but not the postcentra.

In *Lepidosteus osseus* the combination of parts into one vertebral complex is superior to that of Amia, because each vertebra belongs, with its entire anterior half, to one, and with its posterior half to the next following myomere. The vertebræ are now truly bi-protovertebral or bi-myomeric.

PARIS.

Academy of Sciences, September 10.—M. Lœwy in the chair.—Truffles (*Terfâs*) from Tunis and Tripoli, by M. Ad. Chatin. Truffles have been received by the author from Tunis belonging to the species *Terfezia Claveryi.* They seem always to occur in company with a herb called by the natives *Arong-Terfess*, which is *Helianthemum sessiliflorum*, Pers. (*Cistus sessiliflorus*, Desf.). Truffles similarly received from Tripoli are classed as *Terfezia Boudieri.*—On the equations of mechanics, by M. Wladimir de Tannenberg.—On Pfaff's problem, by M. A. J. Stodolkievitz.—On another determination of the circle derived from seven right lines and on some of its applications, by M. Paul Serret.—On Diptera harmful to cereals; observations from the Paris Entomological Station in 1894, by M. Paul Marchal. *Cecidomya destructor* (Say) has been very prevalent among wheat in the West. Oats have hitherto been considered proof against Hessian fly, but a form of Cecidomya has ravaged large districts in 1894. It remains to be seen whether this fly is a new species or only a variety of *Cecidomya destructor* modified by the difference of food. Other pests noted which have caused serious damage are the following: *Cecidomya* (*Diplosis*), *tritici* (Kirb.), *Oscinis pusilla* (Meig.), *Camarota flavitarsis* (Meig.), which has not heretofore been considered as injurious to cereals, and *Elachiptera cornuta* (Meig.).—On the recent fall of aeroliths in Greece, by M. C. Maltézos.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—An Introduction to Physical Measurements: Dr. F. Kohlrausch, translated by Waller and Procter, 3rd edition (Churchill).—A Naturalist on the Prowl: "Eha" (Thacker).—Primer of Hygiene: Dr. E. S. Reynolds (Macmillan).—Elements of Marine Surveying: Rev. J. L. Robinson, 2nd edition (Macmillan).—Theophrastus of Eresus on Winds and on Weather Signs, translated, &c., by J. G. Wood (Stanford).—Missouri Botanical Garden, Fifth Annual Report (St. Louis).—Municipal Technical School and Municipal School of Art, Manchester, Session 1894-5, Syllabus (Manchester).—The Earth: E. W. Small (Methuen).

PAMPHLETS.—Creameries and Infectious Diseases: Dr. J. J. Welpley (Baillière).—The Cretaceous Rim of the Black Hills: L. F. Ward (Chicago).—Principes et Méthodes d'Étude de Corrélation Géologique au Moyen des Plantes Fossiles: L. F. Ward (Chicago).

SERIALS.—Proceedings of the Society for Psychical Research, Part xxvi. Vol. x. (K. Paul). Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie, Achtzehnter Band, 5 Heft and Neunzehnter Band, 2 and 3 Heft (Leipzig, Engelmann).—Journal of State Medicine, August (Renshaw).—Journal of the Franklin Institute, September (Philadelphia).—Museum d'Histoire Naturelle des Pays Bas, tome xiv. Catalogue-systematique, &c.: F. A. Jentink (Leide, Brill).—Quarterly Journal of Microscopical Science, August (Churchill).—Proceedings of the Academy of Natural Sciences of Philadelphia, 1894, Part 1 (Philadelphia).—Insect Life, Vol. vi. No. 4 (Washington).—Journal of the Royal Horticultural Society, Vol. xvii. Parts 1 and 2 (117 Victoria Street).—Psychological Review September (Macmillan).—Abstract of the Proceedings of the Linnean Society of New York for the Year ending March 27, 1894, No. 6 (New York).—American Historical Register, No. 1 (Philadelphia).—Economic Journal, September (Macmillan).

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