THURSDAY, JANUARY 18, 1883

GEIKIE'S GEOLOGY[1]

Geological Sketches at Home and Abroad. By Archibald Geikie, LL.D., F.R.S. With Illustrations. (London and New York: Macmillan and Co., 1882.)

Text-Book of Geology. By Archibald Geikie, LL.D., F.R.S. With Illustrations. (London: Macmillan and Co., 1882.)

II.

WE now come to consider the quality of the matter contained in the volume, the discrimination exercised in its selection, the validity of the theories presented, and the fidelity with which the science is portrayed. It is the function of a text-book to exhibit to the student an impartial and symmetric outline of the science. Its author is under obligation to present the views which are generally entertained by the great body of geologists, carefully withholding those which are peculiar to himself. From the great mass of available matter he must select that which will afford a well-balanced and comprehensive review, and he must sedulously avoid giving undue prominence to those matters which have special interest to himself by reason of his individual studies. In the work before us this has been accomplished in a manner which may truly excite admiration. Although the author is an original investigator in several departments of the science he delineates, he has permitted his own predilections to give little if any additional prominence to his special topics, and the wisdom he has displayed in the selection of material and the balancing of parts will commend itself to all professional readers.

It is useless to attempt an analysis of a work which is itself an epitome of a great science, but we may refer to the treatment of a few mooted points and to a few matters of novelty or of current interest.

The microscopical characters of rocks are treated more at length than in any other text-book. In the general account of rock characters they are accorded even more space than are the macroscopical, and they form part of the description of each specific rock. They are, moreover, illustrated by a series of cuts, showing the appearance of thin slices when highly magnified. A chapter is devoted to the subject of rock determination, and an analytical table is included therein.

The results of the *Challenger* exploration of the bottom of the ocean are given at some length, and the conclusion is drawn that the continental regions of the globe have been marked out from the earliest geological times. This is not treated as an hypothesis but as an established theory, and its logical consequences appear in numerous places.

In the taxonomic terms of stratigraphy, the convention of the Bologna Congress is not adopted. The terms *system, series,* and *stage* are used in the same order, but *group,* which by the congress was made more comprehensive than *system,* is by Geikie used as the equivalent of *stage.* He remarks, with propriety, that the attempt to alter the signification of a term so universally employed in English literature would produce far more confusion than can possibly arise from a failure to conform to continental usage.

[1] Continued from p. 239.

One of the most conspicuous omissions of the book is with reference to the antiquity of man. The subject is treated with great brevity, because it is regarded as belonging more properly to archæology, but an account is nevertheless given of the earliest human vestiges. Mention is made of man's association with the Loess and with the inter-Glacial deposits of Europe, but the Californian claims to his pre-Glacial existence are ignored. It is true that these claims have been disputed, and it is true that the evidence in regard to each of the individual finds upon which they rest is incomplete; but since Whitney has assembled all the facts in his "Auriferous Gravels," it must be admitted that their cumulative force entitles them at least to recognition and consideration, however slow we may be to accept them as demonstrative.

In the section which treats of man as a geological agent, there are enumerated a great variety of ways in which he modifies the face of nature, but one of the principal, if not indeed the chief of all, is omitted, namely, the stimulus he gives to denudation by tilling the soil. The mat of vegetation, living and decaying, which naturally covers the soil in all humid regions, affords great protection against the erosive work of rain. Not only is the beating of the rain resisted, but the velocity of its outflow is retarded, so that from surfaces of gentle inclination it washes away very few particles. When this mat has been removed, and especially when the surface has been stirred by the plough, the conditions become exceedingly favourable to rain erosion, and the rain rills are charged with sediment. Moreover, cultivation and the cutting of forests increase the magnitude of river floods, and since rivers perform their chief work of erosion and transportation during flood-stage, the quantity of their work is thus augmented. It is safe to say that the rate of degradation of the surface by rains and rivers is increased several hundred per cent. by the removal of forests and the tillage of the soil, and it may be added that for this reason most attempts to measure the natural rate of denudation by means of the outscour of rivers have been abortive.

The unconformability between the Archæan and the Palæozoic is not mentioned in such way as to convey an impression of the profoundness of the chronological break. There is no known locality where a newer formation rests conformably upon the Archæan. There are few where the discordance of dip is not great. There are few where the superior formation is not relatively unaltered, and none where the inferior formation is not highly metamorphosed. So far as we know, the Archæan strata were both thrown in great folds and plicated in detail, were universally subjected to a metamorphism such as in later rocks seems to have been accomplished only at a depth beneath the surface, and were subsequently worn away upon a most stupendous scale before they received any sedimentary covering within the regions now accessible for examination. Compared with this, all other chronological breaks are trivial, and we may almost say that, compared with this, all other stratigraphical breaks are local.

In treating of the condition of the interior of the earth, Geikie concisely presents the prominent hypotheses, and then remarks that it is "highly probable that the substance of the earth's interior is at the melting-point proper for the pressure at each depth." In treating of the age of the earth, he sets forth the geological and the physical arguments with commendable brevity, but withholds all expression of individual opinion. In treating of the origin of orographical displacement he gives a brief history of opinion, and states that the contractional hypothesis is now generally accepted. A foot-note, however, refers to Fisher's "Physics of the Earth's Crust," which appeared while the text-book was passing through the press. The cause of ice motion is not discussed.

In the classification of formations there is nothing new. The Cambrian and Silurian are marked as independent and co-ordinate divisions, the latter beginning with the Arenig group in Great Britain and with the Calciferous in America, but the opinion is expressed that a subsequent revision of the subject may result in "throwing all these older Palæozoic rocks into one palæontological system." The pre-Cambrian rocks are designated by Dana's title of Archæan. The Rhætic is included with the Trias. In the table of formations the American Laramie is placed in the Tertiary; but this appears to have been done by inadvertence, for in the descriptive text which follows it is treated as Cretaceous.

In the classification of rocks the primary division is into crystalline and clastic. The crystalline are separated into stratified, foliated, and massive, and the clastic into sand rocks, clay rocks, volcanic fragmental, and organic fragmental. Of the massive crystalline rocks, the principal sub-group is indicated as *feldspar bearing*, and four small groups (the nepheline rocks, the leucite rocks, the olivine rocks, and the serpentine rocks) are indicated as co-ordinate with this.

The subject of geological climate is treated almost exclusively from the astronomical point of view, and the theory of Croll is the only one which receives more than passing mention. Its statement was prepared especially for the volume by Dr. Croll himself, and covers six pages. It is undoubtedly true that this theory has been widely accepted, that it is very generally entertained as a working hypothesis, and that it is the most probable one before the public; and it should for these reasons be given great prominence in a text-book; but I cannot help regretting that it has been presented with so little qualification. It deals with a series of physical laws and physical conditions which interact upon each other in an exceedingly complex way—in so complex a way that meteorologists, who have to deal with only a portion of them, do not claim and scarcely hope for a complete analysis of their combinations. The opportunities for arguing in a circle are most seductive, and the *a priori* probability that important considerations have been overlooked is not small. The only manner in which so comprehensive and intricate an hypothesis can be established is by stimulating inquiry which shall lead to corroborative evidence, and this is precisely what Croll's hypothesis after eight years of wide publicity has failed to do. If it is true, then epochs of cold must have occurred with considerable frequency through the entire period represented by the stratified rocks; and iceberg drift, if no other traces, should have been entombed at numerous horizons. It has not been found, however, and of the eight horizons claimed by Croll to show evidence of glacial action, the treatise under consideration mentions only two with confidence, and two others with doubt. In the two instances to which queries are not attached, the phenomena appear to indicate local and not general glaciation. If the hypothesis is true, the cold of the Glacial epoch must have been many times interrupted by intervals of exceptional warm, but little has been added to the evidence adduced by Croll for such an interruption, and in America, where there is now great activity in the investigation of glacial phenomena, the evidence of a *single* inter-glacial period is cumulative and overwhelming, while there is no indication whatever of more than one. If the hypothesis is true, submergence in polar and temperate regions should have been coincident with glacial expansion, and emergence coincident with glacial retreat, but the Quaternary history of Great Britain, as drawn in the new text-book, includes two periods of maximum ice-extension, *separated* by a period of maximum submergence. While these difficulties exist it appears to me unadvisable to convey to the student the impression that a satisfactory solution to the problem of glacial climate has been reached.

Because I have mentioned some points in which my individual judgment differs from that of Prof. Geikie, it must not be supposed for a moment that I undervalue his work, or that I regard it with anything short of enthusiastic commendation. It is broad and catholic, conscientious in detail, masterly in treatment. It is imbued especially with a spirit which for want of a better name may be called scientific modesty. The majority of our text-books, including all of our best text-books, have been written by teachers, and have been more or less affected by the peculiar mental attitude of the teacher. The investigator is under the constant necessity of holding his judgment in abeyance, and of treating every conclusion as an hypothesis, to be tested by future researches, and possibly amended or even abandoned. The teacher is under an equal necessity to formulate his knowledge so that he may communicate it in definite shape—he must not doubt, he must know; and under this compulsion he naturally and unconsciously acquires an undue confidence in results that have simply arisen from the weighing of probabilities. He is especially tempted to regard classifications as final, and not to recognise them as temporary presentations of temporary stages of knowledge. It is the especial merit of Prof. Geikie's book that it is untainted by this teacher's bias. It cautions the student against the confusion of geological synchrony with stratigraphical homotaxis; it cautions against the free use of palæontological evidence in the inference of geological climate; it cautions against deductions which may be vitiated by the imperfection of the geological record, and against negative evidence in general; it cautions against the impression that there are in nature any hard and fast lines separating epochs or formations or rock species; and, in addition, it heeds its own cautions. Its readers cannot escape the impression that the science of geology is in its youth, that it is developing at a rapid rate, that many of its results are tentative, and that its unsolved problems are as numerous and important as those it has successfully attacked.

It is only by a conscious effort that one gives attention to the literary style of Prof. Geikie's text-book. It is so direct and plain that it serves the purpose of conveying thought without leaving an impression of the manner of conveyance. As in the matter, so in the manner, his personality is not permitted to intrude. He says one thing at a time, and therefore his sentences are short; but he does not exaggerate, and therefore he never indulges in epigram.

A noteworthy feature of the illustrations is the reproduction of a large number of De la Beche's cuts, which are derived directly from the original blocks. All of these are good, and so are the majority of the remaining illustrations, but there is also a considerable number, especially in the chapters on stratigraphy, which are not so distinct as is desirable, and which probably owe their imperfection to the employment of some photo-mechanical process. The typography is excellent, and a page of errata is not called for.

The foot-notes contain a very large number of useful references. These are not mere citations of authorities in support of statements in the text, but are indications to the student of treatises in which he may find the fullest exposition of subjects to which the text introduces him.

G. K. GILBERT,
U.S. Geological Survey

SACHS'S TEXT-BOOK OF BOTANY

Text-Book of Botany, Morphological and Physiological. By Julius Sachs, Professor of Botany in the University of Würzburg. Edited, with an Appendix, by Sidney H. Vines, M.A., D.Sc., F.L.S., Fellow and Lecturer of Christ's College, Cambridge. Second Edition. (Oxford, 1882.)

THERE are not wanting signs that the study of botany is steadily increasing in this country. An immense number of text-books or manuals have been published in English during the last thirty years on the subject, some of which have been very popular, to judge by the many editions they have passed through. Referring to these introductions to the study of botany in general terms, it was to be noted that they all, in a more or less complete manner treated of the vegetable kingdom from a morphological and classificatory point of view; but that the morphological portions were deficient in clear descriptions or conceptions of the origin or development of the members of the plant's body which they described, and the student who required instruction as to physiological, anatomical, or embryological details, had to look for such in the pages of the botanical periodical literature of the day. Most modern workers in biology will agree that the greater portion of this literature was derived from German sources, and it is scarcely to be denied that the first general compendium of note appeared in the German text-book of Sachs. This work had reached a fourth edition in 1874, but the previous editions had found their way into several of the centres of botanical teaching in Great Britain and Ireland, and had caused a considerable change in the older methods of teaching botany. Still it must have been a matter requiring some courage for the delegates of the Clarendon Press to undertake the costly work of translating, editing, and printing in English this work of Sachs', forming a large octavo volume of nearly 1000 pages, a text-book one would think far too large and expensive for most ordinary students. This work was, however, issued from the Clarendon Press in the spring of 1875, and it is not without interest to note that for the last two or three years it has been completely out of print, so that the edition must have been exhausted in the course of the first four or five years after its issue. It was most unfortunate that this edition, so ably translated by Messrs. Bennett and Thiselton Dyer, had not been based on the fourth German edition, which had been published nearly a year before the English translation made its appearance. The success of the translation may, however, be looked on as to a certain extent condoning this misfortune, and there can be doubt as to the revolution in the study of botany in these kingdoms, which has been brought about by its appearance. Instead of to an endless catalogue of under- and above-ground forms of stems, instead of a list as long as that of the ships in Homer of the forms of simple and compound leaves, the student has had his attention—at least in some schools—called to the important structures to be met with in these varied portions of a plant and to their peculiar functions and ontogeny. The subject of plant life and development seems to have become of more especial interest and to have fallen like a new story on many even old ears. It was not, under these circumstances, surprising that a new edition was called for, but it did excite some surprise that, having in a great measure made the demand, the Delegates of the Clarendon Press seemed unable for a time to supply it, and let several Long Vacations glide by without its appearance; even this new edition comes to us late in the autumn season of the year, when the year's fruits have been well garnered in. Still it is welcome as an important contribution to the study of a science that has of old and for long been fostered by the University of Oxford.

Welcome as this new edition is, it would, we firmly believe have been a much more complete text-book and have reflected more of credit on the Clarendon Press Series, if the present Editor had been given a fairer field to work on. Although the fourth German edition was in advance of the previous one, yet the half-dozen years that have elapsed since it made its appearance have been years during which botany has advanced with no tardy footsteps. Even Prof. Sachs himself could not be persuaded to face the torture of a fifth edition of the original, for he felt, as he tells us, that the expanded views of the present period would not even fit into the framework of his text-book, so that a faithful translation of the fourth edition is even more out of date in 1882 than the translation of the third edition was in 1875.

Hence it must have been distressing for the Editor of the volume before us to find, on entering on his task, that nearly the whole of Book I., which treats of the general morphology of the cell, the tissues, and the external conformation of plants had been for some time in type, and that consequently a number of recent discoveries had not been noticed in it. No one could have been better fitted than Mr. Vines to have brought this most important section up to date, and it is a pity that only 32 out of its 232 pages were reprinted, for there is a decided awkwardness in looking in an appendix for supplementary remarks which are often found to explain away or totally alter the meaning of the text.

As it is, we would emphasise the prefatory remark of the Editor, that "the Appendix has come to be an important feature" of the book, and is to be especially recommended to the notice of the reader. The student who will judiciously introduce the new material in this appendix into the older structure in the text will be afforded a tolerably clear insight into the present standpoint of vegetable morphology.

Book II. forms the largest third of the volume, and from a purely critical point of view, was the least satisfactory portion of the original. No doubt it was by far the most difficult portion to condense into any reasonable compass, and it bristled with unknown quantities and controverted points, and indeed it may well be doubted if the immense subject of "General Morphology and Outlines of Classification" could be fairly well mastered by any one botanist. That the editor has added a great deal of new material—no doubt assisted by some whose criticisms and suggestions he gratefully acknowledges—is, on the face of this second book, abundantly clear. That a good deal might have been still added is also, on a little examination, made apparent. Detailed criticism on this portion of the volume would be here to a large extent out of place, and serve no good end, but as a justification of these remarks we would observe that among the very first forms alluded to—the Protophyta arranged under the Cyanophyceæ—of which the Nostocaceæ form a highly interesting group—the description of the formation of the Nostœ filament, though amended, as noted within brackets, is, despite the warning of Bornet, founded on a misconception of Thuret's account. In a footnote, too, we read that Archer has described the occurrence of spores in *Nostoc paludosum*, as if this were something novel, but their appearance in many species has not only been known to but made even a factor in their classification by Bornet. It seems inexplicable to us why this distinguished author's works should be so little known to English writers, but so it is, and on turning over page 247 to see what would be said about the Rivulariaceæ—the Scytonemaceæ—we felt disappointed at not finding even a reference to show the student how much has been done by Bornet in recent years to add to our knowledge of these groups. To these remarks we will only add that the large and important groups of Palmellaceæ are dismissed in a paragraph of ten lines. In order that these remarks may not be mistaken, we may observe that we did not expect to find more than a sketch of the natural history of the forms to be found in these groups lying at the base of chlorophyllaceous life, but we did expect that what was narrated of these would be exact, and that a reference to the latest literature of the subject would be given. It would be easy, at least among the Thallophytes, to extend these criticisms. Such an excessively interesting algal form as Pithophora is nowhere alluded to, though its first birth-place seems to have been our Royal Gardens at Kew. Wittrock's paper on this form was fully as important as his on Mesocarpeæ. Nor is the student referred under Fucoideæ to the splendidly illustrated work on the group by Thuret and Bornet; but criticism is not our object, and we gladly pass from the notice of Book II. to notice Book III., from which, knowing the excellent work done by the Editor in vegetable physiology, we expected great things, nor have we been disappointed. It seems to us an excellent account of vegetable physiology, with all or most of all the modern discoveries alluded to, and we know of no compendium on the subject at all approaching to it.

Should in another four years this second English edition be sold out, let us hope that Mr. Vines will, like its author, cease trying to mend the old garment, but will of his own energy and knowledge give us an Introduction to the Study of Botany, which we doubt not would be worthy of appearing as one of the Clarendon Press Series, and which will wipe away the reproach, true to this of physiological botany as of the drama, that we are forced to fly with all too borrowed plumes.

E. P. WRIGHT

RECENT ELECTRICAL PUBLICATIONS

Electricity. By Robert M. Ferguson, Ph.D., F.R.S.E., of the Edinburgh Institute. New Edition, revised and extended by James Blyth, M.A., F.R.S E., Professor of Math. and Nat. Phil. in Anderson's College, Glasgow. (London and Edinburgh: W. and R. Chambers, 1882.)

Electric Illumination. By Conrad Cooke, James Dredge, M. F. O'Reilly, S. P. Thompson, and H. Vivarez. Edited by James Dredge. Chiefly compiled from *Engineering.* With Abstracts of Specifications, prepared by W. Lloyd Wise. Vol. I. (London: Office of *Engineering*, 1882.)

PROFESSOR BLYTH has done good service by the judicious additions which have to a great extent revivified Dr. Ferguson's well-known little manual, and brought it up to the level of the times.

The actual progress in electrical science since the original book appeared has not been anything extraordinary, but the amount of it which the public are willing to learn has undergone a prodigious increase, and the modern text-book is therefore expected to enter into details about a number of matters which a few years ago would have been scouted as altogether too difficult. It is these semi-advanced portions which Prof. Blyth has incorporated with the old stock of the work, the stock remaining about the same. There was very little to which one could object in the original; if it erred, it erred as a rule only by omission. In the new edition, however, we have information, and though concise it is mostly good and reliable information very intelligibly expressed, concerning Sir Wm. Thomson's electrometers, mariner's compass, and thermo-electric discoveries, also concerning electrostatic and electromagnetic induction, and other matters which had been but very lightly glanced at in the original edition. It also refers to Mr. Crooke's experiments, Mr. Spottiswoode's coil, Prof. Tait's thermo-electric diagram, and Dr. Kerr's discoveries. The operation of making a text-book may be compared to the operation of skimming, and the depth to which this operation may be safely carried depends, we suppose, mainly on the taste of the public at the time. Prof. Blyth has added to Dr. Ferguson's original skim a slightly deeper and more substantial layer; and fortunately neither of the authors have forgotten the very important preliminary operation of blowing aside the froth and scum which accumulates on long standing, and which an injudicious skimmer is very apt to obtain and exhibit as his sole result.

The book appears almost contemporaneously with Prof. S. P. Thompson's little work on the same subject, which we noticed some months back, and may be taken as complementary to it. Although both are of the same scope, yet the area open to them was so wide that it seldom happens that they both contain equally full information on precisely the same subjects.

The second volume which we here notice, viz. the compilation entitled "Electric Illumination," is of very different appearance and scope. It is a handsome large octavo, well printed, and with admirable illustrations. It is not addressed to students, but to engineers and practical men, and it is a most useful summary of notices which have appeared in the pages of *Engineering*, concerning dynamo machines, electric lamps, and the other paraphernalia connected with the practical applications of electricity. It aims, of course, more at completeness than at judicious selection; and it therefore naturally includes a number of contrivances which are hardly likely to come into any notorious existence.

While it is very useful as a book of reference, therefore it is scarcely calculated for ordinary reading, the style of the descriptions being not seldom tiresome, and giving one the usual dismal feeling of "letterpress" written up to a picture. Some of the sections are very full, as for instance that relating to the manufacture of Jablochkoff candles, where the account is so complete that the usual form of the Wheatstone bridge is depicted and carefully explained as if it were a specialty of the Jablochkoff system: while some other sections are distinctly meagre. At the same time it is only natural that some kinds of information should be easier of access than others, and that all that came to hand should be utilised. At the beginning of the book we have a sketch of the early history of dynamo machines, several admirable sketches of lines of force, and a very clear elementary exposition of the principles of magnetic induction. There are also very excellent and instructive skeleton figures of the Gramme and Siemens armatures, as designed by the late Antoine Breguet, though the writer of the article rather absurdly seems to take them as embodying researches which throw a new light on the action of the machines, instead of as useful and interesting illustrations of what was perfectly clear to every physicist.

Throughout the book, in fact, one comes across various curious statements, which, if read hypercritically and pressed, would be either annoying or misleading; but still more frequently one is in the presence of a cautious vagueness which conceals the want of exact knowledge by the turning of a phrase, and one notices a laudable desire to avoid the ascription of either praise or blame and to take the odiousness out of all comparisons.

But to say that some of the writers are often only half acquainted with their subject, and that they accordingly take precautions to avoid mistakes, is only to say that the book belongs to modern periodical literature; to that kind of literature, namely, which is written and read with the tacit understanding on both sides that in a few years at most it is sure to be out of date and forgotten, and that accordingly any serious labour expended on either its production or its assimilation would be labour misspent.

Taken for what it is, however, it is difficult to imagine a more complete and handy publication of information for which at the present time there is a great demand, and the book will be welcomed by all who take an interest, professional or otherwise, in those applications of electricity which are now so evidently imminent, and which must ultimately assume such vast proportions.

O. J. L.

OUR BOOK SHELF

Introductory Treatise on Rigid Dynamics. By W. Steadman Aldis, M.A. (London: G. Bell and Sons, 1882.)

THIS little work is truly characterised by its above title. The portions of the subject selected by the author will be best indicated by the headings of the several chapters. An introductory chapter on kinematics is followed by one on D'Alembert's principle: general equations of motion of a rigid body; impulsive forces. Chapter iii. treats of moments and products of inertia; Chapter iv. of motion round a fixed axis (centres of suspension, oscillation, and of percussion); Chapter v. of motion of a body with one point fixed; and Chapter vi. of the motion of a free body. Chapter vii. discusses certain general principles, as conservation of linear momentum, of moment of momentum, and of energy. In Chapter viii. miscellaneous problems are investigated, as of moving axes, initial motions, small oscillations, and "tendency to break." As might have been expected from so accomplished a teacher, the exposition of the general principles is most clear, and these principles are fully illustrated by a capital selection of exercises, many of which are solved, and for the solution of many others hints are given at the end. We know of no better introduction to this difficult branch of study. The text is most carefully printed.

Encyklopædie der Naturwissenschaften. Herausgegeben von Prof. Dr. G. Jäger (and seven other gentlemen). Erste Abtheilung (Parts 16, 19, 20, 22, 24, 26, 27). (Breslau: E. Trewendt, 1880, 1881.)

THESE seven numbers form parts 6 to 12, *i.e.* the second volume of a "Handbuch der Mathematik," edited by Dr. Schlömilch, the several treatises being written by Dr. R. Heger, Professor at Dresden. The pagination is continuous (1-963 pp.), and there are 235 woodcuts.

The first treatise is on "Analytical Plane Geometry" (pp. 1-194). The first 164 pages are devoted to the conic sections: the mode of treatment, or rather the order of arrangement of propositions, is different from that of any English text-book with which we are acquainted, but approximates most closely to that of Dr. Salmon's classical work. It is a full, able, and interesting presentment of the properties of these curves. The remaining thirty pages are devoted to a rapid sketch of the principal known properties of curves of the third order, in which are embodied most, if not all, of the results of modern research.

The second treatise is on "Analytical Geometry of Three Dimensions" (pp. 195-380); the third is on the "Differential Calculus" (pp. 381-568); and the last is on the "Integral Calculus" (pp. 569-902).

This last work is broken up into three parts, of which the second treats of elliptic functions, the theta functions, and of elliptic integrals; the third is devoted to differential equations.

There are two smaller works, one (pp. 903-928) on the method of least squares (Ausgleichungs-rechnung), and the other (pp. 929-957) on insurances (Renten-, Lebens-, und Aussteuer Versicherung). A list of works on the different subjects treated of in the "Handbook" is given on pp. 961-963. These works are all in German, and the only English mathematician whose works are cited is Dr. Salmon, in Teutonic dress.

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. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Pollution of the Atmosphere

IN answer to Mr. Joseph John Murphy's letter in NATURE, vol. xxvii. p. 241, stating that the radiation of marsh gas (from the incomplete combustion of coal) would be insignificant compared to that of vapour, I would like to say that their behaviour in the atmosphere is different; the moisture in the air is there, so to speak, on sufferance as long as the pressure and temperature allow it; that is, it is held in suspension by what might be called the capillary attraction of the air of a certain pressure and temperature. If you reduce the temperature you reduce the capacity of air for vapour, first by its reducing the capillary attraction, and secondly, by reducing one of the conditions that makes OH_2 a vapour. If you reduce the pressure, you enlarge the spaces between the molecules and reduce the capillary attraction, if I may apply this term to a gas. This is borne out by the balloon ascents of Mr. Glaisher. At 4 miles high the temperature was 8°, the dew-point was −15°, or a difference of 23°; at 5 miles it was 28°, and at 30,000 feet he states that there is no doubt that the dew-point is a difference of 50°; that is, the higher, the less vapour. But this will not be the case with marsh gas, as it is a permanent gas, and being of less density than even vapour, or about half the density of air, there is no reason why it should not be found in larger quantities at greater altitudes; and I think that its effect there would be that in the temperate zones and at the poles it would radiate its temperature of say from −8 at 30,000 to −30, and produce cold and rain, snow and floods as the storms on the Alps and the floods on the Continent, and in the Tropics to make the nights colder. In fact, it will have a tendency to do the reverse of vapour; vapour retains our heat and shields us from the cold of space. This radiator and absorber will tend to radiate the cold to us or to the vapour in the lower atmosphere, and produce rain and wind.

9, Bootham Terrace, York, January 13 H. A. PHILLIPS

A "Natural" Experiment in Complementary Colours

SINCE I wrote to NATURE last October (vol. xxvi. p. 573) on the above subject, I have been both surprised and gratified to read no less than six communications on the same matter (vol. xxvi. p. 597, vol. xxvii. pp. 8, 78, 150, 174, 241). Only to-day I have received a letter from a German friend drawing my attention to Goethe's observation at Schaffhausen, he evidently being unaware of Mr. W. R. Browne's interesting letter (vol. xxvi. p. 597). My friend goes on to point out that "Gischt" is certainly foam, for in the context Goethe describes how he saw a rainbow in the "Dunst," or mist, thus enabling us to contrast the two words.

The special point of my communication was the excellent illustration, afforded us naturally, of the advantage of toning down the brightness of the white surface, upon which the complementary tint is to be cooked, until that brightness is suitable to that of the exciting colour. In the experience related by me I was unable to see complementary tints in the foam, upon which full sunlight was falling; the glare of light was too strong.

Mr. C. R. Cross (vol. xxvii. p. 150) speaks of seeing them even in strong sunlight on the crests of waves; may not these crests have been in slight shadow, if the waves were just curling over? The example he gives of cloud *shadows* appearing purple on the ocean illustrates excellently my own observations. The letter from Mr. E. J. Bles (vol. xxvii. p. 241) gives a quotation from Sir C. Lyell, but without further detail I do not feel that much weight can be given to his observation from my special point of view. But I do not at all wish to say that complementary tints are not visible on a white surface in full sunshine; but theory and my own observations are certainly in favour of the advantage (and this is all I claimed) of a reduction of brightness to a level comparable with that of the exciting colour.

CHAS. T. WHITMELL

8, Maryland Street, Liverpool, January 15

The Comet

IN my letter relating to the September comet, published in vol. xxvii. p. 108, I was guilty of carelessness in copying from my notes the difference of micrometer readings instead of their value in arc. The value of one revolution of the screw is 15″·31075, and consequently the distances given in my letter should be as follows:—

$$\left.\begin{aligned} a &= 6''\cdot57 \\ b &= 16\cdot90 \\ c &= 8\cdot34 \end{aligned}\right\} \text{November 3}$$

$$\left.\begin{aligned} a &= 7\cdot36 \\ b &= 16\cdot51 \\ c &= 10\cdot15 \end{aligned}\right\} \text{November 6}$$

W. T. SAMPSON

U.S. Naval Observatory, Washington, D.C., January 2

The Transit of Venus

WILL you be kind enough to make the following correction in your published report of the times of contact of phases of the transit of Venus. The third contact should be 2h. 39m. 57s. in place of 2h. 38m. 57s. These were both inadvertencies. From a comparison of Mr. Finlay's place at the Cape of Good Hope on September 8, I find that these elliptic elements satisfy the place within 7 seconds of arc in Right Ascension and 1·5 seconds of arc in Declination. EDGAR FRISBY

U.S. Naval Observatory, Washington, D.C., January 3

Early Coltsfoot

LAST year I recorded (NATURE, vol. xxv. p. 241) Coltsfoot in blossom on January 6, on the sides of the railway near here, probably an unprecedentedly early date. The mild weather lately prevailing induced me to suspect the former early blossoming might find a parallel *this* year. I saw the plant in flower *this morning*, near the same spot; one flower-stalk was fully four inches high, so it should have been observed some days previously had sunshine prevailed. Last year the winter was practically over (so far as hard frost was concerned) at the beginning of January. Will this be paralleled by the winter of 1882-83? R. MCLACHLAN

Lewisham, January 12

Baird's Hare

SOME of your readers may be interested in reading the following extract in which mention is made of a fact similar to that found in NATURE vol. xxvii. p. 241, about *Baird's Hare.* The extract is from the Life of St. Francis Xavier, by H. J. Coleridge, S.J. In a letter written from Amboyna in May, 1546, Francis says:—

. . . "In the island of Amboyna I have seen what no one would believe . . . a *he-goat* giving suck to his young kids with his own milk; he had one breast which gave every day as much milk as would fill a basin. I saw it with my own eyes, for I would not believe it without seeing it. A respectable Portugese has the goat, and is taking it away, meaning to carry it to Portugal." T. MARTYR

49, High Street, Clapham, S.W., January 15

The Projection of the Nasal Bones in Man and the Ape

THE form and projection of the osseous frame-work of the human nose being considered by anthropologists of considerable value in a racial point of view, a close comparison has recently been made of the profiles of the external nose of man and the nose-case of the anthropoid apes. It has resulted in the conviction (1) that the absence of projection in the nasal bones of the chimpanzee, the gorilla, and the orang constitutes a distinction of more importance than has generally been assigned to it, and not the less so seems the fact (2) that a slight nasal elevation is observable in the skulls of some of the gibbons, and in the lower monkeys, as, for instance the baboons.

The distinction appears to me to be of the same kind as the erect position of man and the different order of the length of his toes as compared with the ape and many of the lower animals—as for instance the third toe in the lion, bear, dog, badger, and hare.

It should be remembered that the nasal bones in man form merely a bridge or back to the osseous structure of the nose, which is mainly due to the upheaval laterally of the pre-maxillary bones. These are less elevated in other animals, and there is no tilting of the nasals proper. In the chimpanzee and the orang the nasals are as flat as in the hippopotamus. On referring to Prof. Mivart's essay on the apes in the "Encyclopædia Britannica," I find he alludes to the transverse convexity of the bones of the nose, which he considers a marked character of man's skull, entirely absent in the chimpanzee. He adds: the nasals in the orang are exceedingly small and flat, "often even uniting in one bone."

In connection with the subject, it may be mentioned that in Quain's "Anatomy" the external nose is said to be due to the development of the frontal lappets in the fifth or sixth week of the human embryo. It is represented in a woodcut in Balfour's "Embryology" as well-formed and prominent so early as in the ninth week.

The existence of the nasal spine in the nostrils of man, but not in the ape or any of the lower animals, is a fact that has to be accounted for. It appears to have been overlooked, but is of some importance in connection with the development of the human nose.

J. PARK HARRISON

January 14

P.S.—The peculiarities of the human nose and the *rationale* of its formation are fully treated of in Prof. Humphry's "Human Skeleton," p. 220.

THE COMET

THE following communication from Dr. Gould of Cordoba Observatory (Argentine Republic) appears in *Astronomische Nachrichten*, No. 2481:—

On September 6 I received information that a bright comet was visible in the east before sunrise. My informant had seen it on the morning of the 5th, and described it as being as bright as Venus and with a brilliant tail. Inquiry showed that it had been seen for several days by *employés* of the railroad and other persons whose duties required them to rise before daylight.

Not only was the morning of September 7 cloudy, but the eastern sky was overcast on every morning for a whole week. On one occasion it seemed that a part of the comet's tail could be distinguished, but not even an approximate position could be obtained for the head. On the morning of the 14th the comet was first seen at the Observatory, and an approximate position obtained from the circles of the equatorial telescope by pointings with the finder. It was then only 13′ south of the equator, and moving northwardly.

The telescope was equipped with the photographic lens and apparatus, and as my series of stellar photographs was nearly completed and its continuance for a few weeks demanded constant attention, I was reluctant to change the adjustments. It has been my uniform policy in Cordoba to confine our instrumental observations to the southern half of the sky, and, in general, to such regions as are not well visible from northern observatories. And as the comet had been conspicuous for more than a week, was on the equator, and the date of equinox was close at hand, it appeared unadvisable to sacrifice important and unique observations for the sake of determinations of the comet's position which I could not doubt were making under more favourable circumstances in the north. Consequently no micrometric observations were undertaken; but rude determinations of position were repeatedly made, from that time on, by use of the finder and the graduated circles, in order to follow the comet's course and deduce approximate elements and ephemeris.

On September 16 the brightness of the head was such, that it was visible with the finding-telescope throughout the day; and I prepared to observe it on the meridian, having followed it with the equatorial until within half an hour of the time of transit. Its declination was about $+0° 52'$. But not more than five minutes before that moment a large cloud drifted across the meridian, making the observation impossible.

September 17 the comet was very bright and easily found in the full sunlight. At 10h. 40m. a.m. it was necessary to use a shade-glass, on account of its proximity to the sun; and at 11h. the sun and comet were in the same field of view. I again attempted to observe it upon the meridian, but was prevented by a new difficulty. The comet was hidden by the disc of the sun, and although I carefully scrutinised this and especially the preceding limb as it traversed the field of the meridian-circle, no token of the comet could be seen, nor could it be found during the afternoon. Although it must have passed in front of the sun, I then supposed it to have passed behind it and been occulted.

On Monday the 18th the comet was again on the preceding side of the sun and decreasing in declination at the rate of more than 2½′ hourly. Early in the day its brilliancy attracted popular attention throughout the country, and the "blazing star near the sun" was the one topic of remark. Telegrams came to me from all parts of the country, as well as from Chile and Uruguay, calling attention to the phenomenon. In the small telescope it presented the aspect of a brilliant nebulous mass, having at each end curved appendages like horns or wings, nearly large as the central body, and at their base quite as brilliant; the general form of the whole reminding one of the winged globes carved on ancient monuments. This appearance, unquestionably due to the outrush of glowing vapour from the nucleus, was also exhibited, although to less extent, on the two following days, during both of which the comet remained visible to the naked eye.

As soon as the elements of the orbit could be obtained, its similarity to that of the comet of 1843-1880 was manifest, and the suspicions regarding its identity and the hypotheses to which these gave rise presented themselves forcibly, as I am sure they must have done to astronomers in the northern hemisphere, where I doubt not they have long since been a theme of discussion. The perihelion-distance, although small, seems clearly larger than that of the orbits of 1843 and 1880; but how far such discordance is consistent with the hypothesis of identity must be decided by future investigation. The comparatively small amount of study which I have been able to give to the question leads me to think that the orbit deduced from observations before the perihelion may differ somewhat from that indicated by the observation since September 17; but as the Cordoba observations prior to that date were of a crude description, I have impatiently waited for tidings from other observatories. No. 2459 of the *Astr. Nachr.*, which has just reached me, leads me to fear that micrometric or meridian observations may not have been made before perihelion. In such case the rough positions obtained here with the finder and circles of the equatorial may possess a value far greater than was supposed possible at the time. Those previous to the perihelion are ten in number, and although I do not believe that their probable error can exceed a minute of arc in either coordinate, they are not represented within this limit by the elements deduced from observations made since the perihelion. Should no better positions have been obtained I will send these to you; but I cannot yet abandon the hope that some belated astronomer may have seen this brilliant object in season to secure a series of observations before the perihelion passage.

Micrometric determinations have been made here on various dates since October 17, and have now begun systematically, as the comet is growing lower for northern observers. But as it will not pass the limit of 30½°, S. Decl. the southerly observatories of Europe and all those of the United States will probably be able to follow it as long as it remains visible, and will find comparison stars in Argelander's Zones.

It will not have escaped your notice that all the elements differ from those of 1880 in the same direction in which these differed from those of 1843.

In the earliest observations made with the large telescope there appeared to be, in the place of the nucleus, a series of bright points following the axial line. The preceding and brightest of these seemed scarcely to exceed the tenth magnitude, and all were connected by intermediate material of somewhat less brilliancy which made it difficult or impossible to count them. Mr. Thome, who has made all the micrometric measurements, thinks that there were certainly not less than five or six, and perhaps more. The appearance was as though the original nucleus had been resolved into a series of ill-defined granules. These have gradually become less and less distinct, until the place of the nucleus now appears occupied by a line of irregular definition and unequal brightness, about 45″ in length, and of an average width of about 5″. All our determinations of position were made for the preceding and brightest of these nodules while they were clearly distinct; and, since then, for the anterior extremity of the bright line, where is a point which is still somewhat brighter than the remaining portions.

Since we are at present overloaded with work, in the preparation of the Zone-Catalogue, and observations are, without doubt, still making in Europe and North America, I will reserve the micrometric determinations until the reductions can be revised.

Those made on the meridian are as follows:—

		α h. m. s.		δ ° ′ ″
1882, Sept. 18	...	11 20 51·3	...	+0 16 39·3
19	...	11 14 31·0	...	−0 32 38·6
21	...	11 4 57·9	...	−1 59 30·2

Cordoba, November 14, 1882 — B. A. Gould

DESTRUCTION OF LIFE IN INDIA BY WILD ANIMALS

In a recent communication I called attention to the loss of human and animal life in India from snake bites; I now proceed to describe the mortality due to wild animals, which, though much less than the former, is very considerable, and forms an important item in the mortuary returns.

The statement appended shows in detail for each province the number of persons and cattle killed by wild animals, and the number of wild animals destroyed, with the rewards paid for their destruction during the year 1881, as compared with the previous year. The figures are summarised in the following tables:—

Number of Human Beings and Cattle Killed by Wild Animals

	Persons killed. 1880.	Persons killed. 1881.	Cattle killed. 1880.	Cattle killed. 1881.
Madras	223	238	8,667	8,668
Bombay	136	141	4,537	2,398
Bengal	1,295	1,367	14,567	8,423
North-Western Provinces and Oudh	561	470	8,140	7,971
Punjab	42	27	7,986	4,083
Central Provinces	289	248	3,711	2,929
British Burma	32	34	978	898
Coorg	Nil	Nil	219	191
Assam	234	211	3,269	2,802
Hyderabad Assigned Districts	24	18	3,560	3,013
Ajmere-Merwara	4	3	216	264
Total	2,840	2,757	55,850	41,640

Number of Wild Animals destroyed and Amount of Rewards Paid

	1880. Destroyed.	1880. Rewards. Rs. a. p.	1881. Destroyed.	1881. Rewards. Rs. a. p.
Madras	1,284	16,579 10 0	1,429	20,251 5 0
Bombay	1,717	4,775 1 0	1,367	4,965 13 0
Bengal	4,783	24,841 10 6	4,213	23,316 3 0
N.-W. Provinces and Oudh	2,924	7,295 4 0	3,037	8,434 14 0
Punjab	1,389	4,715 0 0	1,411	4,856 3 0
Cent. Provinces	1,408	17,887 8 0	1,351	15,842 0 0
British Burma.	639	3,468 0 0	1,059	4,260 8 0
Coorg	26	140 0 0	15	215 0 0
Assam	541	7,022 10 0	1,176	7,552 2 0
Hyderabad Assigned districts	167	1,590 0 0	216	2,156 0 0
Ajmere-Merwara	8	13 0 0	5	Nil
Total	14,886	88,327 11 6	15,279	91,850 0 0

The resolution of Government, dated November 8, 1882, in dealing with this subject, gives the following details, which are so far satisfactory, as they show that organised measures are now being put in force for the destruction of wild beasts, and that already there has been diminution in the loss of human and domestic animal life. As in the case of venomous snakes, the prevention, or at all events diminution of loss of human and domestic animal life from the ravages of wild animals, is a question mainly of time, perseverance, and expenditure of money. The last consideration perhaps may have stood in the way of progress, not that expenditure of rupees either has been or would be grudged, were there certainty that it would overcome the evil, but that there may have been, perhaps is, a natural reluctance to spend public money for what seems an uncertain benefit, as some have regarded a system of rewards for destruction of snakes and wild animals. The Government of India has always evinced a desire to adopt any steps that might reasonably afford hope of relief, and many resolutions by the supreme and local Governments, and considerable expenditure of money wlth this object in view, proves that the authorities have been and are alive to the magnitude of the evil and to the importance of repressing it, and that they have taken measures which in some districts have been attended with a fair amount of success. But the absence of a thoroughly organised system of dealing with the evil, and the desultory and varying methods employed have prevented the attainment of the success that might fairly be expected and would be obtained under better arrangements; and it will not be until some complete organised system have been steadily and perseveringly prosecuted that the desired result will be accomplished. A few years ago (in 1878), when calling attention to this subject, I noted that the loss of life from wild animals in 1875 and 1876 had been as follows:—

Animals.	Killed in 1875. Persons.	Killed in 1875. Cattle.	Killed in 1876. Persons.	Killed in 1876. Cattle.
Elephants	61	6	52	3
Tigers	828	12,423	917	13,116
Leopards	187	16,157	156	15,373
Bears	84	522	123	410
Wolves	1,061	9,407	887	12,448
Hyænas	68	2,116	49	2,039
Other animals	1,446	3,011	143	4,573
Total	3,735	43,642	2,327	47,962

Comparing these returns with that of 1880-81 it will be observed that the loss of life has not been materially diminished

	Persons killed.
1880	2,840
1881	2,757
1875	3,735
1876	2,327

though there is reason to hope that future yearly reports will be more favourable.

Registration is now becoming more accurate than it has been, and the returns are probably more reliable than they were, but they do not indicate any marked improvement on the whole. It is evident, however, from the terms of the resolution before referred to, that Lord Ripon is determined to deal vigorously with the evil, and, just as in the case of the poisonous snakes—only, perhaps, more surely —will the result, in time, justify the expenditure which must needs be incurred.

Of the wild animals and venomous snakes which destroy life in India, the wolf and tiger, it will be seen, are the chief offenders among the former, the cobra and bungarus (krait) among the latter. A list of the rewards that have been offered at various times and in different parts of India is appended, but I do not know the amount now offered for each animal, though it is probably much on the same scale. If these rewards be distributed regularly and systematically throughout India, they will probably suffice to insure a steady reduction in the number of noxious animals, and so will diminish a great evil.

"The figures quoted show a decrease during the year under review, as compared with the previous year, both in the number of persons and cattle killed; and, on the other hand, an increase in the number of wild animals destroyed. As was the case in the previous year, the mortality which occurred in Bengal and in the North-Western Provinces and Oudh, was far greater than in other provinces. Of the total number of deaths, 2757 were caused by wild animals, the figures for the previous year being 2840.

The number of persons killed in Bengal (747), and in the North-western Provinces, and Oudh (208) by wild animals other than those specifically named in the returns, was considerable. In future returns the animals which come under the general head "other animals," and which causes in all provinces a very large proportion of the mortality, should be specified in a foot-note, with the number of deaths caused by each kind.

The total number of cattle killed also decreased. This result is chiefly due to the exclusion from the Bengal return of sheep and goats, of which a large number were included in the figures of the year 1880. There has, however, been a marked decrease in the number of cattle killed by wild animals in the Bombay Presidency. In the Punjab, also, the number of cattle killed was considerably less than in the preceding year, but in this province, as in the case of Bengal, the decrease appears to be due to the exclusion of sheep and goats from the returns of the year 1881.

The number of wild animals destroyed was 15,279, against 14,886 in 1880. The number of tigers, leopards, bears, and wolves destroyed was 1557, 3397, 991, and 4538 respectively, as compared with 1689, 3047, 1100, and 4243 in the preceding year; and the number of human beings killed by these animals respectively, amounted to 889, 239, 75, and 256, against 872, 261, 108, and 347 in the year 1880.

Of the total amount of rewards paid during the year, Rs 91,850 were awarded for the destruction of wild animals.

In the review of the returns for the year 1880 a hope was expressed that endeavours would be made to induce men belonging to the Shikari class to devote themselves specially to the work of destruction in districts which are more than usually infested with wild animals, and Local Governments were authorised to make special arrangements for the experimental employment of such men. From the present reports it appears that the Government of Madras has decided that the employment of a paid corps of Shikaris is undesirable, as the cost of supervision would be excessive, while the employment of such a corps would discourage local Shikaris. On this point the Governor-General in Council desires to remark that where local Shikaris exist it is very desirable that every encouragement should be held out to them, and that in such cases it is preferable to trust to fixed, certain, and prompt payments according to results, as the most effective way of inducing the Shikaris to devote themselves to the work. At the same time certain tracts of country exist in which the special and temporary employment of men from outside may be very useful and expedient, and the reports show that the adoption of this plan has in some cases been followed by satisfactory results. For instance, in the Futehpore district, in the North-Western Provinces, the entertainment of a body of special Shikaris resulted in the destruction of a considerable number of wolves with which that district was infested. In Dinapore, in the Lower Provinces, also, professional hunters were engaged during the closing month of the year for the destruction of tigers.

"In the Central Provinces the ravages committed by tigers in the Balaghat and Seoni districts necessitated the offer of enhanced rewards for their destruction, and the district officer of Seoni has endeavoured to organise a special expedition of shikaris for the purpose of hunting down the animals, and has provided the shikaris with ammunition. Licenses under the Arms Act appear to have been more freely given than hitherto to persons who require arms for protecting themselves and their cattle and crops from the attack of wild animals, but the Governor-General in Council desires to take the opportunity of expressing a hope that this matter will be carefully kept in view by Local Governments and Administrations in order that every possible facility may be offered to cultivators and others for obtaining such licences in districts in which wild beasts are more than usually abundant."

Wild Animals destructive to Life in India

CARNIVORA	
Felidæ	
Felis—F. leo	Lion
F. tigris	Tiger
F. pardus	Leopard
F. jubata	Hunting Leopard
Hyæninæ	
Hyæna—H. striata	Striped Hyæna
Canidæ	
Canis—C. pallipes	Wolf
C. aureus	Jackal
Ursidæ	
Ursus—U. isabellinus	Brown Bear
U. tibetanus	Black Bear
U. labiatus	Sloth Bear.
UNGULATA	
Elephantidæ	
Elephas—E. indicus	Elephant
Rhinoceros—R. indicus	Rhinoceros
Suidæ	
Sus—S. indicus	Wild Boar
Bovinæ	
Gavæus—G. gauri	Bison, gaur
Bubalus—B. arni	Buffalo, arna
SAURIA	
Crocodilidæ	
Crocodilus—C. palustris	Crocodile
C. biporcatus	,,
C. pondicerianus	,,
Gavialis—G. gangeticus	Gharial
PISCES	
Carcharidæ	
Carcharias—C. gangeticus	Groundshark of Ganges

Poisonous Snakes of India

Those marked with an * are most deadly.
Those marked with a † are most common among the most deadly.

POISONOUS COLUBRINE SNAKES

Elapidæ

1. Naja	N. tripudians †, cobra, several varieties
2. Ophiophagus	O. elaps *, hamadryas
3. Bungarus	B. cæruleus †, krait
,,	B. fasciatus, sankni
4. Xenurelaps	X. bungaroides
5. Callophis	C. intestinalis and several other species

Hydrophidæ, or Sea Snakes (all deadly)

1. Platurus	P. scutatus, P. Fischeri
2. Hydrophis	H. cyanocincta, and several other species
3. Enhydrina	E. bengalensis
4. Pelamis	P. bicolor

VIPERINE SNAKES

Crotalidæ, or Pit Vipers

1. Trimeresurus	T. gramineus and several other species
2. Peltopelor	P. macrolepis
3. Halys	H. himalayanus
4. Hypnale	H. nepa

Viperidæ, or true Vipers

1. Daboia	D. russellii †, Chain Viper, Tic-polonga
2. Echi	E carinata †, Phoorsa snake, Afaë, Kuppur

The following is a scale of the rewards offered in different parts of India, at different times, for wild beasts and snakes :—

TIGERS

	Rupees.
Bengal	12½ to 50
Berar	10 ,, 20
Bombay	6 ,, 60
Burmah	5 ,, 20
Central Provinces	10 ,, 100
Hyderabad	20
Madras	50 to 500
Mysore	35
North-West Provinces	10
Oudh	None
Punjab	None
Rajpootana	10 to 15

LIONS

The only record of which I find official mention, is 25 rupees in Kotah.

PANTHERS, LEOPARDS, CHEETAHS

	Rupees.
Bengal	2½ to 10
Bombay	3 ,, 12
Burmah	5 ,, 10
Hyderabad	10
Madras	25
Mysore	15
North-West Provinces	5
Rajpootana	8 to 10
Central Provinces	5 ,, 12

WOLVES

	Rupees
Bengal	5 to 20
Berar	3 ,, 5
Bombay	4
Central Provinces	2 to 5
Madras	5
North-West Provinces	5
Oudh	1 to 6
Rajpootana	5

HYÆNAS

	Rupees.
Bengal	1 to 2
Berar	5
Central Provinces	½ to 2
Madras	3¼

BEARS

	Rupees.
Bengal	1¼ to 2½
Berar	5
Bombay	3 to 12
Burmah	5 ,, 12
Hyderabad	5
Madras	5
Central Provinces	2 to 5
North-West Provinces	3
Rajpootana	5

SNAKES (Species not reported)

Bengal	4 annas
Berar	—
Bombay	6 pie to 4 annas
Burmah	—
Central Provinces	1 rupee
Hyderabad	8 annas to 2 rupees
Madras	1 anna
Mysore	8 annas
North-West Provinces	2 rupees
Oudh	—
Punjab	2 annas
Rajpootana	1 to 8 annas

No rewards appear officially proclaimed for elephants, buffaloes, or bisons. In cases of notorious rogue elephants rewards have been specially given. In Burmah 5 to 20 rupees offered for alligators ; in special cases, more has been given in Bengal and Madras.

The difference in the amount of the rewards appears to indicate that higher sums were offered in special cases, probably when the creature was a notorious man or cattle-slayer.

Now I cannot help thinking that if Government made it part of the duty of district officers, not only to proclaim these rewards but to encourage the destruction of wild animals and snakes, by means of an organised establishment, which should be supplied in these districts, much benefit might result. The money rewards already offered would probably suffice for wild animals, but those for venomous snakes should be increased; if, at the same time, the people were encouraged to work for the rewards, and were aided by persons acting under properly selected superiors, the result would soon show a diminution of the wild animals and snakes. But, I repeat that not until some organised establishment is formed, to be worked steadily throughout the whole country—not dependent on the will or subject to the caprice of individuals, but under local officers subject to one head—will any real or progressive amelioration of the evil be effected. Such a department under a selected officer, would, as was the case with the Thugs and Dacoits, soon make an impression on a death-rate which, so long as it continues in its present condition, must be referred to a defect in our administration.

J. FAYRER

PALÆOLITHIC IMPLEMENTS OF NORTH-EAST LONDON

IN 1855 Prof. Prestwich published in the *Quarterly Journal of the Geological Society* an account of a fossiliferous deposit in the gravel of West Hackney. The precise locality of the excavation is given, and from 1855 to now many neighbouring excavations have been made. They almost invariably exhibit the "Palæolithic Floor." In 1855 only little was known of palæolithic implements, yet it is a remarkable thing that none of these objects, so common and well-made as they usually are at West Hackney, arrested Prof. Prestwich's attention. It is also remarkable that although a list of twenty-three land and freshwater shells is given in that paper, yet it does not include the only two of especial interest, viz. *Corbicula fluminalis*, Müll., and *Hydrobia marginata*, Mich. ; the first of which is extremely common, and the latter frequent. The branches of trees, "sharply broken into short pieces," and the fossil bones, "showing no trace of wear or fracture," are frequent in all the West Hackney pits. One may be sometimes very near a curious discovery and yet miss it.

In NATURE, vol. xxvi. p. 579, I described and illustrated the West Hackney, or Stoke Newington, palæolithic gravels as understood by me, confining myself to the geological aspects of the situation. I now approach the subject of the weapons and tools contained in the drift of that place. Of the stone implements there are three distinct varieties, each belonging to a different geological time. The implements of these ages are not confined to the valley of the Thames, as they are marked with almost equal distinctness in other places as at Canterbury, Bedford, Southampton, and elsewhere.

In looking for the oldest human works, it would be unreasonable to expect symmetrical implements. The very earliest weapons and tools used by our most remote precursors must have been natural or accidentally broken stones :—naturally pointed stones and stones with a naturally suitable cutting or chopping edge; the first attempts at implement making must have been at the time when the primæval savages "quartered" a stone by smashing it, and then selected pointed and knife-like pieces of this stone for tools.

None of the following rules are without exceptions, for amongst the implements which are usually very large, a very small specimen may now and then occur; and amongst those which are usually very small, there may be at times a large example. The lustre and deep ochreous tints may at times vary a little. Notwithstanding exceptions, when all the characters are taken together, the distinctness of the three classes will hold good.

The oldest known tools are the rarest, and, according to my estimate, can be recognized by the following characters :—they are generally lingulate, or club-shaped, with a heavy butt, often rudely ovate, never acuminate, generally large and very rude, frequently with a thick, ochreous crust, and always greatly abraded, as if they had been tossed about for ages in the sea. Some of these implements are so much abraded that they have lost almost every trace of flaking. These old implements acquired their ochreous crust before they were buried in the gravel, as they occur amongst sub-angular lustrous flints and even chert gravel, where only the implements and a few stray stones exhibit the ochreous crust. I have seen no trimmed flakes or scraping tools belonging to this older age. In London, these old implements are generally found near the bottom of the twenty feet (or even thirty feet) excavations. At Canterbury they occur in thin seams of distinct ochreous material where all the contained flints have an ochreous surface. All these older tools were made at a long distance from where they are now found. Two Canterbury examples are illustrated, half actual size at Fig. 1 and 2, Nos 100 and 126 in my collection. A very important point has now to be especially noticed : when these ochreous instruments were originally tossed about and buried in the gravel some of them became chipped and even broken. Now, the chipped and broken surfaces of these older implements, as at A A, Fig. 1, are *never ochreous*, but invariably of the natural colour of the flint and lustrous. This lustre has been acquired since the gravels were laid down, and it exactly agrees with the lustre of the sub-abraded lustrous implements of medium age found from 8 feet to 10 feet above the ochreous ones. It follows, therefore, that the lustrous implements, although enormously old, can only be as old as the time when the ochreous ones were bruised and broken in the gravels where they are now found.

Another fact must be mentioned here: the men who used the oldest known tools sometimes broke them in two whilst they were at work with them ; the accidentally fractured surfaces of this class are of course as old as the tools, and therefore always ochreous. Points and butt ends wholly ochreous are of common occurrence : these pieces of tools must have been shattered for long ages before the gravels of middle age were laid down.

The men who made and used the rude ochreous tools were to a great extent a "whole handed" race—they had not learned the full use of their fingers but held the weapons as one would now hold a heavy stone for smashing. It is probable that the more pointed end of the club-shaped implements was sometimes grasped in the hand and the butt used as a club or hammer. The absence of scrapers indicates that the men probably knew nothing of dressing skins, and were unclothed.

In and near London lustrous and sub-abraded tools of medium age are commonly found at a depth of 12 feet; these tools show a distinct improvement in workmanship over the older ones. Most of the examples are lingulate and acuminate, and the butt, and sometimes the umbo, shows signs of hammering, the ovate form is not uncommon, but the cutting edge all round I have not yet seen. A few chisel ended implements occur. Rude choppers and somewhat large scraping tools are common. All the artificially chipped stones of this medium age are sub-abraded and lustrous. They were not made where now found, but have been carried by the drift for a short distance. A pointed weapon and chopper of medium palæolithic age are illustrated half real size at Figs. 3 and 4, Nos. 588 and 482 in my collection. A scraper of the same age is illustrated at Fig. 5, Scraper No. 9 in my collection.

When the lustrous sub-abraded tools were made the men had by that time acquired the habit of holding their weapons in a lighter fashion,—still in the palm, but more lightly held with the thumb and two next fingers. The frequent presence of horse-shoe and side scrapers now indicates that the men had possibly learned to rudely dress skins for clothing. Sometimes unfinished implements are found; one of medium age from Lower Clapton, London, is illustrated at Fig. 6. The dotted line shows where the point would have been, if the maker had finished it. Implements roughly blocked out to form, and without any secondary trimming, are common: it would appear that the men sometimes first blocked out a number of implements rudely with a heavy hammer-stone, and afterwards finished with neater fabricating tools. An implement in a preparatory stage, of which I have many similar examples, is illustrated in Fig. 7, from Bedford. Many implements were accidentally shattered in the course of manufacture, and the shattered failures are common in all implementiferous gravels.

Long after these two classes of tools were buried by floods of water deep in the gravel and sand, there lived a third race of palæolithic men, as far removed from the men who made the lustrous sub-abraded implements as these latter men were from the makers of the ochreous and highly abraded instruments. These newer tools are found at Stoke Newington at about 8 feet above the lustrous examples, and generally about 4 feet from the present surface. In some places so much top material has been taken off for brickmaking that the stratum containing the newer implements is almost exposed on the surface. Denudation since palæolithic times has considerably altered the contours round north London, and the "Palæolithic Floor" at South Hornsey, close to Stoke Newington, is 14 feet below the surface instead of 4 feet—this 10 feet has been removed in some places by the rains of centuries, in others by modern brickmakers and nurserymen.

The newest palæolithic implements are as a rule not highly lustrous as in the last, but sub-lustrous, and often even dull; not abraded or sub-abraded, but as sharp as on the day they were made. As a rule they are very much smaller and lighter than anything belonging to the two previous periods. An example is illustrated half real size at Fig. 8, No. 403, in my collection. Other characteristic specimens are illustrated at Figs. 9 and 10. Fig. 9

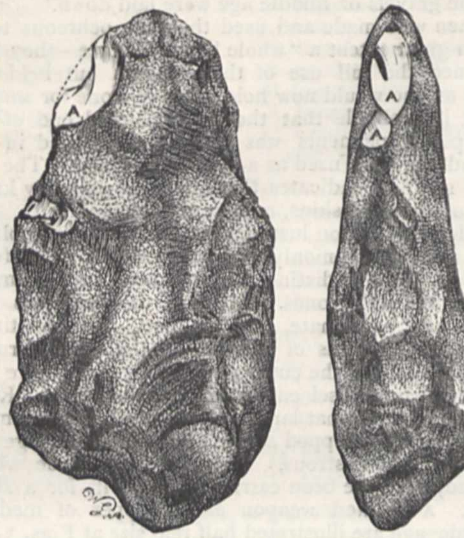


FIG. 1

is a thin and exquisitely manipulated trimmed-flake, No. 47 in my collection, weighing only $1\frac{3}{10}$ ounces. Fig. 10 is an implement worked on both sides, the natural crust of the flint being left untouched on the butt, weight only $1\frac{1}{8}$ ounces, No. 627 in my collection. Oval implements with a cutting edge all round now appear; a few examples, as in the last period, occur where the broad end (as in neolithic celts) appears to have been designed for cutting or chiselling; scrapers are common, not large

FIG. 2.

and rough, but as a rule small and extremely neat. One is illustrated at Fig. 11, half actual size, scraper No. 22 in my collection; small knives, *i.e.* flakes, with the edge or edges showing very neat secondary trimming, are common, and hardly to be distinguished from neolithic "knives." As a rule every object is now neat, small and fine.

That these later implements are of a different age from the last is proved by the curious fact that the newer implements are sometimes re-made from older ones, *i.e.* re-trimmed after the lapse of a vast period of time. I have several such examples, one a scraper belonging to the "Palæolithic Floor": it is made from an old lustrous flake of medium age, all the more recent work being dull and sharp. At Fig. 12 is illustrated, half real size (No. 452 in my collection), an implement of later palæolithic age from Bedford. It is an old implement that was "found" after a lapse of time by a newer palæolithic man and re-pointed. The finder had probably sense enough to know that the thing he found was really a human-made implement, only wanting a little fresh work to make it "as good as new." This man stands in contrast with the very few individuals (still extant) who say they can see no evidence of design in drift tools. The original form of the implement is indicated by the dotted lines, C, C, C; the natural crust of the flint is present at the base on both sides, shown by dots in the illustration. The original mid-age flaking is shown at B, B, B, B, and

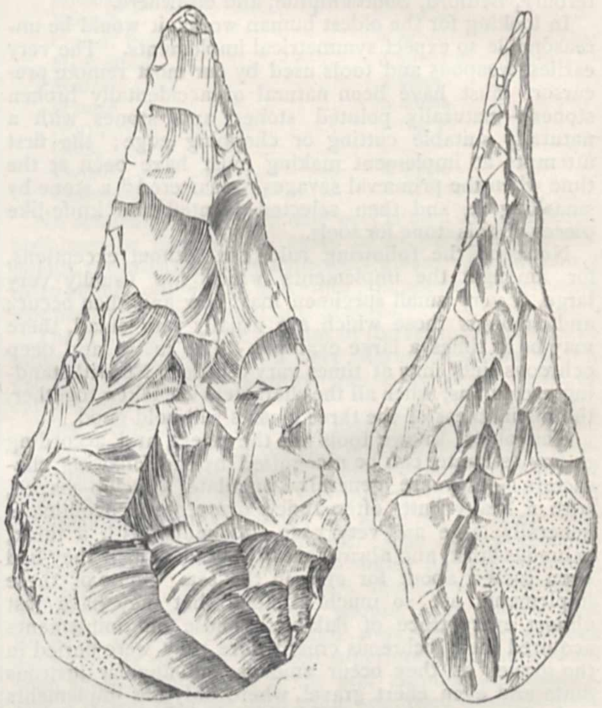


FIG. 3.

the work of the newer palæolithic man is exhibited at D, D, D. The old finder of the implement gave two new edges and a new point to the tool, and improved the shape of the butt; the newer work is creamy white and lustrous, and in distinct contrast with the older work. When this implement was thrown out of the pit by the workman, the newer point got accidentally injured, at E, F. This injury, by exposing the interior of the flint, shows that the tool was originally a greyish-black one, and that since it was last pointed, it has acquired a thick, white bark by the decomposition of the flint. Now, neolithic flints at Bedford (where the example under examination was found) remain blackish-grey to the present day; the thousands of years (say from two to ten) since they were chipped have been insufficient to cause even the thinnest conceivable while film of decomposition to appear, but this palæolithic example has acquired a white bark of a sixteenth of an inch in thickness. How much older then must this *new point* be than the neolithic flints from the same place. The new point being inconceivably old, how much older must the old butt be! The implement, however, that was "found" (as proved by the flaking of medium age) was new as compared with the older, highly-abraded examples. There is other evidence of the extreme antiquity of these things. They are *all* beneath the "trail and warp." Now the "trail" belongs to geological time, and the period of its deposition is so remote that one can only guess at its age in years. The newest palæolithic implements are every one beneath and older than the "trail," how very much older, then, must be the oldest implements. The proofs that they are really older I have given.

The tools of the later palæolithic period show a marked development of the hand in the makers, for the chippers of these later tools had learned to hold small instruments with the fingers, much as we now hold a small pen, pencil or knife. From the rude and heavy bludgeon the men had advanced to beautiful oval and ovate forms almost perfect in geometrical precision. The progress from the large and rude, to the extremely small and neat scraper, shows that the men had probably progressed in the art of dressing skins, and in every way did finer and neater things. That these men and women now wore necklaces, and possibly bracelets, seems proved by the fact of specimens of *Coscinopora globularis*, D'Orb., occurring with the natural

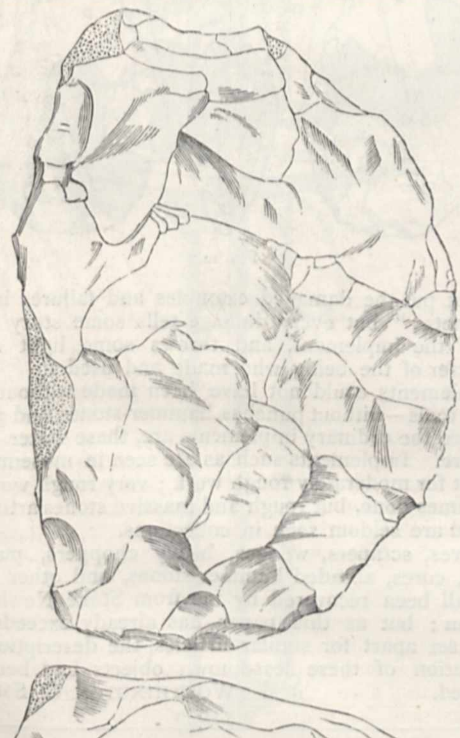


FIG. 4.

orifice, artificially enlarged. I have several specimens thus enlarged from a horde of more than two hundred, examples all found together near Bedford. Mr. James Wyatt, F.G.S., noticed a similar fact, as recorded by him in the *Geologist* 1862, p. 234. These later palæolithic men lived in large and probably peaceful companies, and their living places stretched in unbroken lines on the old river banks. The "Palæolithic Floors" are not little isolated patches, but places extending for many miles, how large they are it is impossible to say from paucity of excavations.

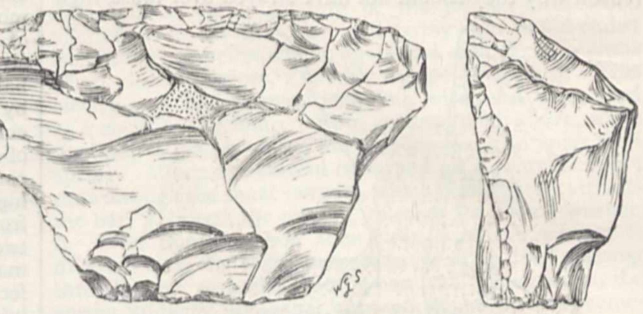


FIG. 5.

They are not confined to the valley of the Thames, but they occur in many places.

The newer implements and those of middle age are innate with, and have belonged to the gravel from the first. The older implements are distinctly "derived" like the cretaceous fossils commonly found in the gravel. We know whence the fossils have come because they are so common, the abraded ochreous implements on the other hand are very rare, and this rarity makes it difficult to say whence they have been derived, they possibly belong to none of our existing rivers. As in 1868 (*Journal of Anthropological*

FIG. 6.

Institute, Feb. 1879), I recorded my discovery of flakes and implements in the so-called middle-glacial gravel of Amwell, Ware, and Hertford, I have little doubt that the older implements found at North-East London have been derived from these positions. Whether the abovementioned gravels are really glacial or not, I am not prepared to decide. How the implements got into the gravel I cannot say. I found them in the ballast thrown out of the pits and in the pits themselves. If the gravel is glacial could not glaciers have swept up flakes and tools from old surfaces in the same way as the "trail" has undoubtedly done?

Great caution must be exercised in the acceptance of implements as of glacial age, even if found on the surface of glacial gravels. Men of the later palæolithic age lived only seven miles south of Ware, and there is no reason why they should not have strayed over those high

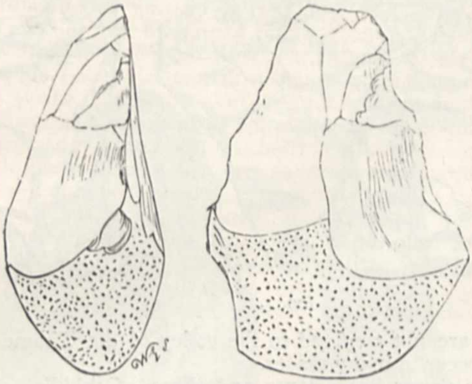


FIG. 7.

positions. Some of the later tools have glacial striæ on the original crust.

There is apparently, but perhaps not really, a gap between each of these three palæolithic periods, as there is apparently a gap between palæolithic (in its vague general sense)

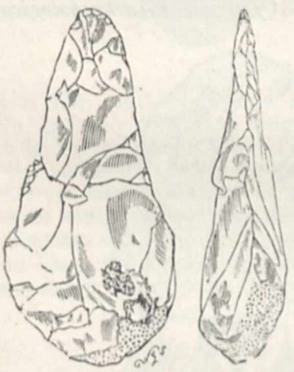


FIG. 8.

FIG. 9.

and neolithic times. Each older period however, has forms which foreshadow the forms which follow in succeeding periods even down to neolithic times. No doubt the fossil bones, if a good series could be obtained, would show a succession of, or possibly different groups, of animals

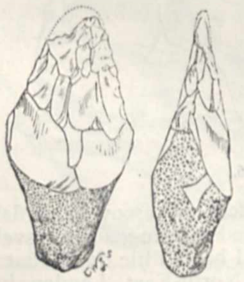


FIG. 10.

FIG. 11.

in the different deposits, but the bones, antlers, and teeth met with by me, are at present insufficient to define any such groups with distinctness.

The day will come when we shall know much more of palæolithic men than we know now. At present we only know that such men once existed and made weapons and tools of stone during long periods of time. How or where they first appeared as human creatures we can only guess. When we know more we shall modify our use of such terms as "River Drift Men," "Cave Men," &c., and we shall probably be able to mark out more or less distinctly a succession of men, a succession of geological events, and a distinct succession of progressive steps in the men from the lowest savage to the barbarian. Some of our ignorance is undoubtedly caused by the undue attention that has been bestowed on the collection of ornate implements and to the employment of gravel-diggers for their collection. No greater mistake can be made than the mere getting together of the more highly-finished and perfect implements. We only learn from them that certain makers, at first few and far between, common at last,—acquired extraordinary skill in the manufacture of stone tools and weapons. For one perfect example, twenty have their points, butts, or edges injured either by peaceful or warlike work. Collectors

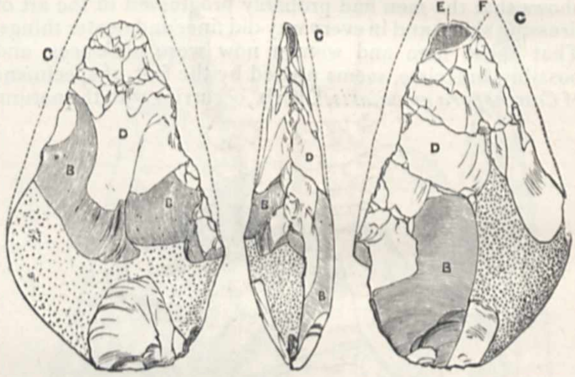


FIG. 12.

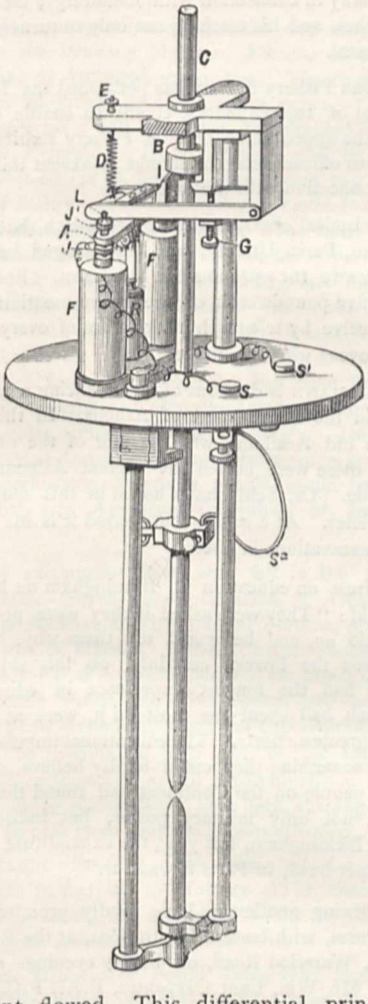
will not put the damaged examples and failures in their "cabinets;" but every damage tells some story of the use of the implement, and throws some light on the character of the being who made and used it.

Implements could not have been made without fabricating tools—without punches, hammer-stones, and anvils; —where the ordinary implements are, these latter things also are. Implements such as are seen in museums are only fit for moderately rough work; very rough work was sometimes done, but rough and massive stones artificially worked are seldom seen in collections.

Knives, scrapers, wedges, heavy choppers, punches, anvils, cores, abraded hammer-stones, and other things have all been recovered by me from Stoke Newington, London; but as this paper has already exceeded the limits set apart for similar articles, the description and illustration of these less-known objects had better be deferred. WORTHINGTON G. SMITH

LEVER'S ARC LAMP

SO many rival forms of lamps have recently been devised for regulating the electric arc light that even specialists in this branch of applied science have some difficulty in keeping up a knowledge of all the various systems. Amongst those, however, there is a tolerably well-defined class of lamps in which the movements of the carbon-holder are regulated by a clutch or kindred device, which grips the holder and raises it, lowers it, or releases it when required. Clutch lamps date back, indeed, to the year 1858, when a lamp of this type invented by Hart, the instrument maker, received a prize from the Royal Scottish Society of Arts. Amongst the more modern forms of clutch lamp those which have hitherto found favour with the public are the well-known inventions of Brush and Weston. Though the clutch device is in itself simple and efficient, the difficulty which has beset the action of such lamps has been that of arranging suitable electric mechanism to work the clutch. In Hart's lamp an electro-magnet through the coils of which the main current passed on its way to the lamp, lifted the clutch, and again released it when the increasing resistance of the arc interfered with the strength of the current. In the lamps of Weston and of Brush a much more complicated arrangement was adopted, the magnets which worked the clutch being in both these patterns of lamp wound "differentially," that is to say, with a coil of fine wire connected as a shunt to the lamp, acting in opposition to another coil of thick wire through which the



main current flowed. This differential principle was originally applied in the Siemens' lamp, wherein, however, no clutch was used. In the Pilsen lamp, and in many others, combinations of shunt magnets and main-circuit magnets have been similarly applied. The lamp which we illustrate in the figure, the invention of Mr. Charles Lever, of Manchester, is a clutch lamp, but of remarkably simple, yet efficient construction. And as it possesses sundry points worthy of notice from a scientific aspect, we will briefly describe it. The upper carbon is clamped in a holder or carbon rod C, which consists of a tube of brass sliding smoothly through the upper framework of the lamp. Fitting accurately, but not tightly to it, is a brass washer, or collar, B, which is supported from below or on one side by an adjustible screw, G, and on the other by a metal piece, I, projecting from the jointed framework below. This framework is held up by a spiral spring, D, which, when the lamp is not in action, keeps the piece, I, pressed up under the washer, B, and tilts it. When thus tilted it clutches the carbon-holder, C, and raises it. Attached to the under-side of the jointed framework alluded to is an iron bar, A, bearing two broad-ended iron screws, J, below which, again, are seen the two limbs of an electro-magnet, F F, with the poles upward. This electro-magnet is wound with fine wire, and connected as a shunt to the lamp. Now, as described above, when the lamp is not in action, the carbons are held apart by a spring. When the current is turned on it must therefore pass through the shunt magnet, which immediately attracts the bar, A, lowers the piece, I, releases the clutch-washer, B. The upper carbon then falls, and the current is diverted from the shunt-magnet to the lamp itself, passing through the carbons. But when this takes place, the spring, D, being no longer opposed, draws up the framework, and picks up the clutch, thus raising the upper carbon through the space requisite for the production of the arc. A more simple or efficient mechanism would be difficult to devise; and its action is extremely regular and steady in practice.

NOTES

PROF. HUXLEY has been appointed to deliver the Rede Lecture (Cambridge) this year.

MR. G. H. DARWIN, M.A., F.R.S., has been elected to the Plumian Professorship of Astronomy and Experimental Philosophy at the University of Cambridge, vacant by the death of the Rev. James Challis. This was the first election to a professorship since the approval of the new University Statutes by Her Majesty in Council. By the new statutes the election to certain professorships is vested in a Board nominated by the Special and General Boards of Studies and by the Council of the Senate, the persons so nominated being elected by the Senate. The members of the Board appointed to elect to the Plumian Professorship are the Vice-Chancellor, Prof. H. J. S. Smith, of Oxford, Mr. W. H. M. Christie, the Astronomer-Royal, Mr. W. Spottiswoode, President of the Royal Society; Professors Adams, Stokes, Cayley; Dr. Ferrers, Master of Gonville and Caius; and Mr. Isaac Todhunter, of St. John's.

THE subscription for the Darwin Memorial has awakened so much enthusiasm in Sweden that the local committee there formed has received subscriptions from no less than 1400 persons, including "all sorts of people," writes Prof. Loven in a letter to the English Committee, "from the bishop to the seamstress," the sums varying from five pounds to twopence. The English Committee, which has its head-quarters at the Royal Society, London, has now received (inclusive of subscriptions from abroad), 4000*l.*, but the number of subscribers in the United Kingdom is only about 600. From this it would seem that an interest in science is not nearly so widely spread in Britain as it is in the more thinly peopled land of Sweden.

IN announcing the death of Mr. Darwin to the American Philosophical Society at its meeting on April 21, 1882, Dr. Le Conte stated the general bearing of Darwinism in a striking and unusual way:—"To no man more than to Darwin does the present age owe as much, for the gradual reception of the modern method of close observation over the scholastic or *a priori* formulæ, which, up to a brief period, affected all biological investigations. To him, above all men, we owe the recurrence to the old Aryan doctrine of evolution (though in those ancient times promulgated under the guise of inspiration) as preferable, by reasonable demonstration, to the Semitic views, which have prevailed to within a few years, and are still acceptable to a large number of well-minded but unthinking men. The doctrine of evolution, in its elementary form, means nothing more than that everything that exists has been derived from something that pre-existed; that the former is related to the latter as effect is to cause. And it is most pleasing evidence of the acceptability of this doctrine, that it is now heard from many pulpits in the land, and is a strong illustration of the instructions which are thence given."

LETTERS have been received from Mr. Forbes dated from Shonga, on the Niger, at the end of October last. Shonga is a small trading-station a short distance up a creek on the right bank of the main stream some fifty miles below Rebba. Mr. Forbes had been there three weeks, and was expecting to remain about three more, when the steamer would call for him, and try to get up to Sokoto—an excursion that would occupy at least six weeks. After this Mr. Forbes would return direct to England. Having been pulled down by fever and the want of good food, Mr. Forbes had not been very successful in his collections at Shonga. His list of species of birds obtained at the date of his letter was only 105, and the difficulty in obtaining spirit had interfered with the preservation of fishes, of which many species were abundant.

IN a collection of birds and insects just received from Mr. Andrew Goldie by Messrs. Salvin and Godman are specimens of a fine new Bird of Paradise, obtained in the D'Entrecasteaux Islands, south-east of New Guinea. This species, which belongs to the restricted genus *Paradisea*, is shortly characterised by Messrs. Salvin and Godman in the last number of the *Ibis* as *Paradisea decora*, and will be fully described and figured in the next number of the same journal.

THE *Lancet* is happy to be assured that the rumours respecting the infirm state of health of Prof. Owen are unfounded. The large circle of the professor's friends will share with us in the hope that his valuable life will be prolonged many years beyond the seventy-nine which it has already reached.

A GROWING want has for some time been felt by lecturers on biological subjects, and especially by those whose lot it is to address large audiences or classes, of a good series of lantern slides, which would do for biology what has been so well done for physical science by York's series of slides. The ever increasing use of the oxyhydrogen lantern as a means of illustration, especially with popular audiences, renders this need more apparent. Arrangements have, however, now been made with Messrs. York and Son, 87, Lancaster Road, Notting Hill, London, W., to issue such a series, under the supervision of Dr. Andrew Wilson and of Mr. Wm. Lant Carpenter, to whom, at 36, Craven Park, Harlesden, London, N.W., or to Dr. Wilson, 110, Gilmore Place, Edinburgh, any communications on the subject may be addressed. It is intended that, in the first instance, the series shall comprise some of the principal types and life-histories of the lower forms of plant and animal life, and the elementary facts of animal and vegetable physiology. It is believed that the knowledge that these are in preparation, may save the construction of diagrams by some lecturers, and may lead others to make valuable suggestions as to sources of illustration, &c., to one of the above named gentlemen.

PROF. COOK, of Canterbury College, New Zealand, points out in the new number of the *N.Z. Journal of Science* that while the colony is remarkably well provided with museums, it is entirely without a public astronomical observatory. It is a fact that some years ago about 250*l*. were collected for such an observatory, but it came to nothing. We heartily endorse Prof. Cook's able advocacy for the foundation of an observatory in New Zealand, which, if perfectly equipped and directed could not fail to do good work. Out of a total of ninety-five observatories in the *Nautical Almanac* only eight are in the southern latitudes.

AT the Guildhall last week Dr. Siemens and Dr. Percy were each presented with the freedom and Livery of the Worshipful Company of Turners. The honour was conferred upon Dr. Siemens in recognition of his eminence as an engineer, his successful application of physical science to valuable practical purposes, especially electricity and metallurgy, and his personal support of technical education. The new member made a suitable reply in returning thanks for the honour conferred on him, an honour which was specially precious to him, and of which he should ever be proud. Referring to electricity, he said it was a new science, the applications of which had all to be developed, and in the development of which wonderful results had been produced. In the case of Dr. Percy, the honour was conferred in recognition of his distinguished scientific attainments, especially in connection with metallurgy, the great value of his researches, and his teaching not only to turners, but to all workers in metal.

THE German Fishery Society has petitioned the Reichstag to make a grant of 10,000 marks, chiefly to enable Germans to take part in the approaching London Fishery Exhibition. It is desired that an official delegate should represent this Empire in London in connection with the enterprise.

THE astronomical observatories of Greenwich, Kiel, Pulkova, Vienna, Milan, Paris, Utrecht, and Copenhagen have fixed on Kiel as the centre for astronomical telegrams. For an annual payment of five pounds each of the above-mentioned observatories will receive by telegraph information of every fresh astronomical discovery wherever made.

DR. SCHLIEMANN is desirous of commencing a new series of excavations in the North-West of Athens. In the neighbourhood of the old Academy was the site of the official burial-ground, and there were buried the ancient Athenians who had fallen in battle. Dr. Schliemann hopes in this spot to find the grave of Pericles. At a subsequent period it is his intention to begin fresh excavations in Crete.

IN an address on education at Birmingham on Monday, Mr. Mundella said: "They were asked if they were not over educating; he said no, and he would tell them why. Our idea of education was the lowest, certainly, on this side the Alps. Those who had the longest experience in education, those nations which had spent the most on it, were at this moment making the greatest efforts. The educational impulse throughout Europe was something they could hardly believe, and it was so because the people on the Continent had found that knowledge was power, not only military power, but industrial power. Whereas in Birmingham, last year, the expenditure on education was 2*s*. 3*d*. per head, in Paris it was 12*s*."

THE following gentlemen have kindly promised to deliver popular lectures, with lantern illustrations, at the Royal Victoria Coffee Hall, Waterloo Road, on Friday evenings at 9 o'clock. January 19, Mr. Wm. Lant Carpenter, B.A., F.C.S., on "The Telephone and how to talk to a man 100 miles away." January 26, Mr. C. A. V. Conybeare on Pompeii. On February 2, instead of a lecture a magic lantern entertainment, entitled "Here, There, and Everywhere," will be given by Major George Verney. February 9, Mr. E. B. Knobel (Sec. R.A.S.), "The Sun and his Family, with a glance at other Suns."

ACCORDING to the *Journal* of the Russian Physico-chemical Society, the priority in photographing with the electric light belongs to the well-known St. Petersburg photographer, M. Lewitski, who obtained such photographs in the winter of 1856, on the following occasion:—To produce the electric light during the celebration of the coronation of the Czar Alexander II. at Moscow, a Bunsen battery of 800 elements had been constructed.

The following winter this battery was taken to St. Petersburg, and Prof. Lenz demonstrated its action to a distinguished auditory, formed of members of the Imperial family and generals of the army. It was during this lecture that M. Lewitski obtained a photograph of the professor. A positive of this portrait was presented by M. Lermantoff to the Russian Physical Society at the *séance* on December 14, 1880. It is by no means a poor photograph, but full of detail in the shadows and half tints.

IN a recent report of the Berlin Physical Society (p. 95) we referred to some valuable observations by Dr. Kœnig with Prof. Helmholtz's new instrument, called the *leukoscope*. We observe that a detailed account (with illustration) of the instrument and of the results obtained with it, appears in *Wiedemann's Annalen*, Nos. 12 and 13 of last year.

PROF. F. W. PUTNAM has concluded a very successful course of lectures at the Peabody Museum, Boston, on some of the most interesting of American antiquities. The *Boston Evening Transcript* in an article on the lectures says:—"It is to be hoped that the curator will not again be retarded in his work from the want of means for its prosecution, when he has shown, as he has in this course of lectures, how much can be done at comparatively little expense under proper methods of research. As he said in his lecture, what is to be done must be done at once, and it would be a great pity to have the opportunities now open to him lost to science. The ancient city known to the present inhabitants of the Little Miami Valley, thirty-five miles east of Cincinnati, as 'Fort Ancient,' would be worth to American scholars for study as much as any of the old Greek cities that have been so thoroughly dug over by European explorers and students. Certainly American scholars should lead in American archæology and ethnology. The restoration or preservation of these wonderful remains of a comparatively enlightened prehistoric American people would be a glorious monument for any American Institution of learning and science."

SHOCKS of earthquake have been felt in the province of Murcia, in Spain. Seven shocks occurred at Archena on the 11th inst. Shocks have also been felt at Fortuna, Muta, Ricotel and other towns in Murcia. Eleven distinct shocks were felt on Tuesday morning at Archena, between the hours of three and six. Some lasted fifteen, and others lasted two seconds. An earthquake of a few seconds duration was experienced at Kultorp, near Kalmar, in Sweden, at 8.50 p.m. on the 12th inst. A slight shock of earthquake was felt at Monmouth at five o'clock on Tuesday evening, accompanied by a light, rushing noise. The wave seemed to pass from south-east to north-west.

A REMARKABLE discovery of the elder *Runic* inscriptions has just been made in Ryfylke in Norway. The characters have been made on a stone, the arrival of which in Christiania is awaited with great interest by *savants*.

THE French Minister of Postal Telegraphy in France has established at the central office a special course of lectures on Wheatstone's automatic apparatus, to which sixteen competent operators, from different parts of the country, have been admitted. The course of lectures and experiments has lasted two months. The pupils are now passing an examination, and a special certificate will be issued to the successful candidates, which will greatly help them in their future promotion in the postal telegraphic service.

THE Parc Montceau, placed in one of the most fashionable parts of Paris is now lighted by Jablochkoff candles with success.

ADMIRAL MOUCHEZ has issued his invitation for the Soirées de l'Observatoire, at which as usual will be exhibited all the scientific novelties of the year.

M. CHEVREUL has been unanimously nominated once more President of the French Société Nationale d'Agriculture.

IT is expected that the French Government will take in hand the celebration of the centenary of the discovery of balloons. The two committees which had been formed by several aëronautical societies have been amalgamated, and M. Gaston Tissandier has been appointed president. The scheme of an international exhibition for balloons and instruments used in aërial investigations has been adopted by M. Herrisson, the Minister of Public Works, and will be carried into effect by M. Armengaud Jeane, the well-known civil engineer.

IN his speech on laying down his office, previous to being admitted Vice-Chancellor for the year 1883, Dr. Porter, Master of Peterhouse, Cambridge, referred to the endowments of the new Professorships of Physiology and Pathology, increased grants to the museums and lecture-rooms, and a chemical laboratory on an adequate scale, as among the more urgent claims on the new funds available to the University.

PROF. FRISBY writes from the U.S. Naval Observatory, Washington, that in the circular he lately sent (NATURE, vol. xxvii. p. 226), giving elliptic orbit of great comet, $\phi = 89° 7' 42''\cdot70$ should be $\phi = 89° 13' 42''\cdot70$.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus radiatus* ♂) from India, presented by Mr. C. James; a Common Otter (*Lutra vulgaris*), British, presented by Mr. E. P. Squarey; a Black-necked Hare (*Lepus nigricollis* ♂) from Ceylon, presented by Mr. W. Bowden Smith; an Indian Antelope (*Antilope cervicapra*) from India, presented by Capt. R. Brooke Hunt; a Bohor Antelope (*Cervicapra bohor* ♀) from India, presented by Mr. W. J. Evelyn; a Black-backed Jackal (*Canis mesomelas*) from South Africa, presented by Mr. J. S. Crow; a Larger Hill Mynah (*Gracula intermedia*) from India, presented by Mrs. M. R. Manuel; three Passenger Pigeons (*Ectopistes migratorius*) from North America, presented by Mr. F. J. Thompson; a —— Horned Lizard (*Phrynosoma* ——) from California, presented by Mr. Martin R. de Selincourt; a Common Adder (*Vipera berus*), British, presented by Mr. J. Harris; an Indian Black Cuckoo (*Eudynamys orientalis*) from India, purchased; an Axis Deer (*Cervus axis* ♂), born in the Gardens.

APPROXIMATIVE PHOTOMETRIC MEASUREMENTS OF SUN, MOON, CLOUDY SKY, AND ELECTRIC AND OTHER ARTIFICIAL LIGHTS[1]

SIR WILLIAM THOMSON pointed out that the light and heat perceived in the radiations from hot bodies were but the different modes in which the energy of vibration induced by the heat was conveyed to our consciousness. A hot kettle; red-hot iron; incandescent iron, platinum, or carbon, the incandescence in the electric arc, all radiate energy in the same manner, and according as it is perceived through the sense of sight, by its organ the eye, or by the sense of heat,[2] we speak of it as light or heat. When the period of vibration is longer than one four-hundred-million-millionth of a second, the radiation can only be perceived by the sense of heat; when the period of vibration is

[1] Abstract of lecture at the Glasgow Philosophical Society, by Sir William Thomson, F.R.S.

[2] Sometimes wrongly called the sense of touch. The true list of the senses, first given, I believe, by Dr. Thos. Reid, makes two of what used to be called the sense of touch, so that, instead of the still too common wrong-reckoning of five senses, we have six, as follows:—

Sense of Force.
,, Heat.
,, Sound.
,, Light.
,, Taste.
,, Smell.

shorter than one four-hundred-million-millionth of a second, and longer than one eight-hundred-million-millionth of a second, the radiation is perceived as light, by the eye.

Pouillet, from a series of experiments, deduced a value of the energy radiated by the sun, equal in British units to about 86 foot-pounds per second per square foot at the earth's surface, or about 1 horse-power to every 6½ square feet of the earth's surface. We may estimate from this the value of the solar radiation at the surface of the sun. The sun is merely an incandescent molten mass losing heat by radiation, and surrounded by an atmosphere of incandescent vapour, so that the radiant energy really comes out from any square foot or square mile of the sun's surface, as from a pit of luminous fluid which we cannot distinguish as either gaseous or liquid. Take, however, instead of the sun, an ideal radiating surface of a solid globe of 440,000 miles radius. The distance of the earth being taken as 93 million miles, the radius of the sun is equal to, say in round numbers, one two-hundredth of the earth's distance, hence the area at the earth's distance corresponding to one square foot of the sun's surface, is equal to 40,000 square feet. The radiation on this surface is (40,000 × 86, or) 3,440,000 foot-pounds, which is therefore the amount of radiation from each square foot of the sun's surface. This amounts to about 7000 horse-power, which, according to our brain-wasting British measure, we must divide by 144, if we wish to know the radiation per square inch of the sun's surface, which we thus find to be 50 horse-power.

The normal current through a Swan lamp giving a 20-candle light is equal to 1.4 amperes with a potential of 40 to 45 volts. Hence the activity of the electric working in the filament is 61·6 ampere-volts or Watts (according to Dr. Siemens' happy designation of the name of Watt, to represent the unit of activity constituted by the ampere-volt). To reduce this to horse-power we must divide by 746, and we thus find about 1-12th of a horse-power for the electric activity in a Swan lamp. The filament is 3½ inches long, and ·01 of an inch in diameter of circular section; the area of the surface is thus 1-9th of a square inch, and therefore the activity is at the rate of 3-4ths of a horse-power per square inch. Hence the activity of the sun's radiation is about sixty-seven times greater than that of a Swan lamp per equal area, when incandesced to 240 candles per horse-power.

In this country the standard light to which photometric measurements are referred is that obtained from what is known as a standard candle. Latterly, however, objections have been raised against its accuracy. It has been said that differences of as much as 14 per cent. have been found in the intensity of the light given by different standard candles, and that serious differences have been observed in the intensity of the light from different parts of the same candle in the course of its burning. The Carcel lamp, the standard in use in France, has been regarded as the only reliable standard. It is, no doubt, very reliable and accurate in its indications, but it should be remembered that its accuracy is greatly owing to the careful method and the laborious precautions taken to secure accuracy. If something akin to the precautions applied to the Carcel lamp by Regnault and Dumas were applied to the production and use of the standard candle, there is little doubt but that sufficient accuracy for most practical purposes could also be obtained with it; probably as good results as are already obtained by the use of the Carcel lamp.

At the Conference on Electrical Units which met in Paris lately, a suggestion was made to use as a standard for photometric measurements the incandescence of melting platinum, and very interesting results and methods in connection with the proposal were presented to the meeting. According to experiments by Mr. Violle, which M. Dumas reported to the Conference, a square centimetre of liquid platinum at the melting temperature gives of yellow light seven, and of violet twelve times the quantities of the same colours given by a Carcel lamp. The apparent area of the Swan filament, being one-ninth of a square inch, is ·23 of a square centimetre, and when incandesced to 20 candles must be about as bright as the melted platinum of Mr. Violle's experiment, as the 7 carcels of yellow and 12 of violet must correspond to something like 10 carcels or 85 candles, in the ordinary estimation of illumination by our eyes. The tint of Mr. Violle's glowing platinum cannot be very different from that of the ordinary Swan lamp incandesced to its "20 candles." Thus both, as to tint, and brightness, it appears that melted platinum at its freezing temperature is nearly the same as a carbon filament in vacuum incandesced to 240 candles per horse-power.

For approximative photometric measurements the most convenient method is certainly that of Rumford, by a comparison of the shadows cast by the sources of light on a white surface. The apparatus necessary are only a piece of white paper, a small cylindrical body such as a pencil, and a means of measuring distances. Ordinary healthy eyes are usually quite consistent in estimating the strength of shadows, even when the shadows examined are of different colours, and with a reasonable amount of care photometric measurements by this method may be obtained within 2 or 3 per cent. of accuracy. The difference in the colours of the shadows is of course due to each shadow being illuminated by the other light.

Arago has compared the luminous intensity of the sun with that of a candle, and estimates it as equal to about 15,000 times that of a candle-flame.

Seidel, as Sir W. Thomson had been informed by Helmholtz, estimated the luminous intensity of the moon as about equal to that of grayish basalt or sandstone. An experiment on sunlight made in Glasgow on the 8th of this month (since this paper was read), compared with an observation on moonlight, which he made at York during the meeting of the British Association there in 1881, had led him to conclude that the surface of the moon radiates something not enormously different from one-quarter of the light incident upon it. It would be exactly this if the transparency of the Glasgow noon atmosphere of December 8, 1882, had been exactly equal to that of the York midnight atmosphere of September, 1881, referred to below, for the respective altitudes of the sun and moon on the two occasions. The observation on moonlight referred to above showed the moonlight at the time and place of the observation (at York early in September, 1881, about midnight, near the time of full moon) to be equal to that of a candle at a distance of 230 centimetres. The moon's distance ($3·8 \times 10^{10}$ cm.) is $1·65 \times 10^8$ times the distance of the candle. Hence, ignoring for a moment the loss of moonlight in transmission through the earth's atmosphere, we find $(1·65 \times 10^8)^2$, or 27 thousand million million as the number of candles that must be spread over the moon's earthward hemisphere painted black, to send us as much light as we receive from her. Probably about one and a half times as many candles, or say forty thousand million million would be required, because the absorption by the earth's atmosphere may have stopped about one-third of the light from reaching the place where the observation was made. The moon's diameter is $3·5 \times 10^8$ centimetres, and therefore half the area of her surface is 19×10^{16} square centimetres, which is nearly five times forty thousand million million. Thus it appears that if the hemisphere of the moon facing the earth were painted black and covered with candles standing packed in square order touching one another (being say one candle to every five square centimetres of surface), all burning normally, the light received at the earth would be about the same in quantity as estimated by our eyes, as it really is. It would have very much the same tint and general appearance as an ordinary theatrical moon, except that it would be brightest at the rim and continuously less bright from the rim to the centre of the circle where the brightness would be least.

The luminous intensity of a cloudy sky he found about 10 a.m. one day in York during the meeting of the British Association to be such that light from it through an aperture of one square inch area was equal to about one candle. The colour of its shadow compared with that from a candle was as deep buff yellow to azure blue, the former shadow being illuminated by the candle alone, the latter by the light coming through the inch hole in the window shutter.

The experiment on sunlight of last Friday (December 8) showed, at 1 o'clock on that day, the sunlight reaching his house in the University to be of such brilliancy that the amount of it coming through a pinhole in a piece of paper of ·09 of a centimetre diameter produced an illumination equal to that of 126 candles. This is 6·3 times the 20-candle Swan light, of which the apparent area of incandescent surface is ·23 of a square centimetre, or 3·8 times the area of the pin-hole. Hence the sun's surface as seen through the atmosphere at the time and place of observation was 24 times as bright as the Swan carbon when incandesced to 240 candles per horse-power. By cutting a piece of paper of such shape and size as just to eclipse the flame of the candle and measuring the area of the piece of paper, he found about 2·7 sq. centims. as the corresponding area of the flame. This is 420 times the area of the pin-hole, and therefore the intensity of the light from the sun's disc was equal to

(126 × 420) about 53,000 times that of a candle-flame. This is more than three times the value found by Arago for the intensity of the light from the sun's disc as compared with that from a candle-flame; so much for a Glasgow December sun!

The ·09 cm. diameter of the pin-hole, of the Glasgow observation, subtends, at 230 centimetres distance, an angle of 1/2556 of a radian; which is 23·7 times the sun's diameter (1/108 of a radian). But at 230 cm. distance the sunlight through the pin-hole amounted to 126 times the York moonlight (which was 1 candle at 230 cm. distance). Hence the Glasgow sunlight was [$(23·7)^2$ × 126 times or] 71,000 times the York moonlight. We cannot therefore be *very far* wrong in estimating the light of full moon as about one-seventy-thousandth of the sunlight, anywhere on the earth. This, however, is a comparison which, because of the probably close agreement of the tints of the two lights, can probably be made with minute accuracy: and we must therefore not be satisfied with so very rough an approximation to the ratio as this 70,000. A lime light, or magnesium light, or electric arc-light, carefully made and remade with very exactly equal brilliance, for each separate observation of sunlight and moonlight, might be used for intermediary.

THE HYPOTHESIS OF ACCELERATED DEVELOPMENT BY PRIMOGENITURE, AND ITS PLACE IN THE THEORY OF EVOLUTION[1]

IN our days the student of the biological sciences may look forward towards his life-task with sincere gratitude. Gratitude not only for what has already been achieved, and for the ends that have been attained in this domain, but more especially for all that which the future promises, since the sage whose mortal remains were lately deposited in Westminster Abbey has thrown the light of his genius over regions which hitherto were shrouded in deepest obscurity and has opened new vistas on old problems, of which man has been seeking the solution for many thousands of years.

It is to him we have to give thanks that the dawn of a new life has commenced for those sciences; to him, moreover, we owe it that the twilight has only lasted a short time, and that the full light of day has shone so soon upon an extensive field. And if by this light we perceive numerous new problems, the existence of which was not even dreamt of before, and which cover the field of our work as far as the horizon reaches, still we notice that their shapes have obtained definite outlines. In future they may serve as milestones on our way onwards, before, when we were still groping in the dark, they were as many stumbling-blocks which prevented us from advancing.

If to-day I call before your mind the image of this great reformer, it is not to give you an eulogy of Darwin, whose sudden death some months ago has filled with grief the whole civilised world. He is before my mind, because I belong to the generation whose youth coincides with that of the "Origin of Species;" a generation deeply filled with gratitude towards this great master. A gratitude bursting forth with doubled intensity in him who enters upon a career in which he will have ample opportunity to continue work in that field of science to which he has become more and more attached through the inspiring influence of Darwin.

It is not only by the contents of his work that Darwin takes hold of us, it is also his personal character which leaves such a forcible impression. The history of his life, his method of work, his amiable individuality, have excited our enthusiasm over and again, and always in an increasing measure. Similar to other grand figures in the history of the world, who by their life and their example have perhaps wrought more than by their teaching—which at the hands of less eminent adepts soon took a dogmatic, *i.e.* a degenerate shape—this reformer of biological science has left behind him a remembrance which will be kept and transmitted by his followers with quite as much care and piety as the writings he has left.

What strikes us most and all at first in everything emanating from him is his passionate honesty,[2] which has already become proverbial. Never did he pass over in silence, in the interest of his argument, a point which might eventually appear to be in favour of the opposite plea. In the enumeration and refutation of such points he was always quite as careful as in the collection of positive proofs. He was never biassed, unless biassed in the good sense of the term, *i.e.* enabled, when once he was of opinion that it was necessary to choose a decided side with respect to any dubious point, to devote to the careful consideration of this point not only hours, but if necessary months and years of his life,—months and years of daily returning observations concerning what appeared to be unimportant facts, which, however, when they were afterwards brought together, permitted him to draw highly important conclusions.

Unlimited veracity and undaunted patience, two principal requirements of the true naturalist, thus found their most perfect incarnation in Darwin, and with these two for his guides, he brought together, from far and near, building stones for the completion of the grand structure which his mind had conceived. The quarries from whence he excavated those building stones were very different from those to which the scribes in biological science habitually resorted. It must be understood that since the appearance of Cuvier's "Le Règne Animal distribué d'après son Organisation," a reaction had sprung up against descriptive zoology which in many cases went further than Cuvier himself would ever have acknowledged. The numerous volumes of his excellent "Histoire naturelle des Poissons" furnish ample proof that Cuvier had always endeavoured to combine careful description of the species and conscientious sifting of all the material concerning its life history, its geographical distribution, and its synonymy with the study of the comparative anatomy of the group to which it belonged. Several of his followers have, however, concluded that since researches upon the internal organisation of so many classes of animals allowed him to make most important deductions, it was from similar researches only that anything could be expected for the future. Their ambitious aspirations could not manage to forget that a combined investigation by Cuvier and Geoffroy St. Hilaire was once described by one of the two in the following words:—"Nous ne déjeunions jamais sans avoir fait une découverte."

And so a period was opened up in which our knowledge of the internal organisation of animals was not only increased on all sides and firmly based upon facts by zealous workers, but in which this knowledge was gradually pushed into the foreground as the pre-eminent, as the only true zoology. The careful study of the species and its life history was left with a smile and a shrug of the shoulders to dilettanti and museum zoologists. In order further, to indicate how the results of researches of these men were looked upon as popular and unimportant, this new school invented the well-sounding name of "scientific zoology."

The eminent researches of von Siebold on parthenogenesis and on the freshwater fishes of Germany; Kölliker's important monograph of the Pennatulids, &c., show that even its founders were subject to impulses which drove them back into this very field, or rather that it was not they, but their less gifted followers from whom the contemptuous meaning which that combination of words gradually attained has emanated.

Thus for a certain lapse of time the wind blew from a different quarter, and attempts have repeatedly been made to call into life classifications which were based upon certain points in the internal organisation, points which were considered to be of the more importance the less they were visible. Fortunately the great masters to whom we owe comparative anatomy, and who have made it such as we know it in the present day, have not joined in this movement. Johannes Müller's "System der Plagiostomen" stands side by side with his "Comparative Anatomy of the Myxinoids," showing that this one-sided exaggeration would never have been encouraged by himself. Gegenbaur, Huxley, &c., have similarly kept aloof from the "scientific zoologists" in the stricter sense, whose narrow-minded doctrines are still pullulating, be it in a somewhat modified form. At the present day it is not so much the internal organisation which forms the shibboleth by which entrance is obtained to the holy circle of self-styled orthodox zoologists, but now it is the history of development, embryology, that gives the pass-word. This important branch of biological science has made gigantic strides of late; it counted in its foremost ranks, among the most promising and large-minded, the man whom a cruel fate had doomed to find his death in the Alps of Switzerland, the talented Balfour. He never overvalued in a petty way the labours of the select batallion of which he was one of the leaders. In the rear of this army, however, voices are heard claiming infallibility for embryology, and the splendid generalisation: "the development of the individual is a repetition on a reduced scale of the development of the race," must often serve to hide unripe

[1] By Prof. A. A. W. Hubrecht. Inaugural Address delivered in the University of Utrecht. September, 1882.
[2] Cf. Huxley, NATURE, May, 1882.

attempts at classifications deduced from the developmental stages of eggs and larvæ of questionable origin, and applied to groups of animals of which the adventurous embryologist would certainly not be able to distinguish the different members specifically.

But enough of this distressing partiality, knowing that we find a complete reaction against it, in Darwin's word and example, which will be our strongest antidote against similar influences. We are thus carried back to our starting-point, where it was observed that the value of the sources from whence Darwin has drawn so much valuable information, was scarcely recognised up to his time. He entered into connection with cattle-rearers and bird-fanciers, and gladly availed himself of the remarks of trustworthy observers who were acquainted with animals and plants in their daily life, even if they had always remained outside the pale of science.

And what far-reaching results may be obtained by careful study of the habits and life-history of animals is shown by the last volume which we owe to Darwin's hand. Here it is apparent, upon almost every page, that from conscientious observations on the habits of an animal so common as the earthworm, conclusions follow which furnish us with new and quite unexpected views about the formation and the changes of a large area of the earth's surface.

The most striking example of Darwin's all-embracing genius is obtained when his Monograph of the Cirripedia is compared with the chapters in which he enunciates and discusses his hypothesis of pangenesis. The one, the most scrupulous study of details, the comparison of slight differences both between individuals of the same species and between specifically distinct specimens; the evaluation of these distinctive characters one against the other; in one word, pure systematic zoology with all its appurtenance of patience, scrupulousness, and nearly painful conscientiousness. The other—one of the most daring hypotheses which the human understanding has ever wrought, upon which only a very limited number of observed facts can be brought to bear. A hypothesis which boldly penetrates into the most hidden secrets of organic nature; which brings the marvellous effects of heredity on a level with the reproduction of lost parts, yea even with the healing of wounds. A hypothesis which no longer looks upon the cells as the morphological units of the living organism, but which postulates the existence of a continual flow of separate minute gemmulæ, feeding and reproducing themselves, and being derived from all the cells and all the tissues in all the consecutive periods of their existence. These gemmulæ, in the individual being we have before us, circulate along paths which remain wholly unknown to us, and finally reunite in millions in every ovum, in every spermatozoon, in every bud, and in every pollen-grain.

The laws by which these inscrutinable processes are governed, do not lose anything of their mysteriousness when we glance at the disparate and incomprehensible phenomena which they have to explain: atavism, in which heredity takes a sudden leap backwards into the grey mists of the past; the transmission to the child of the effects of an increased or decreased use of a limb by the parents: the reproduction of a lost limb or tail; the growth of an entire plant out of a severed portion of a leaf; the change which pollen and sperma may occasionally call forth not only in the ovules but also in the tissues of the mother-form; the hybridisation in the vegetable kingdom by the union of the cellular tissue of two plants independently of the organs of generation; the appearance of a complex metamorphosis in the course of the development of certain animal forms, the nearest allies of which are entirely devoid of anything like it; &c.

Nevertheless this hypothesis was put forward by the very same Darwin whom we have to thank for the monograph of the Cirripedia. It is clear that the frame of mind required for completing the one is widely different from that in which he enunciated the other. There is, however, a common link uniting the two. In the specific description of the Cirripeds we find him ever and again in collision with the opinion then generally accepted of the definite boundaries limiting the species, and thus this work cannot have remained without influence on the later development of his ideas. On the other hand, he looked upon the hypothesis of pangenesis as a necessary sequel, to a certain extent as "le couronnement de l'édifice" of his theory of evolution by means of natural selection.

We have not here to enter into a discussion concerning the hypothesis of pangenesis, nor to inquire into the different attacks to which it has already been exposed. I must, however, observe that with it Darwin has entered the domain of physiology, a field upon which all the questions into which the great problem of evolution may be subdivided, as heredity, influence of use and disuse of organs, adaptation to modified circumstances, must find their solution.

Whereas the physiology of man and the higher animals is developing and growing with rapidity, and what has been thought and wrought in Utrecht has largely influenced this development, Comparative Physiology, which has to track all the different problems just mentioned all through the animal kingdom down to their simplest form in the lowest organised beings, is only in its infancy. And yet this branch of science will shortly come abreast of morphology further to secure the basis of the theory of evolution and to contribute to its harmonious development. It was not by mere chance that the legislature specially mentions Comparative Physiology as a branch of science which will have to be cultivated and taught by him who is called to the chair I am about to occupy.

Although the greater part of this territory is still wrapt in obscurity, still it is at the University of Utrecht that the prospects for Comparative Physiology are promising in the highest degree, be it by the efforts of others than the legislature had in view. It must for certain be acknowledged that researches concerning the phenomena of life in the very smallest organisms, investigating their reaction towards light and oxygen, and even penetrating into the effects of hunger and thirst as manifested by these lowly-organised beings, eminently belong to the domain of Comparative Physiology. The vicinity of a laboratory in which such excellent results have already been obtained is a strong stimulus for us all towards further labour in this field.

Venturing to-day along that road, I may hope to claim your attention, because in so doing, I wish to make an attempt to weaken one of the chief arguments against the theory of evolution, an argument which was termed by Huxley "the stock objection." [1]

I wish to speak to you about the hypothesis of accelerated development by primogeniture and its place in the theory of evolution.

I must begin with calling to mind that provisionally it is not upon the firm basis of proved facts, but more upon the quicksands of theoretical conjecture that we shall be moving. Our track first leads us into the domain of a science which is of such an exceptional value for the theory of evolution, because this science only, the science of palæontology, can furnish us with direct evidence towards the truth of that theory.

If, indeed, living organisms form one continuous chain with those that have already become extinct; if these organisms have not been called into life in successive periods by repeated creative acts but if they are in direct blood-relationship to each other—a relation which as we penetrate further into the past must be accompanied by a simplification of organisation—then palæontology must furnish us with the evidence of this process. Then, indeed, the superposed strata which have been deposited since the cooling of the earth's crust under the combined influence of internal vulcanism and external atmospherical influences, must contain the archives in which the most trustworthy and direct proof for the validity of the theory of evolution are to be found. Moreover, the material which we find heaped in these archives must show—if we place confidence in it—that gradual increase of complication which accompanies the development of the more highly differentiated forms out of simpler types by the aid of natural selection, in a succession exactly corresponding to that of the deposition of the strata. We know how far palæontology had advanced in 1859, we understand how it was that Darwin insisted on the imperfection of the geological record in the first edition of his "Origin of Species." He diligently collected arguments to explain this incompleteness and to oppose the objection against his doctrines which it might furnish. I cannot at present enter into details concerning this refutation. Still it is quite as valid to-day. So many deposits are wholly devoid of animal remains, it is so obvious that of other animal forms, fossils can hardly ever have been formed, and lastly, only such a small portion of the earth's surface has been adequately searched, that we have indeed more reason to be astonished at the quantity of facts that have already come to our knowledge, than at the much larger quantity which yet remains hidden from our view.

This is especially present to our minds when we remember

[1] T. H. Huxley, American Addresses.

the invaluable deposits that have of late years been opened up in North America, where not only the successive periods of the tertiary epoch form extensive deposits, but where they moreover contain perfectly preserved animal specimens which have lived in these successive periods, and which indeed show in the most irrefutable way that a direct connection accompanied by an increase of differentiation undeniably exists. We here find a very remarkable page of the book thrown open upon which nature has written down for us the history of the development of the horse, and whoever has learnt to read this handwriting is brought to the inevitable conclusion: this development has started from an older form of a less specialised organisation, and has proceeded along successive steps which are entirely in accordance with the theory of evolution.

Similarly the numerous remains of the fossil group of the Ornithoscelidæ are only known since a recent date, and a gradually increasing knowledge is thus attained of those interesting animals which link together reptiles and birds, two classes of animals which were formerly looked upon as amongst the most thoroughly separated.

Together with these irrefutable proofs that evolution has indeed taken place, starting from the simpler, more generalised types, and tending towards the more complicated and more specialised forms, palæontology acquaints us with certain other facts. I allude to the persistence of the same form, of the same genus, sometimes even of the same species in all successive strata and periods. Thus, for example, among Mollusks, Chiton and Pleurotomaria have persisted from the Silurian down to the present period; Dentalium from the Devonian; Pinna and Cyprina from the Carboniferous period. Amongst the Foraminifera certain genera occur in the Carboniferous epoch, which at the same time are members of the living fauna. Amongst Brachiopods our living Lingulas, Rhynchonellas, and Terebratulas are very ancient types; representatives of the osseous fishes lived in the Cretaceous period, which cannot be generically distinguished from their living relatives, whilst certain genera of cartilaginous fishes reach even into a much farther distant past.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—Owing to the early occurrence of Easter, the term has begun a week earlier than usual this year. The first University business of importance will be the constitution of the New Boards of Faculties. These will consist of the professors as *ex-officio* members, and of members elected by the College lecturers in the various faculties, the number to be so elected being first decided by vote. The first step towards the new state of things has been the appointment of Mr. Lockhart, of Hertford College, as General Secretary to the Board of Faculties.

In the department of Physics at the University Museum, Prof. Clifton continues his course on the Electricity Developed by the Contact of different Substances; Mr. Stocker lectures on Mechanics, and Mr. Heaton on Problems on Mechanics and Physics. Prof. Price continues his course on Optics, and also gives a course on Hydro-mechanics.

Prof. Pritchard is absent in Egypt completing his measurements of the magnitude of the stars. The observatory will be open on Tuesday and Thursday evenings under the charge of Mr. Plummer.

In the Chemical Department of the Museum, Prof. Odling will give a course on Elementary Facts and Doctrines. Mr. Fisher will lecture on Inorganic Chemistry, and Dr. Watts on Organic Chemistry. The laboratory will lose the services of Mr. F. D. Brown in the middle of the term, as he has been elected to the Professorship of Chemistry and Physics in the New University at Auckland, and leaves for New Zealand in March.

In the Biological Department Prof. Moseley continues his course on Comparative Anatomy (followed by practical work). Mr. Hatchett Jackson lectures on the Fundamental Principles of Embryology, Mr. Poulton on the Geographical Distribution of Animals, Mr. Lewis Morgan on the Teeth of Vertebrata and on Human Osteology, and Mr. Hickson on Histology. Mr. Barclay Thompson has been obliged to give up lecturing on account of ill health.

Prof. Prestwich gives a course of lectures on Stratigraphical Geology.

The following courses will be given in the private College laboratories:—At Christchurch Mr. Vernon Harcourt lectures and gives practical instruction in Quantitative Analysis, and Mr. Baynes on Thermo-dynamics. At Balliol Mr. Dixon lectures on Organic Chemistry, and Elementary Electricity. At Magdalen Mr. Yule gives a course of demonstrations on the Chemical and Physical Properties of the Blood, Circulation, Respiration, &c.; and Mr. Chapman gives a practical course on Elementary Vegetable Morphology.

A scholarship in Natural Science will be offered at Keble College of the value of 80*l.* per annum. The examination will be in Biology and Chemistry; a scholarship will also be offered for competition at Queen's College in Physics, Chemistry, or Biology.

CAMBRIDGE.—Mr. J. E. Marr, M.A., Fellow of St. Johns College, is the Sedgwick Prizeman this year.

Science lectures commence on the following days: Prof. Liveing, General Principles of Chemistry, January 23; Prof. Dewar, Organic Chemistry, January 23; Prof. Newton, Geographical Distribution of Vertebrate Animals, January 31; Mr. Caldwell, Morphology of Invertebrata, Advanced, February 1; Dr. Hans Gadow, Morphology of Vertebrata, Advanced, January 30.

The names of Messrs. Casey (Trin.), Harvey (King's), A. R. Johnson (St. John's), Turner (Trin.), and Welsh (Jesus) appear in alphabetical order in the First Division of the List for the Third Part of the Mathematical Tripos, to which only the Wranglers were admitted. One name is in the second division, and eight in the third.

MR. F. J. M. PAGE, B.Sc., F.C.S., of University College, London, was elected, on January 11, Lecturer on Physics at the London Hospital Medical College.

SCIENTIFIC SERIALS

Journal of the Franklin Institute, December, 1882.—An improved dynamometer, by W. P. Tatham.—The isochronal Worthington pumping engine, by J. K. Maxwell.—Explosive and dangerous dusts, by T. W. Tobin.—Economical steam power (continued), by W. B. Le Van.—The universality of vibrations, by C. C. Haskins.—Report on European sewerage systems, &c. (continued), by R. Hering.

Annalen der Physik und Chemie, No 13 (December 2, 1882).—Absolute measurements with bifilar suspension, and especially two methods for determining the horizontal intensity of terrestrial magnetism without time measurement, by F. Kohlrausch.—The reduction of the Siemens unit to absolute measure, by E. Dorn.—On electric vibrations with special regard to their phases, by A. Oberbeck.—Experimental researches on galvanic polarisation, by F. Streintz.—On M. A. Guebhard's representation of equipotential curves, by E. Mach.—The electromotive force of the Daniell element, by E. Kittler.—On amalgamation-currents, by H. Haga.—Explanation of electric shadows in free air, by P. Riess.—On the material parts in electric sparks, by F. Wächter.—On the magnetic screening action of iron, by J. Stefan.—On tone-vibrations of solid bodies in presence of liquids, by F. Auerbach.—A small alteration of the pyknometer, by E. Wiedemann.—Remark on Herr Galn's memoir on the density of the luminiferous ether, by the same.—On the true cohesion of liquids, by the same.—On the condensation of liquids on solid bodies, by the same.—The leucoscope and some observations made with it, by A. König.—Contribution to the theory of diffraction in telescope-tubes, by H. Struve.—On the elliptical polarisation of reflected diffracted light, by W. Kœnig.—On the Poggendorff fall-machine, by K. L. Bauer.—Contributions to the history of natural sciences among the Arabs, viii. and ix., by E. Wiedemann.

Bulletin de l'Academie Royale des Sciences de Belgique, Nos. 9 and 10.—Notice on a peculiarity in the aurora borealis of October 2, 1882, and on the increase in intensity of scintillation of stars during auroræ, by C. Montigny.—Some theorems of elementary geometry, by E. Catalan.—On curves of the third order, by C. Le Paige.—Aspect of the great comet of 1882 (Cruls) observed at Louvain, by F. Terby.—Note on the aurora borealis of October 2, 1882, by the same.—Action of chlorine on tertiary butylic chloride, by Baron d'Otreppe de Buvette.

No. 11.—Note on some bones of the Biscay whale at the

Museum of La Rochelle, by P. J. Van Beneden.—On some uniform geometric transformations, by C. Le Paige.—Second notice on the comet, by F. Terby.—On the functions of M. Prym and M. Hermite, by A. Genocchi.—On glycogen in Mucorineæ, by L. Errera.

Journal de Physique, December, 1882.—Remarks on timbre, by M. Kœnig.—Remarks on the critical state, by M. Stolatow.—Experimental study of the reflection of actinic rays; influence of specular polish, by M. de Chardonnet.—Note on the theory of the Laurent saccharimeter with white light, by M. Dufet.—Notes of science in *Il Nuovo Cimento* and the *Journal* of the Russian Physico-Chemical Society.

Rivista Scientifico-Industriale e Giornale del Naturalista, October 31, and November 15 and 30, 1882.—Inconveniences of the usual pluviometer, and a few words about the pluvio-pulverometer, an apparatus for rain, dew, and atmospheric dust, by P. Lancetta.—Non-sensitive mercury thermometer; demonstration of the principle of the telephone, by G. Govi.—A doe with hairy horns.—Review of a prize memoir by G. Poloni, on the permanent magnetism of steel at different temperatures, by A. W.—Double-action mercury air-pump, by G. Serraville.—Fundamental principle of electrostatics, by S. Mugna.—Male genital armatures of saltatory Orthoptera, by A. Tozzetti.—Brief notice of the fluoriferous volcanoes of Campania, by A. Scacchi.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti. Vol. xxv., fasc. xviii.—On a recent landslip near Belluno, by T. Taramelli.—On drunkenness in Milan, II., by A. Verga.—Jacobi's theorem regarding periodicity, and the illegitimacy of a part of the consequnces that have been deduced from it, by F. Casorati.

Nouveaux Mémoires de la Société Helvetique des Sciences Naturelles, vol. xxviii., 2nd part.—The Diluvium round Paris and its position in the Pleistocene, by A. Rothpletz.

SOCIETIES AND ACADEMIES

LONDON

Mathematical Society, January 11.—Prof. Henrici, F.R.S., president, in the chair.—Messrs. H. T. Gerrans and W. L. Mollison were elected members.—Dr. Hirst, F.R.S., spoke on the resolution of congruences into systems of quadric reguli; Mr. Glaisher, F.R.S., discussed the solution of a differential equation allied to Riccati's; and Mr. Tucker communicated a paper by Prof. Cayley, F.R.S., on the automorphic transformation of a binary cubic function.

Zoological Society, December 19, 1882.—Prof. W. H. Flower, LL.D., F.R.S., president, in the chair.—Mr. Sclater exhibited some photographs of a new Zebra, from Shoa, lately named *Equus grevyi*, by M. A. Milne-Edwards, F.M.Z.S., which had been sent to him by that gentleman, and pointed out the difference which separated this animal from the nearly allied *E. zebra*.—The Rev. H. H. Slater, F.Z.S., exhibited and made remarks on the skin of a Shrike (*Lanius* sp. inc.) which had been obtained near Spurn Point, Yorkshire.—The Secretary exhibited, on behalf of Lord Lilford, the skin of a young male *Emberiza rustica*, which had been taken at Elstree Reservoir on November 19 last. Only one other example of this bird had hitherto been recorded as having been met with in Great Britain.—Dr. Günther exhibited, on behalf of Sir Campbell Orde, Bart., a specimen of a Charr (*Salmo alpinus*), obtained in a loch in North Uist, being the first example ever obtained in this loch.—Mr. P. H. Carpenter exhibited and made remarks on some microscopical preparations of *Antedon eschrichti*, in which a nervous plexus derived from the fibrillar envelope of the chambered organ was visible at the sides of the ambulacra of the disk.—Prof. Flower exhibited a photograph (presented to the Society by Mr. James Farmer, F.Z.S.) of Seal Point, Farallone Islands, off the coast of California, showing the immense number of Seals (*Otaria gillespii*, M'Bain) frequenting that locality.—Prof. Flower read a paper on the whales of the genus *Hyperoodon*, in which he pointed out that one of the most important points in the history of these animals yet unsolved was whether the large-headed form, with great development of the maxillary crests, called by Dr. J. E. Gray *Lagenocetus latifrons*, was a distinct species, or whether, as suspected by Eschricht, it was the adult male of the common form known as *Hyperoodon rostratus*. The author had asked Capt. David Gray to avail himself of his exceptionally favourable opportunities of observing these animals in their native haunts, to solve this question, with the result shown in the next communication.—A communication was read from Capt. David Gray, ss. *Eclipse*, called "Notes on the Characters and Habits of the Bottlenose Whale (*Hyperodoon*)," in which it was stated that he had killed 203 of these animals last season, and had traced in the males every gradation of development between the two forms, and had therefore conclusively proved that *Hyperoodon* or *Lagenocetus latifrons* had no existence as a distinct species. The communication was illustrated by sketches and photographs, showing the external characters and cranium in various stages of growth.—Mr. P. H. Carpenter read a paper on the classification of the *Comatulæ*. He criticised the method of formulation recently proposed by Prof. F. J. Bell, and pointed out its disadvantages for the purposes of classification, owing to its being inapplicable to those *Comatulæ* which have irregular arm-divisions. He explained his own system of formulation and classification, and stated that he believed it to be capable of dealing with all possible variations of *Comatula* structure.—Mr. F. Day read a paper on the identity of *Arnoglossus lophotes*, Gthr., with *Pleuronectes grohmanni*, Bonap. A second paper by Mr. Day contained remarks on some hybrids between Salmon and Trout.—A paper by Messrs. Godman and Salvin was read, describing some Butterflies from New Ireland, received from the Rev. G. Brown and Mr. E. L. Layard. Among these were examples of two new species, named respectively *Prothoe layardi* and *Danaius adustus*.—Mr. Oldfield Thomas read a paper containing descriptions of two new species of Fruit-Bats of the genus *Pteropus* from the Caroline Islands. The author proposed to call them *Pteropus phæocephalus* and *Pt. breviceps*.—A communication was read from Major G. F. L. Marshall, F.Z.S., containing some notes on Asiatic Butterflies. A species of *Amecera* was mentioned as new to the Beluchistan fauna, and three species were described as new to science.—Mr. G. A. Boulenger read the description of a new species of Lizard from Dacotah, based upon some specimens lately presented to the Society's collection by Mr. S. Garman, of the Museum of Comparative Zoology, Cambridge, Mass., and proposed to name it *Sceloporus garmani*.—Mr. Arthur G. Butler read a paper in which he gave an account of a collection of Spiders made by the Rev. Deans Cowan in Madagascar. In addition to many inteesting and singular forms were specimens of the curious tailed species *Arachnoura scorpionoides* from Central Madagascar. Six new species were described.—Mr. W. N. Parker read a paper on some points in the anatomy of the Indian Tapir.—Mr. Herbert Druce read a paper descriptive of new species of Moths chiefly from Western Africa and New Guinea. Fifteen new species were described, as was also a new genus of *Chalcosiidæ* from New Guinea.

Geological Society, December 20, 1882.—J. W. Hulke, F.R.S., president, in the chair.—Percival Fowler, Alfred Eley Preston, and Robert Blake White, were elected Fellows of the Society.—The following communications were read:—On generic characters in the order Sauropterygia, by Prof. Owen, C.B., F.R.S. After referring to the subdivision of De La Beche's group of Enaliosauria into the orders Ichthyopterygia and Sauropterygia, the author indicated that the latter showed differences in the proportional length of the neck and the number and form of its vertebræ bearing relation to the size of the head, together with modifications of the teeth, of the sterno-coraco-scapular frame and of the paddle-bones, leading to the formation of two genera, namely, *Plesiosaurus* and *Pliosaurus*, the latter so-called to indicate the nearer approach made by it to a generalised Saurian type. In Crocodilia the crowns of the teeth show a pair of strong enamel ridges, placed on opposite sides of the teeth, and these occur also in *Pliosaurus*; while in *Plesiosaurus* they are not present. *Pliosaurus* further approaches the fresh-water Saurians by the large size of the head and the shortness of the neck.—On the origin of valley-lakes, mainly with reference to the lakes of the Northern Alps, by the Rev. A. Irving, B.A., B.Sc., F.G.S. The author, having given reasons for considering this question, still an open one, proceeded to criticise Prof. Ramsay's theory as it was expounded by him in 1862. The author proceeded to show that the lakes of the Northern Alps are found, as a rule, just among those strata where subsidence would be most likely to occur. In this way it was shown that we are *not shut up*, by Prof. Ramsay's reasoning, to the hypothesis of *glacial excavation*. Further, other agencies than those discussed by Prof. Ramsay may have co-operated to form lakes, such as (*a*) *Alterations in the relative levels* of different parts of a floor of a valley, connected with movements of parts of a mountain-system on a large scale. The effects of (1) lines of flexure crossing older lines of valley-erosion; (2) of lateral thrusts closing in a valley (partly), were here considered. (*b*) *Upthrust* of the more yielding strata (as in the "creeps" of coal-mines) by resolution of forces due to pressure of the mountain-masses at the side of a valley. (*c*) The *dead weight of the huge glaciers* which filled the Alpine valleys, and *crushed in the floor*, in places where extensive underground erosion had gone on in preglacial times. (*d*) The partial *damming up of valleys*, (1) by *diluvial detritus*, (2) by *moraines*, (3) by *Bergstürze* (recently investigated by Prof. Heim of Zürich. (*e*) *Faults*. (*f*) *Chemical solution*, by Alpine waters derived from the melting of the snow, which has undergone long exposure to the atmosphere. It was shown that the very situation of the great majority of the lakes of the Northern Alps is distinctly favourable to the operation of one or more of these agencies. The Königsee was mentioned as a special instance of *subsidence*; the Achensee of a lake lying in a *faulted* line of dislocation; Lake Alleghe and Lake Derborence as lakes formed by Bergstürze during the last century; the prehistoric delta of the Arve as the most conspicuous instance in the Alps of the partial damming-up of a valley by diluvial detritus; the *quondam* Lake of Reutte as an instance connected with violent inversion of strata; and the ancient lakes of the Grödner and Oetz Thals as instances of the action of moraines. The common fact of observation that lakes are more numerous in glaciated than in non-glaciated countries, the author thought, was partly explained by some of the foregoing principles, partly by the better preservation of lake-basins in glaciated countries from silting up and from becoming thus obliterated, while in some glaciated regions lakes are wanting.

Victoria (Philosophical) Institute, January 15.—Prof. Stokes, F.R.S., Lucasian Professor of Mathematics at Cambridge, read a paper on the Absence of Real Opposition between Science and Religion.

Edinburgh

Royal Society, December 18, 1882.—Mr. Robert Gray, vice-president, in the chair.—Prof. Tait read a paper on the laws of motion, in which an attempt was made to express the fundamental principles of dynamics without introducing the idea of "force." The conservation of energy forms of course the basis. The region of space, in which a given particle is, is mapped out by its equipotential surfaces. Newton's First Law is expressed, then, by saying that the potential of the space is the same from point to point, so that the kinetic energy of a moving particle suffers no change. If the potential varies, then the kinetic energy must vary. As a simple case, consider two regions separated by a plane, the potential function being constant throughout each region. Then the velocity of a particle approaching the plane may (since motion is purely relative) be referred to a point moving parallel to the plane, so as to make the velocity of the particle wholly perpendicular to the plane. It thus appears that the component of the velocity at right angles to the plane only is altered, so that if the direction of motion is originally inclined to the plane, the direction as well as the speed is altered. This, in fact, is the well known problem of refraction according to the corpuscular theory of light; and the principle of least action thus appears under the form of the conservation of velocity at right angles to the direction of greatest potential slope. In expressing Newton's Third Law, Prof. Tait extended the second interpretation as given in the now well known Scholium to include vector as well as scalar quantities.—Mr. George Seton, in a paper on illegitimacy in Scotland, gave a careful analysis of the returns for the last decade, which showed a decrease of ·9 per cent. as compared with the returns of the previous decade. The counties in which the percentage was under the average for the whole country all lay to the west of a line drawn from the north coast to Loch Ryan, down the eastern boundaries of Sutherland, Inverness, Perth, Argyle, Renfrew, and Ayr. That this difference could not be referred as altogether due to difference of race was proved by the fact that amongst the pure Scandinavian population of Orkney and Shetland the rate was much below the average. The results pointed to a low moral tone in the agricultural districts of Elgin, Banff, Aberdeen, Roxburgh, and Galloway.—Prof. Tait communicated an account of Prof. J. E. MacGregor's experiments on the absorption of low radiant heat by some gaseous and vaporous bodies. The apparatus was a gigantic form of that which has already been described in these columns (see NATURE, vol. xxvi. p. 639). Air saturated with water vapour at 12° C. behaved almost exactly like air mixed with ·06 per cent. by volume of olefiant gas.—Prof. Tait, in a note on the compressibility of water, stated that water seemed to be less compressible at higher than at lower pressures, and more compressible (as compared with steel or glass) at lower than at higher temperatures. This latter result was obtained by comparison of his own laboratory experiments with the experiments carried out by Mr. Murray and Prof. Chrystal in their deep-sea sounding expedition last summer on the north-west coast of Scotland. Both series of experiments were made with Prof Tait's steel and glass gauges.—Prof. Crum Brown communicated a note by Mr. A. P. Laurie on an application of Mendeljeff's law to the heats of combination of the elements with the halogens. Laying off as abscissæ numbers representing the heats of combination of different salts of a given halogen, and measuring as ordinates the corresponding atomic weights of the other element in the compound, Mr. Laurie obtains a succession of points which show a remarkable periodic arrangement. The curves so drawn for the different halogens are strikingly similar.

Paris

Academy of Sciences, January 8.—M. Blanchard in the chair.—The following papers were read:—Observations on the last communication of Dr. Siemens concerning solar energy, by M. Faye.—On the ice-plant (*Mesembrianthemum crystallinum*), by M. Mangon. This plant (which is covered with transparent vesicles filled with liquid, like frozen dew-drops) is formed of a weak solution of alkaline salt, kept in the solid state by a vegetable tissue, whose weight reaches less than two per cent. of the whole mass. The ashes, formed of salts of soda and potash, constitute nearly half (43 per cent.) the weight of the dried plant (recalling seaweed). M. Mangon notes the plant's elective power, suggests that its cultivation, as a potash-plant, might be useful in some cases, and in any case, it might do good service in removal of alkaline salts in excess from ground on the Mediterranean coast.—Researches on hyponitrites; second part; calorimetric measurements, by MM. Berthelot and Ogier.—On the natural formation of bioxide of manganese, and on some reactions of peroxides, by M. Berthelot.—Experiments relating to disorders of motility caused by lesions of the apparatus of hearing, by M. Vulpian. He describes a series of disorderly movements produced in rabbits by pouring a few drops of hydrate of chloral solution into one ear or both ears. The same experiment with dogs and guinea-pigs gave much less marked effects.—On complex units, by M. Kronecker.—Examination of the analogy between electrochemical and hydrodynamical rings, and the curves $\Delta V = 0$; Best process of discussions in the experimental method, by M. Ledieu.—Experiments on the motion of current waves in various passages, contracted either in the interior or at the extremity of a canal debouching into a reservoir, by M. de Caligny.—Report on a memoir of M. de Salvert on conic umbilici.—On the precision of longitudes determined with use of the new chronometric method, by M. de Magnac. He shows by a list of chronometric longitudes obtained in the *Jean Bart*, on the coast of Brazil and Montevideo, compared with the telegraphic longitudes, deduced from observations by three American officers, that the difference is remarkably small.—A case of damage to a building from lightning was reported; the effect was attributed to breaks in certain metallic parts (there was a good lightning-rod and there were trees near).—The periodicity of comets, by M. Zenger. He finds the origin of comets intimately connected with the rotation of the sun. Dividing the intervals of times of perihelion by various whole numbers, he obtains a mean value of 12·56 days, which is exactly that of a demi-rotation of the sun. Thus, between successive formations of comets there must have elapsed an even or odd number of solar demi-rotations. He supposes enormous explosions driving far out the matter of protuberances; large meteorites near the outer border of the corona may thereby be enabled to agglomerate coronal matter round them and form a comet. The general law of motions of planets applies equally to comets, but the duration of revolution of comets must be a multiple of that of a half-rotation of the sun.—Addition to a note on prime numbers, by Mr Lipschitz.—Influence of cooling on the value of maximum pressures developed in closed vessels by explosive gases, by M. Vieille.—Remarks on the expression of electric magnitudes in the electrostatic and electromagnetic systems, and on the relations deduced from it, by MM. Mercadier and Vaschy.—

Phosphorography of the infra-red region of the solar spectrum; wave-lengths of the principal lines, by M. Becquerel. He gives a determination of new lines of the solar spectrum and their wave-length, [and he has observed in the infra-red spectrum, maxima and minima of extinction proper to different phosphorescent substances manifested by various luminous sources, and similar to phosphorogenic maxima and minima in the other end of the spectrum.—On solar photometry, by M. Crova. Correcting a numerical error, he obtains 8,500 carcels for the sun's luminous intensity in a clear sky, and so removes the inexplicable discordance of his former figures with those of Bouguer and Wollaston.—Manganese in dolomitic strata; origin of the nitric acid, which often exists in natural bioxides of manganese, by M. Dieulafait. There are two classes of ores of manganese; those of the first class are directly derived from action of sea-water on primordial rocks, and they are deposited but a short distance from their place of extraction. Those of the second class have been, since the origin of seas, in complete solution in their waters, and have been deposited at all epochs, where chemical conditions have been favourable.—On the existence of the genus *Todea* in Jurassic strata, by M. Renault.—On a trombe observed at sea, by M. de Tromelin.—A work by Prof. Inostranzeff, of St. Petersburg, "On the prehistoric man of the stone age of Lake Ladoga," was presented by M. Daubrée.

Berlin

Physical Society, January 5.—Prof. Helmholtz in the chair.—Prof. Spörer, of Potsdam, first communicated the results of an investigation of the sun-spot observations in the twenty years, 1861 to 1880, with a view to settlement of the question whether movements of the spots indicated surface-currents on the sun. It appeared that such currents, towards the pole, or towards the equator, were not demonstrable. Herr Spörer further spoke at length on a quite peculiar phenomenon he had noticed on observing the transit of Venus on December 6. He premised that the phenomenon might be explained in two ways; either it might be regarded as an effect of fatigue or over-stimulation of the eye (though he had not marked other signs of such exhaustion), or it might be connected with a very cloudy atmosphere of Venus, whose presence is supposed to be indicated by the glow which some astronomers have seen to extend along the Venus-crescent over the whole planet. The phenomenon itself was as follows: the transit of Venus was observed in Potsdam with a 10-foot telescope; the sunlight was reduced to a degree of brightness bearable by the eye by means of a polarising arrangement (two pairs of parallel mirrors). The sun's limb was much agitated, and the first contact could not be observed. When the planet had made a distinct indentation on the sun, it was considerably blacker than the ground of the heavens; and the part of the planet lying outside the sun was invisible. After more than half the disc had entered the sun, it was observed that the borders of the black-planet disc was still at right angles to the sun's border, and the two sun-points were absent. Later, when Venus was further advanced, the whole disc, and even the small part lying outside, appeared brighter than the ground of the heavens, and with a dull grey light. Another minute later a small interrupted line having previously been seen outwards and upwards from the planet's disc, on the ground of the heavens, there appeared, out from the grey disc, a dark crescent-shaped segment, which, above and below, was distinctly defined, and in the middle merged indefinitely in the similarly coloured ground of the heavens. The grey disc with the dark crescent advanced on the sun, so that it was not possible to distinguish precisely the planet's disc. At about 3h. 11¾m. the outer border of the grey disc was in the connecting line of the two solar horns, and so in the first internal contact; one minute later, an alteration (not more exactly describable) had occurred in the aspect of the planet's disc, and about 3h. 13¼m., at the time of the previously-calculated first internal contact, the outer border of the dark segment had entered; one saw a fine luminous line on the sun without black drop. One minute later the sun disappeared behind a bank of clouds.—Dr. Herz communicated the results of calculations he had made with a view to answering the question, whether the tidal action of the moon is capable of producing currents of water-masses on the earth of such an order of magnitude, that the ocean-currents observed might be explained by this cause. Proceeding on the assumption of a water channel running round the equator, he found for liquids with friction, that the tide must indeed produce a current; and for a whole series of such channels reaching from the equator to the pole there appeared currents, which in their co-operation would present the form of the great ocean currents, but their order of magnitude was such, on the assumption at the outset, that the actual ocean currents cannot be due to this cause. Herr Herz then, conversely, calculated from the astronomically-proved retardation of the earth's rotation, the tangential force, which can produce such a retardation, and determined the differences of the water-levels on the east and west coast of a very narrow dividing ridge of land, which would produce such a pull; these differences of level were deducible from the tidal action of the moon.—Prof. Ostwald, from Riga, reported, on his experiments for measurement of the chemical forces of affinity. As is usual in physics, he measured these forces by mass and velocity of the reactions, or by the force with which equilibrium is maintained. Two acids were each brought into contact with a base, and the salts formed were determined; in all cases, the affinities were found proportional to the reacting mass and the square of the velocity of the reaction. The formula construtecd a few years ago by Herren Guldberg and Wage for affinity, has been confirmed by the author by numerous experiments.

Vienna

Imperial Academy of Sciences, November 30, 1882.—V. Hausmaninger, on the variability of the coefficient of diffusion between carbonic acid and air.—P. Kowalewsky, on the relation of the nucleus lentiformis to the cortex of brain in man and animals.—V. Hilber, on recent land-snails and land-snails found in the loess from China (part 1), containing a description of Helix species collected by L. v. Loczy during the Asiatic Expedition of Count Szecheniji. E. Stefan, on the experiments made by Boltzmann on sound-vibrations.

December 7, 1882.—V. v. Lang, on his capillary balance.—H. Niederriss, on trimelhene-glycol and the bases of trimelhene.

December 14, 1882.—F. Streintz, on the usefulness of the method of Fuchs.—Tg. Klemencic, on the capacity of a plate-condenser.—A Wassmuth, on the internal connection of some electro-magnetic phenomena resulting from the mechanical theory of heat.—V. Gruber, fundamental experiment on the cutaneous sight of animals.—G. Vortmann, on the separation of nickel from cobalt.—R. Canaval, on the earthquake at Gmünd (Austria) on November 5, 1881.—E. Weiss, communication on the observations of the transit of Venus in Austria.—H. Weidel and M. Russo, studies on pyridine.

CONTENTS