THURSDAY, MARCH 5, 1896.

THEORIES OF EVOLUTION.

Darwin and After Darwin: an Exposition of the Darwinian Theory, and a Discussion of Post-Darwinian Questions. By the late G. J. Romanes, F.R.S. &c. II. Post-Darwinian Questions—Heredity and Utility. Pp. 344. (London: Longmans, Green, and Co., 1895.)

PROF. LLOYD MORGAN tells us, in a prefatory note, that the greater part of this work was in type before the lamented death of the author. The material for chapters v. and vi. existed in the form of "notes and isolated paragraphs," which have been arranged for the press, but otherwise practically untouched. The editor has performed his task with great skill, and has succeeded in attaining the object which he wisely held in view—the production of a work which is in every way characteristic of its author and of no one else.

The frontispiece is an admirable reproduction of a photograph of the author—a most excellent likeness, which will, in itself, invest the book with deep interest for many readers.

Of the ten chapters, the first is introductory, the succeeding five deal with "characters as hereditary and acquired," while the remaining four are devoted to "characters as adaptive and specific."

In the introductory chapter, the views of Darwin and Wallace are contrasted in much detail. In a table on p. 6, "the theory of Natural Selection according to Darwin" is apparently compared with "the theory of Natural Selection according to Wallace": in reality, however, the theories are not compared or contrasted in any way—the only comparison being in the extent to which they were applied by these two naturalists respectively, and in their use or neglect of accessory theories. The high importance which Wallace ascribes to natural selection, and his inability to accept any other existing suggestions as to the origin of species, are, in this table, brought together into a set of dogmatic statements, which, as the present writer thinks, are far from expressing his views.

It is contended that Darwin progressively ascribed less and less importance to natural selection: "The longer he lived, and the more he pondered these points, the less exclusive was the *rôle* which he assigned to natural selection, and the more importance did he attribute to the supplementary factors" (p. 8; see also p. 40). Some of his latest letters, however, do not support this view of an unbroken progressive tendency.

Many of the author's well-known arguments against the use of the term "Darwinism," as opposed to "Lamarckism," are here reproduced and brought forward in a very forcible manner. The contest, however, is entirely due to the fact that the combatants ascribe different meanings to the same word. To the author, "Darwinism" means the whole of the views which Darwin entertained upon the origin of species; to his opponents, "Darwinism" means those views upon this subject which were originated by Darwin (viz. the theory of natural selection). It is no doubt true, as is contended on pp. 10, 11, that the "Lamarckian" principles (of use and disuse, &c.) accepted by Darwin were independently conceived by him, and that he did not owe them to Lamarck; but the fact remains that they were originated by the latter, and not by Darwin.

The latter part of the introductory chapter deals in a brief but very effective manner with the three theories of evolution associated with the names of Cope, Geddes, and Henslow, and in greater detail with Wallace's well-known views upon the insufficiency of natural selection to account for the origin of the human race.

In chapter ii. the relationship between Weismann's views is represented in the diagram on p. 43, and in statements which describe the formation of a "postulate as to the absolute non-inheritance of acquired characters" in order to support the "deduction as to the absolute continuity of germ-plasm," and this again in order to support the further deductions "as to the theory of organic evolution" and "as to the architecture of germ-plasm." From this mode of representation the reader unacquainted with Weismann's writings, at first hand, might readily receive the impression of a flimsy speculative structure unsupported by investigation, which would be doing scant justice to the distinguished German biologist.

Weismann's theory of heredity, based on the continuity of the germ-plasm, grew directly out of his researches upon the sexual cells of Hydrozoa, and was thus founded directly upon the results of investigation. The hereditary transmission of acquired characters was not at first called into question, but, later on, the extreme difficulty of explaining such transmission by means of a theory of heredity, which on other grounds appeared to be sound, suggested an inquiry into the supposed fact of the transmission itself. This subject was then dealt with on its own merits, and it was soon apparent that the evidence had a very different bearing from that which had been generally assumed. The later and frequently changing hypotheses as to the architecture of the germ-plasm were an attempt to explain the results of the unceasing inquiry into the changes undergone by the sexual cells. Newer and more complex phases of change were ever being made out in this most fruitful field of investigation, suggesting modifications in the details of Weismann's hypothesis of the structure of germ-plasm, and not ending here, but suggesting also fresh lines of observation and research. Indeed it may be maintained that the errors which have appeared from time to time in the details of Weismann's hypotheses are due to an attempt to render the hypotheses too much up-to-date, by taking into account all the most recent observations in an exceptionally difficult line of research—observations many of which could not be final, and some of which were bound to be altogether erroneous.

It will be impossible to attempt any adequate discussion of the admirable treatment of the facts and arguments for and against the hereditary transmission of acquired characters. These chapters will require the careful consideration of writers on either side of the controversy. Not only is the discussion itself most valuable, but new facts are submitted. Brown-Séquard's experiments on guinea-pigs have been repeated with great care, but no definite conclusions can be safely drawn from the results. "On the whole, then, as regards

Brown-Séquard's experiments, it will be seen that I have not been able to furnish any approach to a full corroboration. But I must repeat that my own experiments have not as yet been sufficiently numerous to justify me in repudiating those of his statements which I have not been ably to verify" (p. 122).

The second section of the work deals with "Utility," and opens with the contention already familiar in the author's earlier writings, that natural selection is not a theory of the origin of species, but of the origin of adaptations. The discussion throughout this section is of great interest, although perhaps somewhat too controversial in tone; but this is a consequence of previous controversies on the same subject. The effect of controversy here, as in other cases, is to emphasise the differences of opinion. The present writer ventures to think that if this question of the utility of specific characters were treated less controversially and more by the discussion of particular examples, very little difference of opinion would be found to exist. The essence of the question is contained in the definition of the term "specific character," and this again depends on the definition of the term "species." But we know that no satisfactory, viz. generally applicable, objective definition of species can be given, inasmuch as the subjective ideas of the species describer have been of pre-eminent importance.

In certain classes of cases the species describer has, and obviously correctly, made adaptive characters his criteria; for instance, in the species of Ranunculus alluded to by Mr. Thiselton-Dyer in his discussion of this question, as President of Section D, at Bath (British Association Reports, p. 692). Of the opposite kind are the various representative races or species which we meet as we trace the distribution of numerous forms of life over the earth's surface, and which are especially well seen in the Heliconine Danainæ from tropical America, in the Godman-Salvin Collection. Following one of these forms in its range we find, in numerous cases, that different areas are characterised by differences in the colours and markings of the wings. The colours and markings themselves are believed by many to be adaptive, and to be of value for the purposes of warning; but the local differences alluded to cannot be explained in this way, except in the cases of mimicry between local forms. Assuming the received explanation to be correct, natural selection would appear to have operated only in preventing the local differences from diminishing the efficiency of the warning character. But these local forms of colouring and marking are made the criteria—and are, indeed, apparently the only criteria—of specific distinction in numberless cases. It may be that, in many of these cases, future investigation will prove a biological continuity of the forms over the whole of the range, so that the names which are now applied to species will have to be used for geographical races. In the interests of biological science it is necessary that the naming of different forms should proceed at a much faster rate than the scientific proof of specific rank: indeed, the latter must, in the majority of cases, be a very slow and arduous process. Much confusion and controversy would be avoided if describers were clearly to state, as regards a large proportion of the forms described every day, that specific rank is only provisionally claimed. There is abundant justification for conferring a name, or a number, or some kind of ticket, upon every clearly marked form, quite apart from the question of its specific rank.

It therefore follows that this controversy must be a barren one as regards a very large proportion of the forms which are now distinguished as species, especially in groups like the Insecta, in which such forms are most numerous. Among the cases in which specific rank is indisputable, it can hardly be maintained that all the superficial differences between two allied species which have resulted from separation on the opposite sides of some geographical barrier, are necessarily adaptive.

This work, like all the writings of its author, is sure to appeal to a wide circle of readers, and will be of high value in bringing before the public the discussion, by an exceptionally acute thinker, of some of the most disputed and difficult points in modern theories of evolution; while biological science cannot fail to gain by the attention directed to the need for further observation and experiment in order that a final decision may be reached.

E. B. P.

COMPLETION OF THE "INDEX-CATALOGUE."

Index-Catalogue of the Library of the Surgeon-General's Office, United States Army. Authors and Subjects. Vol. xvi. W—Zythus. Folio, pp. xiv. + [282] + 822. (Washington: Government Printing Office, 1895.)

THIS sixteenth volume completes the twenty years' labour of Dr. J. S. Billings, and brings the catalogue of the finest medical library in the world to the close of the alphabet. We have in previous articles remarked on its extraordinary fulness, and its value to all engaged in the study of medical literature. For it is not merely a guide to the Washington Library; it is a classified index to something like a moiety of all that has ever been published on medicine and its allied sciences. Ample and distinctive descriptions are given of more than 300,000 books and articles, with over 800,000 cross-references. The volume before us has an additional feature of the greatest usefulness. No less than 282 folio pages are required to contain a list of the abbreviated and the complete titles of the periodicals, transactions, reports, and the like, now or formerly issued in all parts of the world and in every civilised language. The abbreviations are those used in the catalogue; but they are so concise, and at the same time so sufficient, that it would be well if they could be uniformly adopted by all who quote—and give their authority.

The recent international testimonial to Dr. Billings, and the public banquet at which, with his fellow-workers, Dr. Chadwick, of Boston, and Dr. Fletcher, originally of Bristol, he was a few weeks ago honoured in Philadelphia, have furnished some indication of the widespread feeling of grateful admiration his great enterprise has evoked among his medical and scientific brethren. The feeling has found stately expression in the Latin diploma whereby an honorary doctorate was conferred by the University of Munich on the Surgeon-General:

"A man who deserves of his country and of literature the highest praise, not only for his numerous important writings on the relations of physicians, on the proper construction and administration of hospitals, on the public health of the United States according to the precepts of the science and art of hygiene, on the preservation and improvement of the health of the army, but also for the great collections thereto relating which he has established and extended; a man who, in the "Index Medicus" of which he is the editor, includes by indefatigable industry all the branches of medicine that are being advanced throughout the whole world, who also, as author of the book entitled the "Index-Catalogue," which by the remarkable munificence of the Government of the United States has been laid before an immense number of learned men, has entitled himself to the gratitude of physicians and students of history over the entire world, and has fashioned for himself a monument more enduring than brass."

It must be remembered that not only the "Catalogue" but the Library itself is essentially of Dr. Billings' creation, and that about one-sixth of its contents have been presented either by way of direct gift or in exchange. It speaks highly for his personal "magnetism" that he can write: "There are few medical writers now living who have not sent to the Library at least one pamphlet." Thus, while the "Catalogue" has been passing through the press, a multitude of fresh gifts and additions have accumulated, and the completion of the "first series" only makes way for the commencement of a second. The manuscript of this is already prepared, and will be forthwith printed in five volumes as large and full as those already given to the world. Dr. Billings has taken up new duties in a different sphere of activity; but the "labour of love" which he here dedicates to international science will still be carried on under the inspiration of his singular genius. The gratitude of his innumerable debtors will be enhanced by a lively expectation of benefits to come.

OUR BOOK SHELF.

Mesures Électriques. By Eric Gerard. (Paris: Gauthier-Villars et Fils, 1896.)

TO those who are acquainted with M. Gerard's previous work ("Leçons sur l'Électricité"), the publication of the present work will probably be extremely welcome, for in it he has, in his usual clear and satisfactory style, gone more fully into the question of the measurement of electrical quantities.

In an introductory chapter, the author considers the question of the errors of observation, and the effects they have on the final result. In this discussion, that interesting branch of pure mathematics called the method of least squares for determining the probable error, and which, in the hands of many observers, seems to perform much the same function as the ink does in the case of the cuttle-fish, is left comparatively in the background. Such questions as errors of observation—properly so called—and of systematic errors are, however, dealt with, and the importance of exercising judgment in deciding the accuracy with which the different quantities have to be observed, in order that the result may be correct to within a certain amount, is insisted upon. There is one paragraph which ought to be written up as a text in all laboratories and testing-rooms, and is to the effect that in making electrical connections too much care cannot be taken in arranging the wires and in cleaning the contacts, and that connecting wires ought not to consist of long spirals, for these only serve to increase the resistance and self-induction of the circuit. Some very useful instructions as to the best method of recording observations are given, together with some hints as to choice of an algebraic function to represent a given curve.

There is also a chapter on the measurement of lengths, time, angles, forces, velocity and power; and one on photometry, a subject which, since the expiration of the incandescent lamp patent, and the introduction of the incandescent gas-lamp, has become of very great importance to the electrician.

The more purely electrical part of the book consists of chapters on electrical standards, galvanometers (including ammeters), voltmeters, coulomb- and watt-meters, and two very fairly complete chapters on the measurement of self-induction, and the magnetic properties of iron. There are also chapters on the measurements of the characteristics of motors and dynamos (both for continuous and alternating currents), and on transformers. Although the devotee to the slide-rule is probably born and not made, an appendix on this instrument may be of service to those who have not yet been initiated.

The whole book is essentially a practical and readable text-book, though, perhaps, hardly a laboratory manual of the subject; it is remarkably free from useless and uncalled-for mathematical formulæ, and will undoubtedly be found of great use. W. W.

Problems in the Use and Adjustment of Engineering Instruments. By Walter Loring Webb, C.E. (Pp. iv + 64. (New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1895.)

IN every college or university where field work is a subject in the curriculum, such a book as this is found to be almost indispensable. Its aim is to set out problems for each student or group of students to pursue, in order that no time shall be lost, and so that every one may have complete practice with individual instruments. For such a purpose, this is perhaps one of the most concisely written books on the subject, and it at the same time covers a large amount of ground, from single chain measurement to a preliminary railroad survey.

Besides the instruments usually noted, one is glad to see instruction with the plane table and Amsley's polar planimeter, both such very admirable instruments when used with precision, that it is remarkable their introduction is not more universal. Throughout the book, convenient forms for entering notes are shown, and there is also a short chapter on the use of the formulæ of probable error, the utility of which cannot be over-estimated.

Graphic Arithmetic. By H. D. Ellis. (Philip and Son, 1896.)

THIS contribution to the teaching of arithmetic consists of two charts, each 40 in. by 10 in., which can be mounted, or otherwise adapted to class teaching. Chart i., whole numbers, consists of a series of horizontal lines, divided by dots respectively into ones, twos, threes, &c., twelves. By means of vertical lines the multiples of 2, 3, &c., are shown on the line of ones, which is numbered from 0 to 144. In Chart ii., fractions (vulgar and decimal), the series of horizontal lines are 1 metre in length and 1 cm. apart. These lines are divided by dots into halves, thirds, &c., tenths. There are subdivisions into hundredths (cm.) and thousandths (millim). On Chart i. explanations are given of magnitude, unit, number, multiple, &c.; and on ii., of the multiplication and division of decimals, the expression of a vulgar fraction as a decimal, and several other matters. The charts are well adapted for the purpose of giving a sound grounding in the subject, so far as they go.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Sacred Tree of Kum-Bum.

THE eighth number of the *Bulletin du Muséum d'Histoire Naturelle* for 1895, which has just reached me, contains a paper by M. Édouard Blanc, entitled "L'Arbre à prières de Goumboum." This reminds me of a brief article which I contributed to NATURE in 1883 (vol. xxvii. pp. 223, 224).

M. Blanc begins his account by the remark: "Je veux parler du fameux arbre qui croît dans un monastère buddhiste, au nord du Thibet, et qui produit des lettres, des mots, des prières et autres formules religieuses, le plus souvent tracées sur son écorce et sur ses feuilles." Of the actual fact he adds, "des voyageurs européens, M. Potanine et M. Grenard entre autres, ont apporté le témoignage de leur observation directe."

It is evident, then, that the tree still exists much as Huc and Gabet described it. And M. Blanc brought back with him to Europe a branch and a portion of the trunk. He says: "Le phénomène est véritable: il existe réellement, et j'ai vu des caractères thibétains très nettement tracés sur les branches de l'arbre en question."

M. Blanc discusses the cause. He dismisses the probability of their being either natural markings or the work of insects accidentally resembling alphabetic characters. He has no doubt that they are produced artificially, probably with the aid of heat.

In 1891 Mr. William Woodville Rockhill's book, "The Land of the Lamas," appeared; in it (pp. 67, 68) he gives the following account of the tree:—

"Although I did not see the convent treasure-house and the 'white sandal-wood tree' until later, I will describe them here. In a small yard enclosed within high walls stand three trees about twenty-five to thirty feet high, a low wall keeping the soil about their roots. These are the famous trees of Kum-Bum, or rather tree, for to the central one only is great reverence shown, as on its leaves appear outline images of Tsong-k'apa. The trees are probably, as conjectured by Kreitner,[1] lilacs (*Philadelphus coronarius*); the present ones are a second growth, the old stumps being still visible. There were unfortunately no leaves on the tree when I saw it; and on the bark, which in many places was curled up like birch or cherry bark, I could distinguish no impress of any sort, although Huc says that images (of Tibetan letters, not images of the god) were visible on it. The lamas sell the leaves, but those I bought were so much broken that nothing could be seen on them. I have it, however, from Mohammedans that on the green leaf these outline images are clearly discernible. It is noteworthy that whereas Huc found letters of the Tibetan alphabet on the leaves of this famous tree, there are now seen only images of Tsong-k'apa (or the Buddha ?). It would be interesting to learn the cause of this change."[2]

I was anxious to see what could be ascertained from the leaves brought back by Mr. Rockhill. An application to my friend Prof. Sargent, at Harvard, procured me the following interesting letter:

1914 *N Street, December* 23, 1893.

MY DEAR SARGENT,—As regards the famous Kum-Bum tree, I was not permitted, in any of my visits to it, to touch the tree, but I got a lot of leaves fallen from it, some of which I gave to the British Museum (Department of Ethnology), where Franks or Read would, I doubt not, be pleased to show them to Dyer.

From what the people at Kum-Bum told me, especially in view of their reference to the big bunches of violet flowers, I *thought* the tree might prove to be a lilac.

The bark turns up on the trunk like that of a birch. Kreitner is responsible for the identification of this "white sandal-wood" with the *Philadelphus coronarius*.

The roots from which the trees I saw were growing look very old, how old I cannot say, being ignorant in all such matters, the live stems are certainly not over 15 to 20 feet in height, and 4 to 6 inches diameter at the root, and some of them look very healthy. It may be that when Huc and Gabet visited this place (in 1842, I believe) the original trunk was yet alive.

They say that "three men could not stretch around the trunk," but he adds that it was not over 8 feet high. He must refer to an old dead trunk, out of which shoots were growing. If this is not the case, we cannot have seen the same tree; that is all there is about it.

As to the "odeur exquise et qui approche un peu de celle de la cannelle," this must be hearsay, and refers to the popular belief that the tree is a sandal-wood, or else is a native simile for the odour of lilacs.

The large red flowers Huc also refers to may be violet ones. Mongol is not so precise a language, in fact certain colours which which we would call violet are invariably called red by them.

Huc mentions the curling up of the bark.

On the whole, I am inclined to think that here as throughout his book, Huc's reminiscences of facts and hearsay have misled him. He certainly could not see the image on the leaves or bark, for even the Kum-Bum lamas, to whom I mentioned my inability to detect anything on the leaves they had given me, assured me that *faith was necessary*—"as one's faith is so is the clearness of the image on the leaf."

I hope the leaves will assist in throwing some light on the question.

Ever sincerely yours,

(Signed) W. W. ROCKHILL.

Sir Augustus Franks kindly sent me some of the leaves, accompanied with the following memorandum:—

"Leaves from the tsandan karpo ('white sandal-wood tree') of Kûmbûm, said to have sprung up on the spot where Toongkàpe's mother threw his hair when, having shaved his head, she consecrated him to the house.

"Used when ground as medicine—also carried in charm boxes.

"Collected by W. W. Rockhill at Kûmbûm in 1891."

They were carefully examined by Mr. W. B. Hemsley, F.R.S., Principal Assistant in the Kew Herbarium, who has long been engaged on a critical study of the Chinese Flora. He arrived at the conclusion that they belonged to *Syringa villosa*, a Chinese species. He published his determination in *Journ. Linn. Soc.* (vol. xxx. p. 133), and I am disposed to regard it as correct. It confirms the statement of Kreitner (NATURE, xxvii. p. 171).

Rockhill's identification with *Philadelphus* is a mistake easy of explanation. He has confused the popular and the scientific use of the name Syringa. Lilac is botanically *Syringa*; Syringa is botanically *Philadelphus*.

It will be seen from the accounts given above that the phenomenon is not consistent with itself at different times. This confirms the opinion of M. Blanc that it is an elaborate fraud. W. T. THISELTON-DYER.

P.S.—I have omitted to add that Blanc says (*l.c.* p. 323): "L'arbre paraît appartenir à la famille des Phytolaccacées ou à une famille analogue."—W. T. T. D.

[1] Kreitner, "Im Fernen Osten," p. 708. I was told that in spring these trees have large clusters of violet flowers, but if they are lilacs I am astonished that the Chinese do not speak of them as such, for that shrub is well known in Kan-su and throughout Northern China (see Prjevalsky. "Mongolia," ii. 79). Tibetans call all sweet-smelling wood *tsandan* (*i.e.* sandal-wood). Sir Joseph Hooker (*Himalayan Journals*, i. 298) says that the Lepshahs and Bhoteas call the funereal cypress *tsandan*. The Kum-Bum tsandan karpo is certainly not a cypress, however.

[2] When Lieutenant Kreitner visited this place (1879), the images on the leaves were as at the present time. See "Im Fernen Osten," p. 707. The Arab traveller, Ibn Batuta, saw in the fourteenth century, at Deh Fattan, on the Malabar coast, in the courtyard of a mosque, a tree called the "tree of testimony." Every year there was a leaf on it, on which was written "by the pen of divine power," the formula, "There is no God but God; and Mohammed is the envoy of God." The inhabitants used it to cure disease (see Ibn Batutah, Defrémery's Transl., iv. 85).

The Röntgen Rays.

REFERRING to two letters in your last issue, p. 388, it is somewhat disconcerting to have Prof. Röntgen's original experiment—viz. the observation of shadows thrown on a barium-platino-cyanide screen—treated as a novelty. No one at all informed can have had the least scepticism concerning the probable observation of such shadows by Prof. Salvioni, though the sensational announcement made by some daily papers, that the eye had been made "actually to see" objects inside enclosures, was received, and is still received, with complete incredulity. A protected barium-platino-cyanide screen is extremely useful as a tester of the condition of an exhausted tube, and I have constantly used it as such, in imitation of Prof. Röntgen.

That a Crookes' tube gets hot when in action is perfectly patent to the touch; so also is the electrostatic attraction of the tube for pieces of paper and the like.

The term "anode rays" for the rays discovered with so much *éclat* by Prof. Röntgen, whether they be the same as those previously discovered by Dr. Lenard or not, is suggested by remarks from Mr. A. W. Porter at a recent meeting of the Royal Society. They certainly do not start from the kathode, but from some opposed surface, a surface which may be an actual anode, and which always has some anodic properties. From each point of such a surface rays start in all directions; this is proved by the shadows they cast of slits, holes, and wires.

OLIVER J. LODGE.

I MAY state that in a lecture which I gave here on the evening of Tuesday last, the 25th ult., I showed to a large audience, by means of a sheet of barium platino-cyanide, rendered fluorescent by the Röntgen rays from a Crookes' tube, all the things referred to by Mr. Campbell Swinton in his letter in the last number of NATURE. The shadows of coins in a purse, and of a hand, were distinctly visible to the audience when placed behind screens perfectly opaque to ordinary light, and, though more dimly, even through a book of eight or nine hundred pages.

I must confess that I cannot see why, after Prof. Röntgen's account of his own work, the success of such experiments as those made by Mr. Swinton or myself should be regarded as surprising, or accounts of them received with incredulity. They seem to me to be merely a variation of Prof. Röntgen's own experiments, or at most to be a matter of the most obvious inference from these experiments.

The statements that have appeared to the effect that Signor Salvioni has devised a method of rendering the retina of the human eye sensitive to Röntgen rays, and that by his method objects are directly *seen* through planks of wood, sheets of aluminium, &c., are simply absurd. The fluorescent light produced is entirely distinct from the Röntgen rays, and affects the retina like ordinary light; and of course parts of the sheet which do not fluoresce, because they are shielded by the opaque objects behind from the Röntgen rays, appear dark. Seeing such shadows can no more be said to be *seeing the objects themselves* by means of the Röntgen rays, than a man can be said to see himself when he looks at his shadow thrown by an ordinary gas-lamp on the street.

Prof. Röntgen discovered the fluorescence of the barium platino-cyanide under the rays now called by his name, and the transparency of ordinarily opaque matter to these rays, and the discoveries of Signor Salvioni and others, so far, at any rate, as they have been described in NATURE [1] and other journals I have seen, amount to nothing more. It is only just that in accounts of verifications of Röntgen's discoveries an attempt should be made to show clearly that such observations are only verifications, so as to prevent the credit of discovery which is Prof. Röntgen's due from any appearance, however unintentional, of indirect diminution.

Scientific accounts of verifications, as far as I have seen them in NATURE or elsewhere, are in themselves unexceptionable; but extra precaution seems necessary in order that the public should not be led by newspaper paragraphists, retailing such accounts at second-hand, to regard as extensions of Röntgen's work what are only direct and obvious consequences, perceived by himself, of the facts which he has observed.

ANDREW GRAY.

University College of North Wales, Bangor, March 1.

IN your last issue (p. 399), in the account of the work appearing in the *Comptes rendus*, you state that M. de Heen "proves conclusively that the X-rays proceed from the anode and not the kathode." May I point out (as I did at the Royal Society, in the course of the discussion on Prof. J. J. Thomson's paper, February 13), that I have proved that this is undoubtedly true for the bulb that I have been using *throughout* my experiments on the X-radiation. The bulb is one in which the negative electrode is concave, and the negative stream is thereby focussed to a point on the anode, which is a platinum disc placed near the centre of the bulb. By measuring the positions of different parts of a radiograph of a series of concentric zones of tinfoil placed in a measured position, I have shown that the actinic rays diverge from the anode disc.

I am of opinion, however, that in this respect this bulb differs from those which have been employed by others. In these latter, judging from the published accounts, the negative stream impinges directly on the glass; and for bulbs of this kind, it has been shown conclusively by Prof. J. J. Thomson that the seat of the origin of the rays is the glass itself. The proof is that a sensitive plate placed inside the bulb in the path of the negative stream is not acted upon. I venture to think that, in the case of my bulb, a sensitive plate placed inside would be acted upon provided it lay in the hemisphere of the bulb in which the kathode lies. I intend to test this conjecture experimentally. Should it prove true, the behaviour of both varieties of bulb will probably be capable of description by the following single statement:—

The seat of the origin of the X-rays is where the negative stream first impinges against a solid, and gives up, or partially gives up, its negative charge.

ALFRED W. PORTER.

University College, London, February 28.

IN your "Notes" of last week you refer to a communication of M. de Heen, stating that the X-rays proceed from the anode. Some experiments, which I made at the beginning of last month, bearing on this point, may be of interest to your readers. It is of course not the case that the X-rays proceed from the anode in general, but they may be made to do so by placing a small disc as anode facing the kathode. The kathode streams impinge on the former, and the X-rays being generated there radiate from it. The experiment was made by placing a lead plate (4 cm. by 10 cm.), with a rough circular hole in it, at a distance of 10 cm. above the photographic plate, and the tube (a small one with a curved kathode facing a small disc anode) 10·5 cm. above the lead. After development the negative was replaced exactly in its former position. Several interesting facts showed themselves, the most striking being that the image of the hole consisted of a well-defined circle showing even individual splinters on the edge, and in addition diffused elongation on two sides. On placing the eye so that the hole exactly covered its well-defined image, it was necessary to put it in the position occupied by the anode.

The diffused images in the same way were seen to be due to the fluorescent parts of the glass sides of the tube—a kind of pin-hole photograph, in fact.

The rays leave the anode as if they were the splash of a jet of water occupying the position of the kathode stream. In other words—supposing the plane of the anode vertical and the kathode to the right, then no rays appear to the left of the plane of the anode, whilst on the right the space is exceedingly rich. The negatives show, in every case tried, two well-defined regions, viz. nothing to the left of the intersection of the plane of the anode with the negative, and a dense deposit on the right, the richest part apparently being close to this line. It is difficult to account for this on the supposition that the rays are due to waves generated at the point of impact. We should expect in this case the action on the plate to increase with the visual angle of the anode disc as seen from points on the plate. On the other hand, certain further experiments seem to show that the action is not in all respects similar to the splash of a jet. Whether the effect is due to the fact that the place of impact of the kathode stream is an anode, or simply an internal obstacle, I have not yet determined, but experiments in progress will, I hope, settle this point.

For photographic purposes, the best kinds of tube are those with a curved kathode converging the streams on a small plane anode, remembering, of course, that the strong field is on the kathode side of the anode plane. This behaves very approximately as a radiating point. With this I have obtained, with comparatively short exposures, and a $2\frac{1}{2}$" to 3" spark length, strong negatives of remarkable definition, certainly finer than any I have yet seen.

W. M. HICKS.

Firth College, March 1.

I WAS interested to see in your last issue a letter from Mr. Swinton describing his reproduction of Prof. Salvioni's experiments with phosphorescent screens. Mr. Swinton uses a piece of blotting-paper impregnated with platino-cyanide of barium. I have tried this method, but have obtained better results with a screen prepared with the same salt, as follows:

A piece of fairly stout black paper, free from pinholes, is coated with gum containing a little glycerine, and, as soon as it has

[1] A translation of Prof. Salvioni's paper will be found in another part of this issue.—ED. NATURE.

got tacky, it is dusted over until covered with the barium platino-cyanide, which has been finely powdered.

Greater distinctness is obtained by this method, insuring, as it does, a thin but compact layer of crystals, unseparated by the fibres of the blotting-paper. J. WILLIAM GIFFORD.

Chard, March 1.

Crush-Conglomerates in Ireland.

ON the sea-coast at Portraine, Co. Dublin, there is an apparent thickness of over 700 feet of conglomeratic rocks, which have hitherto been regarded and described as of volcanic origin, contemporaneous with the Lower Silurian strata and associated felspathic igneous rocks.

This conglomerate is massive in character, and exhibits a structure resembling rude bedding. It consists of sub-angular and rounded blocks and pebbles of grey fossiliferous Bala limestone, calcareous grit, and occasional lumps and fragments of crushed felsite, the whole being enveloped in a brownish-grey argillaceous and calcareous matrix.

The Lower Silurian section here shows grey limestone passing upwards into alternations of grit, limestone, and argillaceous shale, with thick bedded calcareous mudstones at top, the whole series being more or less fossiliferous.

The associated igneous rocks are intrusive basic felsites of several varieties, and, like the sediments, present evidence of intense crushing.

Having had assigned to me, in the Geological Survey, the revision of the Silurian tracts in this part of the east of Ireland, I spent some time on the ground last summer, and was led to form the conclusion that this supposed conglomerate is not of volcanic origin. The work has not yet been officially inspected, but I am enabled, with the sanction of the Director-General, to state here briefly the results at which I have arrived.

I believe that instead of volcanic detritus contemporaneous with the deposition of the Silurian strata, we have here a vast crush-breccia or crush-conglomerate, formed by the breaking-up both of the Lower Silurian sediments and the igneous rocks, along particular zones of earth-movement, and a flowing and subsequent re-cementing together of the broken-up and rolled fragments. So far as I could judge, there are no truly contemporaneous igneous rocks in the district.

Where the intrusive rocks have come within the region of intense squeezing, they are sheared and ground into more or less powdered masses, having a resemblance to volcanic material, and this probably gave rise to the supposition that they were volcanic.

The breaking-up of the hard bedded rocks can best be studied at the south end of the section, and in some cases the beds of limestone and grit can be seen, as it were, in the process of being broken up into detached pieces, the fragments rolling off through the mudstones.

The conditions at Portraine are repeated exactly on Lambay Island, three miles off, but apparently on a grander cale.

I consider this crush-conglomerate rock-structure to be of great importance in connection with many more supposed volcanic areas of Silurian age in Ireland.

ALEX. MCHENRY.

Geological Survey Office, Dublin, February 28.

Science and Morals.

ALL who are engaged in extending the boundaries of natural knowledge will be interested in the remarkable letter of Prof. Ramsay, in last week's NATURE, on the moral claims of original discoverers in relation to the work of subsequent investigators in the same field of research. As one whose experience is of sufficient duration to stand in both these relations, I should like to point out several objections to the position assumed by Prof. Ramsay on this question.

In the year 1866 I announced before the Royal Society the discovery that quantities of magnetism and electricity indefinitely small would induce quantities of these forces indefinitely great, and demonstrated the same, on a large scale, by means of a small magneto-electric, acting in conjunction with a large dynamo-electric machine.[1] The discovery excited considerable interest at the time, and my experiments were repeated by many electricians in Europe and America. Among these were Varley, Wheatstone, Siemens of Berlin, and Farmer in America, who soon found that the residual magnetism of an electro-magnet was sufficient to supply the initial current required for exciting the dynamo; thereby dispensing with the permanent steel magnets of the magneto-electric machine. Although I had actually made experiments in the same direction some time previous to the announcement of my discovery, it never occurred to me, before reading Prof. Ramsay's letter, that I have all these years been a martyr to the injustice inflicted by unscrupulous electricians publishing, without my consent, the happy invention of the self-exciting dynamo machine.

The work of an original discoverer, though popular, is not unfrequently of a very subordinate character; increasing, in some cases, the value and importance of previous discoveries, or preparing the way for still greater ones, which the original investigator may be quite unable to deal with. The pretension set up by Prof. Ramsay, with its personal application, that the permission of an original discoverer should be obtained before the results of subsequent researches in the same field by other workers are published, strikes at the root of all scientific progress, and indicates a simplicity of character rarely to be met with in those engaged in philosophical pursuits.

Prof. Ramsay is again unfortunate in his analogy between the moral questions involved in a scientific discovery and in a patented invention. Law and equity alike encourage the publication of subsequent improvements on original inventions *without the consent of the first inventor*, and only intervene and censure when the right and title *to his own invention* are impugned.

The morality of Prof. Ramsay would suppress all investigations on the Röntgen rays, now being made wherever science is cultivated, or would render it impossible for the original discoverer to consider the numerous applications for permission to publish the results of further experiments.

The policy of secrecy and procrastination suggested as a corrective to the activities of subsequent investigators is not likely to meet with the approval of scientific men who have in mind the history of the discovery of the planet Neptune, and the rival claims of Adams and Leverrier. A great master of science (Sir George B. Airy) has well said with reference to this and other discoveries, "that it is advantageous for the progress of science that the publication of results, when so far matured as to leave no doubt of their general accuracy, should not be delayed till they are worked to the highest imaginable perfection."

February 25. HENRY WILDE.

[1] *Proc. Roy. Soc.*, 1866; *Phil. Trans.*, 1867.

Inverted Images.

IN connection with the view advocated by Mrs. Scott in your last number, it may be of interest to state that, in my own personal case, I have been able all my life to read a book with the greatest facility upside down; it making not the least difference to me which way it is presented. I am told—but this is not within my personal recollection—that I learned to read by looking over the book of an elder brother who was being taught in the usual way, standing in front of him, not behind. The singular circumstance to my own mind is that I have precisely the same facility in reading upside-down books written in any foreign language with which I may be more or less acquainted, in which the letters differ from the English, as Greek and Hebrew; and the facility extends, to very nearly the same extent, to handwriting. I have never at any time practised it systematically; it appears to come perfectly naturally.

ALFRED W. BENNETT.

Remarkable Sounds.

A PECULIAR sound, apparently similar to the "soughing of the wind" (see p. 78, *ante*), is briefly described by Liu Wan-Ping, a Chinese Commodore, in his journal of voyage made in 1595 from Cheh-Kiang to Shan-Tung, in order to defend the latter province from the attack by the Japanese fleet. (Sie Tsai-Kang's "Wu-tsah-tsu," Japanese edition, tom. iv. fol. 46, *a*.) The passage is as follows: "Same night we anchored near Fuh-shan-tau [in Shan-Tung]. This mountain, as if inhabited by a deity, utters a voice sounding mournfully, although on it neither herb nor tree exists, and neither hollow nor cavern therein." KUMAGUSU MINAKATA.

February 8.

THE SHIFTING OF SPECTRAL LINES.

I.

THE *Astrophysical Journal* for February contains some papers of the highest interest, touching small variations in the wave-lengths of spectral lines and the causes which produce them. These are stated to have been, in the first instance, established by Mr. Jewell by an examination of the Rowland series of photographs of the solar and metallic spectra taken by means of a concave grating of 21½ feet radius and 20,000 lines to the inch—an instrument of research which, so far as my own experience goes, is not to be obtained by workers in this country.

Mr. Jewell's investigations began in 1890. Another paper by Messrs. Humphreys and Mohler details the results of work begun last year on the effects of pressure on the arc spectra of the elements, work suggested by Mr. Jewell's prior researches.

Mr. Jewell has, as a basis for his new conclusions, practically studied under modern conditions classes of phenomena which I was the first to observe and describe, as near as may be a quarter of a century ago.

To show the relation of the new work to the old, it is best to begin with a short historical statement, which will have the advantage of giving to non-experts an idea of the meaning of some of the terms employed.

I first employed the method of throwing an image of a light source on to the slit of a spectroscope by means of a lens in 1869, and some of the results obtained by the new method were the following.

(1) The spectral lines obtained by using such a light source as the electric arc, were of different lengths; some only appeared in the spectrum of the core of the arc, others extended far away into the flame and outer envelopes. This effect was best studied by throwing the image of a horizontal arc on a vertical slit. The lengths of the lines photographed in the electric arc of many metallic elements were tabulated and published in *Phil. Trans.*, 1873 and 1874.

(2) The longest lines of each metal generally were wider than the others, the edges fading off; and they reversed themselves; by which, I mean, that an absorption line ran down the centres of the bright lines. These results were afterwards confirmed and extended by Cornu ("Chemistry of the Sun," p. 379).

(3) From experiments with mixtures of metallic vapours and gases, it came out that the longest lines of the smaller constituent remained visible after the shorter lines had disappeared, the spectrum of each substance present getting gradually simpler as its percentage was reduced,[1] the shorter lines being extinguished gradually. Shortly after these observations were made, I included among some general propositions:[2] "In encounters of dissimilar molecules the vibrations of each are damped."

(4) The various widths of the lines, especially of the winged longest ones, were found to depend upon pressure or density, and not temperature.[3]

(5) The "longest lines" of any one metal were found to vary in their behaviour in most extraordinary fashion in solar phenomena, being furthermore differentiated from the shorter ones; and on this and other evidence I founded my working hypothesis of the dissociation of the chemical elements at the solar temperature. In 1876 I set out the facts with regard to calcium.

(6) In 1883, Prof. W. Vogel, in a friendly criticism, pointed out the evidence then beginning to accumulate, that under certain circumstances the wave-lengths of lines are changed.[4] In 1887, I extended this evidence,[5] and I think it was I who coined the word "shift" to express these changes.[1]

I now pass on first to the results which Mr. Jewell claims to have established.

With the enormous dispersion produced by the instruments referred to, it is found that certain metallic lines, but not all, are displaced or "shifted" towards the violet when compared with the corresponding solar lines. "There was a distinct difference in the displacement, not only for the lines of different elements, but also for the lines of different character belonging to the same element."

The "different character" above referred to turns out to relate not so much to the intensity as to the length, and, associated with this, the reversibility of the lines; the longest lines are the most displaced, the shortest, least.

Further, in the spectrum of the arc itself, the position of a line with but little material present "was approximately the same as the position of the line when reversed." Now since the longest lines are most displaced to the violet, this means that the smaller the quantity of a substance present the greater is the displacement towards the violet; and therefore the greater the quantity present, the greater the displacement towards the red.

Further on, Mr. Jewell expressly states "it was found that with an increase in the amount of the material in the arc there was an increasing displacement of the line towards the red," and then he adds, "unless the line became reversed, when all further progress in that direction ceased."

Here is an observation regarding the red line of cadmium. "It was found that if the micrometer wires were set upon it with very little cadmium in the arc, then as the amount was increased the line almost bodily left the cross-hairs, always moving towards the red."

Mr. Jewell considers he has established that the vibration period of an atom depends to some extent upon its environments. "An increase of the density of the material, and presumably an increase of pressure, seemed to produce a damping effect upon the vibration period."

My result of 1872 with regard to pressure is endorsed, "the new results are found to be due to pressure and *not* temperature."

We seem then now to be in presence of two damping effects in the case even of metallic lines, one which extinguishes lines when we deal with dissimilar molecules, and one which changes their wave-length towards the red when we deal with similar molecules.

A carefully prepared table is given by Mr. Jewell, showing the origin, intensity and character of the solar lines considered, the intensity and character of the corresponding metallic lines, the wave-lengths of both, and the observed displacement.

There are many references to solar phenomena in Mr. Jewell's paper, but I do not propose to discuss them now. There is one point, however, I must refer to, in justice to my critics. He considers that the conclusions to be drawn from a study of the new shifts "effectually disposes of the necessity of any dissociation hypothesis to account for most solar phenomena." I have already pointed out that this was Prof. W. Vogel's conclusion with regard to possible shifts, so far back as 1883.

It is quite easy. "Two adjacent lines of iron, for instance, may show the effects of a violent motion of iron vapour in opposite directions, in the neighbourhood of spots, or one line (the smaller one corresponding to one of Lockyer's 'short lines') may show a broadening and increase of intensity in the spectrum of a sun-spot,

[1] *Phil. Trans.*, 1873, p. 482.
[2] "Studies in Spectrum Analysis," 1878, p. 140.
[3] *Phil. Trans.*, 1872, p. 253.
[4] NATURE, vol. xxvii., 1883, p. 233.
[5] "Chemistry of the Sun," p. 369.

[1] Since the parentage is uncertain, I may say that perhaps "shiftings" would have been a better word, as shift is otherwise employed, *e.g.* Love's last shift (translated by a French author, *la dernière chemise de l'amour*).

while the other line (the larger one corresponding to one of Lockyer's 'long lines') is unaffected. But this does not prove that iron vapour is dissociated in the sun. It merely shows that the apparently similar portions of the two lines in the solar spectrum are produced at different elevations in the solar atmosphere. The stronger iron line will be affected in a sun-spot as much as the other one, but it is the portion of the line produced at the same level as the other line, and may be masked completely, or very largely, by the emission line produced at a higher level, while the second absorption line in the solar spectrum may be entirely unaffected, being produced at a still higher altitude."

"This also explains why some of the lines (the short lines generally) of an element may be most prominent in sun-spot spectra, while others (generally the long lines) are those most frequently seen in prominences or in the chromosphere."

My thirty years' work at solar physics leaves me with such an oppressive feeling of ignorance that I willingly concede to Mr. Jewell a knowledge so much greater than my own as to give him a perfect right to dismiss all my work in two lines; but I am compelled to point out that he has not carefully read what I have published.

A comparison of the facts brought together in Figs. 112 and 114 of my "Chemistry of the Sun," for instance, drives his last paragraph into thin air: it is distinctly shown that we have to do with the short lines in the chromosphere and with the long lines in spots, the exact opposite of his statement. Mr. Jewell is not running counter to my views in supposing that different phenomena are produced at different elevations. I thought I had abundantly proved in my eclipse observation of 1882 ("Chemistry of the Sun," p. 363), that the iron lines, to take a concrete instance, are produced at different heights in the solar atmosphere; and that was one among many reasons which compelled me to abandon the thin reversing layer suggested by Dr. Frankland and myself in 1869 in opposition to Kirchhoff's view; but surely the more we consider the solar atmosphere as let out in flats, with certain families of iron lines free to dwell in each and to flit *à discretion*, the more a dissociation hypothesis is wanted. And beyond all this, we have to take into account that at the sun-spot maximum no iron lines at all are seen amongst the most widened lines, while at the minimum we have little else.

Another very interesting part of Mr. Jewell's paper refers to the phenomena of absorption. There is room for plenty of work here. As I pointed out in 1879, we get unequal widenings, "trumpetings," and a whole host of unexplained phenomena.[1] It is clear that the enormous dispersion at Mr. Jewell's command will largely help matters.

I now pass to Messrs. Humphreys and Mohler's paper.

Messrs. Humphreys and Mohler have used an electric arc enclosed in a cast-iron cylindrical vessel, which enabled them to vary the pressure up to fourteen atmospheres. One hundred photographs have been taken, and the shifts of some lines of twenty-three elements have been measured. The accompanying rough diagram, bringing together specimens of their observations, will indicate the kind of result they have obtained.

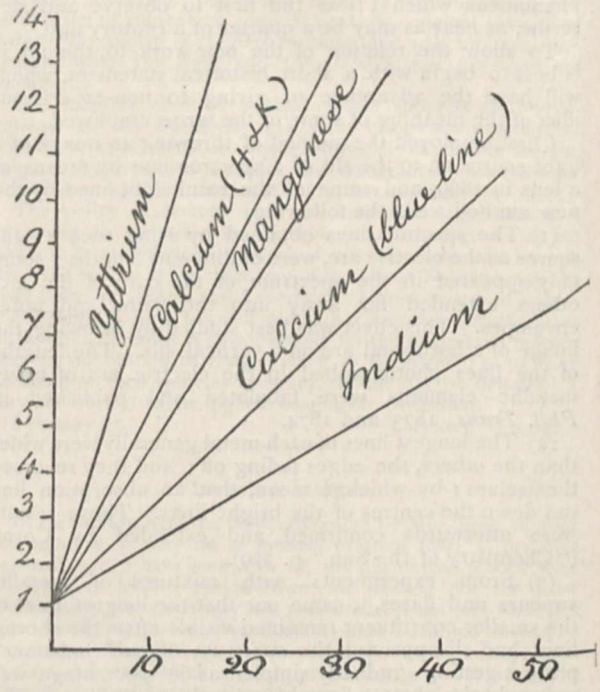
The pressures in atmospheres are shown to the left. The shift towards the red in thousandths of an Ångström unit are shown below. The shifts have been reduced to what they would be at λ 4000, in the neighbourhood of which most of the work was done. I must refer to the paper itself for the method of measurement adopted.

The displacement or shift varied greatly for different elements. It was always towards the red, and directly proportional to the wave-length and the excess of pressure over one atmosphere.

Only one exception to this general statement is given; it refers to calcium. "The lines H and K, among others, shift only about half as much as *g* (the blue line at 4226), and the group at wave-length 5600. That *g* should differ in this respect from H and K is not very surprising, since it is known to differ greatly from them in many other respects."

On this exceptional behaviour of these lines of calcium, I quote the following, from a note by Prof. Hale, which appears in the same number of the journal.

"The difference in behaviour of H and K and the blue line of calcium discovered by Messrs. Jewell, Humphreys, and Mohler, seems to support Lockyer's views as to the dissociation of calcium in the arc and sun. The remarkable variations of the calcium spectrum with temperature have long been known principally through the investigations of Lockyer. The writer has shown that the H and K lines are produced at the temperature of burning magnesium and in the oxy-coal-gas flame. They could not be photographed in the spectrum of the Bunsen



burner, though an exposure of sixty-four hours was given. Since these experiments were made, I have been informed by Prof. Eder that his own efforts to photograph the lines in the Bunsen burner were no more successful, though an optical train of quartz and fluor-spar was employed. It would thus appear that the temperature of the dissociation of calcium is between that of the Bunsen burner and that of the oxy-coal-gas flame. The high molecular weight of calcium has hitherto conflicted with our belief in the presence of this metal in prominences. If, however, it be granted that dissociation can be brought about by temperatures even lower than that of the arc, the difficulty is very greatly lessened."

I may add that it will be very interesting to see if the strontium line at 4607 behaves like the calcium *g* in relation to the lines at 4077 and 4215 representing H and K.

I have said enough in the present paper to show the extreme importance of these new results. So much care has been taken, that there is little doubt that subsequent

[1] "Chemistry of the Sun," pp. 380-387.

work will confirm them ; and when this is done, students of spectrum analysis will find a new region of the highest importance open to their inquiries.

J. NORMAN LOCKYER.

(*To be continued.*)

THE VARANGERFJORD REGION AND THE FORTHCOMING SOLAR ECLIPSE.

WE expect to have during this summer a good many visitors to the far north of Norway under the 70th parallel of north latitude, and close to the frontier of Russia. The total eclipse of the sun on August 9 (a few minutes before 5 a.m.) will attract many astronomers to these high latitudes. The sun will rise only 14° above the horizon during the eclipse, but the mountains here are not so high as to prevent the selection (though with some little difficulty even on the fjords) of places where their height will not prove an obstacle to the observers. In case one is in doubt, our official almanac gives the time when the sun will be visible on May 3 ; add nine minutes to that time, and it will be the time when the sun will rise over the mountains at the particular place.

It will be more difficult for astronomers to get a clear sky. The neighbourhood of Vardö, which otherwise would be very suitable, is plagued with fogs in the summer. Vadsö has more advantages, but still better are such inland places as Polmag, Utsjoki, Karasjok, Kautokeino, and Karasuando (in Sweden).

I shall give here some information for the guidance of those who intend to visit this remote corner of the earth.

The Varangerfjord ("ng" pronounced as in singer, not as in anger) runs inland west-north-west ; the land lying north of it is called the Varanger Peninsula, and that to the south of it South Varanger. All the land is fjeld (mountainous land, highlands), but it rises nowhere to any great height. There are no good maps of this region, except of the eastern part of South Varanger, of which the Government recently published a map on the scale of 1 in 100,000 ; it is the best map. There is also the ethnographical map of Finmark, by Friis, scale 1 in 200,000 (Christiania, 1888). On this remarkable map every family is indicated by a separate mark ; it indicates also the language they speak, and gives other details. It is, naturally, only in such a very sparsely populated region that such minute details can be represented on a map.

The Varanger Peninsula is a plateau which on its western border attains a height of 2200 feet, and on its southern about 1500 feet. The plateau is, however, not quite level, but presents such long, gentle undulations as are seen on the open ocean in calm weather. The permanent population, which keeps to the sea-coast, has here and there some outlying fields in the open parts of the valleys near the sea.

With the exception of these and the immediate neighbourhood of the settled places, the whole region consists of rolling mountain-tops practically unknown to the civilised world. It can, according to all that we know of it, be described as a wilderness of rocks, a stony desert covered here and there with reindeer moss (*Cladonia rangiferina*), and some swampy places where there thrives a scanty vegetation of green plants. Towards the inner part of the Varangerfjord there are some stretches of damp ground, overgrown with dwarf willows. About the centre of the peninsula are some large lakes full of fish, which only a few Norwegians have visited. However, access to them (apart from the question of distance) is not difficult from the south, for although there is no road, one can be driven there in a little cart. In winter, a few clever snow-shoe skaters have crossed this completely desolate, uninhabited land from north to south, a distance of forty English miles.

The western side of the Varanger Peninsula has a steep coast-line, but between Vardö and Vadsö the slope of the land seawards is very gentle ; to those who sail along the coast the country seems quite level.

The appearance of the coast at Vardö is seen in the illustration on p. 418, desolate and dreary, truly an Arctic desert land ; to the right is a bay of the sea, and the flat land in the foreground, consisting of gravel, exhibits some characteristic curved lines ; they are raised sea-beaches. Probably one must go to the great lakes of America to find equally brilliant examples of former water-levels. The uplifting of the land has not been uniform. On the north side of Varanger Peninsula the old beaches are 70 feet above tide, but on the south, at Vadsö, they have been raised to between 260 feet and 295 feet. Probably the land is rising at the present time. In Vardö, old people point out quays which have risen several feet during their lifetime. The Austrian astronomer, Pater Hall, who came to Vardö in 1769 to observe the transit of Venus, was so much interested in this question, that he caused a little pillar to be erected, the height of which above the then existing tide-level was accurately determined. He inserted in the parish register of Vardö a description of the position of this pillar ; but, alas ! though the register is still in existence, the pillar has disappeared. The land on the south side of Varangerfjord, South Varanger, is not quite so bleak and bare as Varanger Peninsula ; it has some pine forest in the valleys. It also can be considered a plateau ; but it is furrowed by valleys and fjords, and is thereby broken up into a multitude of small, flattish, dome-topped mountain masses. The plateau character is shown by the fact that all the mountains rise to about the same height ; in the eastern part, near the sea, to about 1300 feet.

These differences in the landscape and in the character of the country are connected with the fact that there are not the same kinds of rocks on the south side of the fjord as on the north side ; probably there is a line of faulting along the fjord. On the south side there are Archæan gneiss and granitic rocks ; on the north side younger rocks (conglomerates, sandstones, and slates), probably of Cambro-Silurian age ; but fossils have not as yet been discovered in them. A remarkable conglomerate occurs in the inner part of the Varangerfjord ; it may have been formed during a very remote Glacial period, probably Cambro-Silurian. It contains striated boulders, and rests partly on an underlying bed which shows glacial striations.

We shall now take a glance at the inhabitants of this province, Finmark, which touches the Russian frontier. The Norwegians gradually migrated into it during the last few centuries, but the Laps were already there. Many of the Laps wander as nomads with their reindeer, and dwell in tents, but the greater part of them live on the sea-shore, poor fishermen and farmers (like the crofters in the isles of Scotland), who grow a little hay for their cattle, and a few potatoes for themselves. There are no cereals in this northerly province.

Many of the inhabitants live in wretched earth-huts, which they share with their cattle. The Fins, who came from the grand-duchy of Finland, were the last to migrate into this district. The immigration commenced more than a century ago ; it attained its maximum between twenty and ten years ago, and it is now decreasing. The language of the Laps differs about as much from that of the Fins as English differs from German ; the Norsk language, as is well known, belongs to another group, the Germanic. All the three races are Lutherans. Finmark is very thinly peopled ; the whole population in 1891 was 23,000 on an area of 47,000 square kilometres, or about two square kilometres to each individual. Finmark

has three small towns, Hammerfest, Vardö, and Vadsö, each with about 2000 inhabitants; the last two are spoken of as astronomical stations; in both there are small second-class hotels, at which the charges are about five shillings to six shillings a day. In Vardö, Hansen's hotel, and rooms may be had from Herr Holte, the baker, and Herr Ness. In Vadsö, Krog's hotel, and rooms from Herr Lindseth. The charges for labour and assistance, such as men to row a boat or to carry things, are rather high in the summer-time in the whole of Finmark, because work is plentiful and labourers are scarce.

Vardö lies on a little island in the Arctic Sea, but quite close to the mainland; it has a more rigorous climate than any other town in Norway; not the smallest tree will thrive upon the island. Sea-fogs in summer, and the tremendous storms of winter, that never cease for a single day, are not at all cheering. It is not surprising that business people there live with their families in Christiania in the winter, and in summer follow the birds of passage to the north.

Vardö's sole source of income is derived from fishery,

View of the coast at Vardö, East Finmark.

and fish is cheap; haddock in the season sell at 6 lb. for a penny. A manufactory was started here to make dried fish meal from the flesh of this fish, but the people did not succeed in trying to remove the peculiar odour of dried fish from the material, so they were obliged to convert their works into one for the manufacture of damped fish-balls.

The only entertainment that I can recommend is the Russian vapour bath; it is a primitive installation. The vapour is produced by throwing water on heated stones, and the two women attendants whip the bathers with a bunch of quick-beam rods (*Pyrus aucuparia*). After the bath they offer, gratis, the Russian national drink, kvas, which tastes like ale mixed with water. However, Vardö has made progress in some respects within the last half-century. It was at that time, owing to the slowness and irregularity of the means of communication, so thoroughly out of touch with the world, and even with Christiania, the capital, that the commandant of the miniature fortress, who gave instructions to his orderly that the news from the capital should be laid before him every day, duly received them, but, alas, they were a year old!

Vadsö lies on the mainland on the northern shore of the Varangerfjord. The neighbourhood is a quite treeless pasture. The houses, like those in Vardö, are of wood, small and plain. On a little island opposite the town lies a now abandoned whaling station. Whale fishing began in the Varangerfjord; but reckless over-fishing has driven the whales from this locality, and one can foresee the time when whale fishing will be a thing of the past in the whole of Norway. From Vadsö there is a good driving road to the west, past the little town of Nessby, as far as Seida on the river Tana.

Other places which may be mentioned as stations for observing the eclipse are Polmag, Utsjoki, Karasjok, Kautokeino, and Karasuando. The first three may be reached by the steamer, which enters the Tanafjord between sixty and seventy miles east of the North Cape, and sails in a southerly direction and touches at Vagge, thirty-five miles from the mouth of the fjord. Vagge lies near the mouth of the Tana River, and close by is Guldholm, near Tana Kirke, where boats may be hired for rowing up the river to Polmag, Utsjoki, and Karasjok. At Tana Kirke (church), as well as at Vardö and Vadsö, there are telegraph stations, where astronomical time may be received from Christiania Observatory, but not at Polmag, Utsjoki, Kautokeino, nor Karasuando.

Prof. Dr. H. Mohn and Mr. Schroeter, from Christiania University, will probably take their stations at Vadsö and Bugönes, close by. In Polmag the inhabitants are the most civilised of the Laps; they live in wooden houses, and are comparatively cleanly. A party of observers may live here for some time if they bring provisions with them.[1]

In Karasjok, and, so far as I know, in Utsjoki also, one will get a friendly reception and good food from the shopkeepers. In Karasjok there are about 250 inhabitants, including a clergyman; in Polmag, not so many; but how many in Utsjoki (which belongs to Finland), I do not know. The way to Kautokeino, where living can be had at the Norwegian shopkeeper's, is by steamer to Alten, then forty miles on horseback, and seventy miles on the river by boat, which must be ordered in advance. From Kautokeino one may proceed to the village of Karasuando in Sweden, which also is within the boundary of totality, by taking a boat on the river for fifteen miles, and then on horseback or by walking for thirty-five miles more.

Another less generally known way of reaching Karasuando, because it is newer, is by steamer twice a week from Tromsö to Skibotten on Lyngenfjord, where comfortable accommodation can be had, thence by road thirty-six miles to Lake Kilpisjärvi (half-way to which is the not very comfortable stopping-place Helligskogen), then by rowing-boat to Muotkavuoma in Sweden, and then by road to Karasuando. The return journey from here may be made either by Vitangi to Gellivara railway station, about 100 miles, or by the much-frequented route down the river Tornea to Haparanda on the Gulf of Bothnia.

HANS REUSCH.

[1] As the brown (rye) bread in general use in Norway is badly baked and most unpalatable to those unaccustomed to it, and as white (wheat) bread can rarely be had, especially in such places, a supply of biscuits should be taken

THE RÖNTGEN RAYS.

WE beg to send you a negative of a frog taken by Prof. Röntgen's method. The clearness with which the several bones have come out is so remarkable, that we consider the picture well worth reproduction, and trust you will find space for it. The larger transparent patch upon one side of the vertebral column is due to a distended lung, its collapsed fellow being evident upon the opposite side (this was proved by subsequent dissection). If you will carefully look into the larger transparent patch, you will see that the reticulated structure of the lung is evident, but we fear is too slight to bear reproduction by photo-mechanical means.

The negative was obtained by means of a small induction coil (2-inch spark) directly connected to a highly exhausted simple cylindrical Crookes' tube.

E. WAYMOUTH REID.
J. P. KUENEN.

NOTES.

THE Croonian Lecture of the Royal Society will be delivered on March 12, by Dr. A. D. Waller, F.R.S., who has selected for his subject, "Observations upon Isolated Nerve."

WE understand that the editing of the "Icones Plantarum" has passed from the hands of Prof. Daniel Oliver to those of the Director of the Royal Gardens, Kew.

WE learn from *Science*, that an endeavour is being made to establish a permanent scientific head for the U.S. Department of Agriculture. An amendment to the Agricultural Appropriation Bill has just been sent to Congress providing for a "Director-in-Chief of scientific bureaus and investigations, to serve during good behaviour, to have authority to act as Assistant Secretary, and to perform such other duties as the Secretary may direct." This amendment is, we understand, the outgrowth of an effort

to secure a permanent non-political organisation and administration of the various bureaus and divisions engaged in the scientific work of the Government, and at the same time bring about a more intelligent and more effective cooperation than has been heretofore possible. The Department of Agriculture as at present organised comprises a large number of scientific and administrative divisions having for their object the discovery, exploration, and development of the agricultural and other natural resources of the country. The scientific divisions are engaged in researches requiring the highest technical skill, and some of them in the solutions of problems requiring long years of preparation and scientific training. Our contemporary adds that, should the amendment become a law, it is by no means improbable that other scientific bureaus of the Government will seek the protection and support provided thereby, and that in the near future the United States may boast of a National Department of Agriculture and Science.

THE Russian National Health Society is reported by the *Lancet* to be making strenuous efforts for the success of the Jenner centenary celebration to be held in May. Although the method in which the Society proposes to commemorate Jenner's great discovery has already been referred to in these columns, a statement of the first arrangements will be of interest. There are offered four prizes, the first equivalent to 100 guineas, and a gold medal, for the best work upon vaccination. English is one of the languages in which the work may be written, and the work must be sent in before March 12 (New Style). An exhibition of relics of Jenner, and of books, pamphlets, prints, tabular returns, instruments, and other objects relating to vaccination or to Jenner will be held. The Society is also publishing a history of the development of vaccination in Russia and other countries, and a full biography of Jenner, together with a portrait, and copies of his drawings. The price of this "centenary edition" which will be edited by Dr. Ladislas Hubert, the Secretary of the Society, will be three roubles (about 6*s*.). All objects intended for the exhibition, as well as any other communication relating to the centenary, should be addressed either to Dr. Hubert, 15 Dmitrofski Pereoulok, St. Petersburg, or to Dr. F. Clemow, 69 Earl's Court Square, London, S.W., who is acting for the Society in England.

REUTER'S correspondent at St. Petersburg states that the subjoined telegram from Irkutsk was received there on Tuesday:—The Governor of Irkutsk, in reply to inquiries, has received the following from Yakutsk: "Peter Ivanovitch Kuchnareff, who trades at Ust Yansk, by a letter dated November 10, communicated the following to the merchant Kuchnareff at Yakutsk:—'We learn that Dr. Nansen's expedition has reached the North Pole, has discovered a hitherto unknown and, and has now returned.'" In order to verify the news and n case of necessity to render assistance to the expedition, the Governor of Yakutsk has instructed a member of the administration in the Verkhoyansk district to proceed to Ust Yansk.

A BRIEF summary of the facts concerning the Panama Canal, together with a few words as to the present status of the canal construction, are given in the February number of the *National Geographic Magazine*, by Mr. R. T. Hill. So many misstatements are made as to the condition of the works, that Mr. Hill's rticle, and the illustrations which accompany it, will do good ervice in refuting them. It appears that the plant of the Company is not undergoing the ruinous decay that has been represented, both in this country and America, but, on the contrary, it is kept in scrupulously good order, and will be available for the completion of the work, should the Commission which has to report upon the affairs of the late Company decide to carry out the scheme. That the Commission does not consider the route impracticable is attested by the fact that they have kept the work progressing, about two thousand labourers having been employed upon the construction of the canal during last year. When, in February 1895, Mr. Hill took the photograph reproduced as an illustration to his article, he counted five locomotives at work carrying away the excavations from the Culebra summit. It was reported recently that the money to finish the work on the present plan has all been furnished, and that two thousand more men from Jamaica and other West Indian islands are being collected, the intention being eventually to increase the force to six thousand men. It is expected that the work will be completed in six years.

WITH reference to excavations of the island of Philae, the Cairo correspondent of the *Times* writes, under date February 17:—"The work of clearing the island of débris so as to permit a thorough examination of the ancient monuments, which was entrusted by the Egyptian Government to Captain Lyons, R.E., will probably be completed next month. The satisfactory discovery has been made that the foundations of the main temple of Isis are laid upon the granite rock, being in some places over 21 feet in depth, and the temple has nearly as much masonry below ground as above. The south-eastern colonnade has also its foundations upon the granite, and, so far as excavated, they are curious if not unique in design. They consist of parallel cross walls some metres high, but varying according to the slope of the rock surface, with large stone slabs placed horizontally upon their tops, and the pillars forming the colonnade are erected upon the slabs. The nilometer is marked in three characters—Demotic, Coptic, and another much older, probably Hieratic, of which a copy has been sent to Berlin for decipherment. A stela was found bearing a trilingual inscription in hieroglyph. No traces have been discovered of any buildings anterior to the Ptolemaic periods. M. de Morgan, Director-General of the Antiquities Department, is engaged upon repairing the great hall of columns at Karnak."

AT the Royal Artillery Institution, Woolwich, on Thursday last, Dr. G. H. Bryan, F.R.S., lectured on "Flight and Flying Machines." The lecturer pointed out that the power of flying had been developed under more favourable conditions in small than in large animals, both because the risk to life and limb in the case of a fall increased with the size of the animal, and also because, assuming De Lucy's law, large bodies required more power to sustain every pound of their weight in horizontal flight than small ones. These considerations applied equally to flying machines. As Lord Kelvin had said, Maxim's experiments had solved three of the five problems connected with artificial flight, and the two remaining ones were now solved by the soaring experiments of Lilienthal in Germany, and Pilcher in Britain. All that remained was to combine the advantages of Maxim's and Lilienthal's apparatus in a single machine, and in this Dr. Bryan prophesied that artificial flight would be accomplished at no distant date.

AT King's College, on Tuesday next, in continuation of the free lectures given to the public, in the theatre of the College, Prof. Bottomley will discourse on the "Romance of Plant Life."

AT a meeting of the Royal Geographical Society, to be held to-morrow afternoon, a plan for the geographical description of the British Islands on the basis of the Ordnance Survey will be submitted by Dr. H. R. Mill, and a discussion will take place upon it.

THE Council of the Society of Arts attended at Marlborough House on Wednesday, February 19, when H.R.H. the Prince of Wales, President of the Society, presented to Sir Lowthian Bell, Bart., F.R.S., the Albert Medal, "in recognition of the services he has rendered to arts, manufactures, and commerce

by his metallurgical researches and the resulting development of the iron and steel industries."

THE deaths are announced of Dr. G. Wagener, Professor of Anatomy in Warburg University; Dr. R. Benedikt, Professor of Technological and Analytical Chemistry in the Technische Hochschule at Vienna; Dr. Laennec, Director of the Nantes School of Medicine, and formerly Professor of Physiology; and Dr. Per Hedenius, Professor of Pathology, Hygiene, and History of Medicine in the University of Upsala; Dr. D. D. Slade, Lecturer on Comparative Osteology in Harvard University, and known for his contributions to osteology, zoology and botany.

WE see from the *Rendiconti* of the Reale Istituto Lombardo, that, at the recent annual meeting, one of the Cagnola prizes of 2500 lire and a gold medal of 500 lire was awarded to Prof. Ferdinando Sordelli for his treatise entitled "Flora fossilis Insubriæ." The other Cagnola prizes were not awarded. Under the Brambilla bequest a sum of 300 lire and a gold medal was awarded to each of the following for having introduced useful industrial processes:—Messrs. Macchi and Izar, Augusto Stiegler, Anacleto Pastori, Fermo Coduri and Co., Casall Francesco and Sons, Carlo Galimberti and Co.; and 250 lire to Antonio Fusetti for his process of photo-engraving on copper. The Fossabi prize of 1000 lire for a work on arterio-sclerosis was awarded to a work sent in under the motto, *Experientia docet*. The Ciani prize for the best Italian historical reading-book was distributed among the following, who were awarded 500 lire each:—Prof. Francesco Bertolini, "Story of the Italian Revival"; Prof. G. De Castro, "The Mantua Processes and the 6th of February, 1853"; Prof. Pietro Orsi, "How Italy was made." Among the prizes proposed for 1897 are the following:—An Institute's prize of 1200 lire for an experimental proof that an electrified dielectric is in a state of tension in the direction of the field and in a state of compression across it (last date, April 30, 1897). Cagnola prizes of 2500 lire each for works on the orographical conditions of the Alps and the Italian peninsula and islands; and the history of the methods and instruments for registering the phase of alternating currents (both April 30, 1896). Similar prizes for works on the comparative anatomy of the innervation of trophic organs, and on the *rôle* of pathogenic microbes in human pathology (April 30, 1897). Secco-Commeno prize of 864 lire for a work on the genesis, symptoms, effects, and cure of uremia (May 1, 1897). The Tommasoni prize of 500 lire will be given for the best work on the life and work of Leonardo da Vinci, with especial reference to his precepts on the experimental method, and to a project of a national publication of his entire works (May 1, 1896). The competitions enumerated are open to all nationalities, and the memoirs may be written in Italian, French, or Latin. The last-named may also be written in English or German. They must be sent to the Secretary of the Institute, at the Palazzo di Brera, Milan, before the dates named, under a motto or pseudonym, and a statement of the prize competed for.

In reference to the tenacity of life in insects, Mr. J. C. Warburg writes to the *Entomologist*. "When I was still new to collecting in South France, I discovered one day, to my great joy, a large female of *Saturnia pyri* hidden away in some bushes. The specimen was the first I had ever caught, and I decided, on account of its large body, to stuff it (a quite unnecessary operation; I have kept dozens since unstuffed). The moth was first apparently killed by being forced into a cyanide-bottle, where it was left about an hour. The abdomen was then emptied, and the cavity filled with cotton-wool soaked in a saturated solution of mercuric chloride. The insect, pinned and set, was discovered next day attempting to fly away from the setting-board."

THE effect of thunder, or the firing of cannon, on pheasants is very curious; either of these sounds start the cock birds crowing as if in defiance. Mr. G. T. Rope, writing to the *Zoologist*, says that at a place between five and six miles distant from the garrison town of Colchester, he has heard pheasants close to him echoing each report of the artillery practising there, and has on many occasions noticed the same thing elsewhere. The crowing sounds more like the answer to a challenge than the expression of fear. Mr. J. E. Harting points out that the observation is not new. Gilbert White remarked a century ago that the pheasants in his neighbourhood crowed when big guns were fired at Portsmouth, and the wind was blowing from that direction; and, says Mr. Harting, Charles Waterton also, in his "Essays on Natural History" (first series, 1837), makes the following remarks on the subject:—"The pheasant crows at all seasons on retiring to roost. It repeats this call often during the night, and again at early dawn; and frequently in the day-time, on the appearance of an enemy, or at the report of a gun, or during a thunder-storm."

OUR American correspondent writes under date February 21:—"J. Frank Elline, of Baltimore, has demonstrated that ordinary calcium light will produce results similar to the rays from a Crookes' tube. By combining the calcium light with side X-rays, Mr Elline obtained a result directly the reverse of ordinary X-ray pictures, the shadows being darker than the background. Dr. Wellington Adams and Prof. Nipher, of Washington University, St. Louis, have demonstrated that the X-rays can be focussed. Edison is experimenting in the direction of taking pictures by snap-shots, and has already succeeded in reducing the time of exposure to seven seconds, getting clearly-defined images of strips of metal after the rays had penetrated a heavy piece of cardboard and a vulcanised plate. Trowbridge claims to have secured instantaneous results already. Edison reports that his eyes were sore after working for several hours with his fluorescent tubes; but he is not certain that this result is specially attributable to the X-rays. Dr. Wm. J. Morton reports that he sees brilliant flashes of light after he has discontinued work, and, as he has worked with electrical light for many years without injury, he infers that the X-rays are injurious to the eye.

WITH reference to the statement in the foregoing note, as to the effect of Röntgen rays upon the eyes, Mr. Swinton informs us that though Mr. J. C. M. Stanton and himself have worked continuously with the Crookes' tubes for hours together, neither of them has experienced any ill-effects so far as their sight is concerned. In fact, so far as Mr. Swinton has observed, the X-rays do not, *per se*, in any way affect the eye, either at the time of the experiment or afterwards. With regard to Mr. Edison's experiments, a few seconds are found to be ample for taking pictures of pieces of metal. When it is a question of photographing a portion of the body, however, it is a different matter; but even then, with a good tube, thirty or forty seconds' exposure will give a very fair result.

DR. W. J. VAN BEBBER, of the Deutsche Seewarte, has sent us a separate copy of an interesting paper "On the climates of the earth and their influence on mankind," published in *Globus* (vol. lxix. Nos. 6 and 7). After giving a general description of continental and ocean climates, and of the influence of mountains and forests, he discusses in some detail the peculiarities of climate of various zones, and traces their influence on diseases, especially on malarial fever and cholera in the tropics. He finds that the occurrence of the former is closely related to rainfall and temperature; the fevers begin with the rainy reason, usually reach their maximum by the time the rain abates, and decrease as cooler

weather sets in. The malady becomes acute when warm weather occurs after an inundation. During the present century there have been five great epidemics of cholera. In the origin and development of this disease the weather conditions are found to have different effects, according to the locality. In Bombay and Calcutta, for instance, it generally begins before the hot and rainy season, and decreases with increasing temperature and rainfall; while in other parts, cholera is most frequent towards autumn, and decreases with decreasing temperature. The occurrence of land and sea breezes (including monsoons) in various parts of the globe is discussed at some length.

THE relations of the weather to the spread of disease are still involved in obscurity. Prof. Cleveland Abbe defends the general atmosphere from calumny in this connection in the *Monthly Weather Review* (vol. xxiii. No. 8, 1895). History records that, in the fifteenth century, a plague epidemic broke out most violently in a Swiss town immediately after a cloud, coming from an infected but distant region, discharged its rain upon that town. But, as Prof. Abbe points out, without going back to the fifteenth century, there was an excellent opportunity to investigate the subject in 1889-90, when the influenza spread over the whole civilised word. Its progress was so regular that for a long time there was a general belief that the active germs of influenza were carried as dust in the air by the winds, or perhaps by the upper currents. This idea was dissipated by several memoirs that established the fact that the wind and weather were entirely subordinate factors, and that the spread of the disease followed the lines of travel, especially the principal steamboat and railroad routes, and that, therefore, the germs were carried by diseased individuals, or by articles that had been used by or had come in contact with them, and not by the winds. Of course the wind, in the narrow sense, may have carried the germs a few feet or rods from one individual to another, but not for distances of many miles. Several epidemics, such as the yellow fever, small-pox, and cholera, have been traced back to the direct importation of their contagia (whether animate or inanimate) by human agencies. Furthermore, experimental data show that few disease germs can maintain their vitality more than a few hours when freely exposed to the air and sunshine, as would probably be the case if they were carried in the atmosphere as minute particles of dust. Therefore Prof. Abbe thinks it probable that the winds and the rain must not be considered as the means by which diseases are spread between places that are any considerable distance apart.

PROF. SERGI (*Centralblatt f. Anth. Eth.*, &c.) complains that the Indo-Germanic theory of the origin of European peoples has distracted attention from the Mediterranean peoples. For some time past these latter have been studied by him, of whom he recognises four main branches—Lybian, Iberian, Ligurian, and Pelasgian. The Egyptian monuments state that the ancient Egyptians came from the land of "Punt," and anthropologists admit an African origin for that people. Sergi places Punt in Ethiopia, Somali-land, and part of South Arabia, and he finds the same head-forms amongst the ancient Egyptians and modern Somalis. This stock is known under the term "Hamitic," and it differs from the Semitic. Remains of prehistoric men from Spain, France, North Italy, &c., show a close resemblance with each other and with the early inhabitants of North Africa and the Canary Islands. Sergi asserts that the same people form to-day the bulk of the living populations of Spain, Italy, and Greece. He believes that the Hamites arose in East Africa; the first migration entered Egypt, then the stream diverged to the east to Syria and Asia Minor, and spread westwards as far as the Canary Islands; the Iberians, Ligurians, and Pelasgians (with the Etruscans) being branches of the main stem. These Mediterranean folk occupied South Russia, Switzerland, France, and Great Britain. In Neolithic times they were exterminated in the valley of the Po and in Switzerland, were driven beyond the Loire in France, and to the south and west in Britain by the mighty Celts. He describes the physical features of this Mediterranean group as a whole, and declares it to be the most beautiful of all the varieties of man.

THE part of the *Agricultural Gazette of New South Wales* for December 1895, contains a number of papers on the cultivation of fruits, and other crops, and on the diseases which affect cultivated plants in the colony, showing the valuable results obtained by the establishment of a State Department of Agriculture.

IN the *Irish Naturalist* for February is a useful paper by one of the editors, Mr. R. L. Praeger, on the botanical subdivision of Ireland, in which the island is parcelled out into forty districts. The geographical county boundaries are to a large extent preserved, and all the larger counties cut up into several divisions. The paper is accompanied by a map.

FROM the Skandinavisk Antiquariat, Copenhagen, has come to us a catalogue of a good collection of ancient and modern works on geography, ethnography, and travels, together with a number of rare maps and prints, offered for sale. A number of treasures to geographical bibliophiles will be found included in the catalogue.

THE 1896 *Annuaire* of the Observatoire Royal de Belgique has only just come to hand. As in former years (the publication has been issued without interruption since 1834), the contents are composed of ephemerides, containing the principal astronomical date for the current year; geographical, meteorological, and vital statistics; definitions of physical constants, and short articles, chiefly by M. Folie.

DR. G. EISEN reprints, from the *Proceedings* of the Californian Academy of Sciences, a paper entitled "Biological Studies of Figs, Caprifigs, and Caprification." He gives a history of the methods adopted from the earliest times for artificially pollinating the cultivated fig. While the ordinary edible figs grown both in Europe and in America, are independent of artificial pollination, the Smyrna fig will not mature without caprification, since the fig contains no male, but only female flowers.

WE have received a copy of a "Classificatory Chart of the Commoner British Orders of Flowering Plants," by Mr. W. P. Winter. That can hardly be regarded as an ideal selection of the more important orders, which excludes the Solanaceæ, Euphorbiaceæ, and Coniferæ, and admits the Chenopodiaceæ, Alismaceæ, and Naiadeæ. But this is explained by the footnote that "the orders include those necessary for the Elementary Examination, South Kensington." The characters seem carefully drawn up, and the chart will be a useful one to students.

THE development of photography, brought about by the discovery of Röntgen, has afforded the photographic journals excellent opportunities for distinguishing themselves. The special issue of the *Photogram*, brought out under the title of "The New Light," has run into a fifth edition; and the *Photographic Review* for March, apparently aims at obtaining the same measure of success, for its pages are almost entirely devoted to accounts and illustrations of work done by Mr. A. A. C. Swinton and Dr. Hall Edwards with Röntgen rays.

WE again offer our congratulations to the Wellington College Natural History Society. The twenty-sixth annual report of the Society shows that during 1895 the knowledge of the members was improved by means of lectures, and the faculties of a few ardent observers were developed. The Pender prize, founded in 1879, for the best essay on some scientific subject,

written by a member or associate of the Society, was won last year by Mr. H. C. Hayward, with an essay on "Protective Resemblances amongst English Lepidoptera." In awarding the prize, preference is given to essays containing original work.

THE London Amateur Scientific Society held its annual meeting on Friday last, at the Memorial Hall, Farringdon Street. Among the very interesting exhibits were a series of curious botanical specimens shown by Mr. Howell, a collection of rare and abnormal forms of Mollusca, by Mr. S. Pace, and an album of views of the Baku Oil Region, by Dr. W. F. Hume. After the specimens had been described, a paper was read by the President (Mr. W. H. Davis), on the "History of the Determination of Latitude and Longitude." Mr. Davis reviewed the existing state of geographical knowledge from the Homerian period to the time of Strabo and Ptolemy—its eclipse in the Middle Ages, and revival under Arabic influence, and progress up to recent times. He pointed out the method adopted in each successive epoch to determine positions on the earth's surface, and the progressive influences on scientific research induced by these inquiries. The objects of the Society is to further the study of the natural sciences among amateurs and students by the reading of papers, by excursions, lectures, the formation of a library, and in other ways. A Society having for its aim the cultivation of interest in natural knowledge, deserves encouragement and success.

SEVERAL publications have been received from the Meteorological Observatory of the Imperial University of Odessa. The *Annales* for 1894 contain a description of the Observatory; observations made during the year; and an account of the mortality and characteristic elements of the climate of Odessa. In the *Revue Météorologique* (vol. vii.) the meteorological observations made at stations in the south-west of Russia are brought together. The numerous observations at the stations organised in that region by Prof. A. Klossovsky, who is responsible for the whole of the publications, have enabled him to study the question of torrential rains during the period 1886–92, which discussion forms the subject of a separate paper.

THE elaborate "Leçons sur l'Electricité et le Magnétisme," by MM. E. Mascart and J. Joubert, has reached a second edition, the first volume of which, dealing with "Phénomènes Généraux et Théorie," has been received from MM. Masson and Co. Prof. Mascart is alone responsible for the new edition, Prof. Joubert being unable to assist in bringing the work into line with the present state of electrical knowledge. The many modifications introduced into the text, and the additions rendered necessary by the development of the science of electricity, has not resulted in any alteration of the general plan of the work. The second volume will be published at the end of this year, and will be devoted to the study of methods of observation, details of experiments, and the examination of the principal characteristics of industrial applications of electricity.

THE Field Columbian Museum at Chicago, a description of which was given in NATURE of June 6, 1895 (vol. lii. p. 137), commenced last year a series of publications having for its object the description of the contents of the Museum, and the issue of papers which come within the range of scientific or technical discussion. The publications will thus include not only catalogues of collections, but also transactions, memoirs, bulletins, monographs, and handbooks. There will be separate series for botany, zoology, anthropology, geology, and history, and each series is to have a separate pagination and volumes, so that the literature of each science or general subject will be rendered consecutive and complete for binding. No time is being lost in making known the extent of the collections in the different departments of the Museum, and Publications 2 and 3, which have just reached us, show that a high standard is aimed at. In one of these publications (Hist. Series, vol. i. No. 2), Mr. W. E. Curtis describes "The Authentic Letters of Columbus." The original Columbus documents which form the subject of his valuable bulletin were exhibited at the World's Columbian Exposition. Photographs were taken of the entire collection, and the negatives were subsequently presented to the Field Columbian Museum. The facsimiles thus obtained, now form part of the material in the Department of Columbus Memorial of that institution, and from them excellent half-tone plates have been made to illustrate Mr. Curtis's bulletin, which contains translations of all the manuscripts of Columbus existing, arranged in the order of the dates at which they are supposed to have been written; it will, therefore, be of extreme interest and service to students of geographical history. The second publication which we have received (Geol. Series, vol. i. No. 1), is a "Handbook and Catalogue of the Collection of Meteorites," by Dr. O. C. Farrington. Constructed on much the same lines as Mr. Fletcher's "Introduction to the Study of Meteorites," the publication will prove helpful to all who are interested in "holy things fallen from heaven." From the historical portion of the work a knowledge of the principal characters of meteorites will be obtained, while the catalogue of specimens in the Museum will facilitate the study of the collection. Maskelyne's classification of meteorites into aërosiderites, aërosiderolites, and aërolites, is followed in the catalogue. Six plates, each containing several figures illustrating the forms of meteorites, Widmanstätten figures, and microscopic structure, accompany Dr. Farrington's descriptions.

SOME speculations of considerable interest are put forward by M. Guntz in the current number of the *Comptes rendus*. Recalling the observations of Prof. Ramsay on the reduction of the vapour pressure of mercury by dissolved metals, from which the conclusion was drawn, that, at the boiling-point of mercury, the molecular weight of the metal in solution was in general equal to its atomic weight, M. Guntz puts forward the idea that in the case of metals extracted from their amalgams at a low temperature, the residue actually consists, for the most part, of the element in the atomic state. This, and not merely the fine state of division, he regards as the explanation of the energetic properties exhibited by such metallic residues. In support of this, thermo-chemical data are given for ordinary fused manganese, and manganese from its amalgam, the heats of combination with oxygen showing that the conversion of the latter into the former is accompanied with the evolution of heat (3·8 calories for the gram-atom). Besides manganese, both chromium and molybdenum, which after being fused are unchanged in air, are pyrophoric when extracted from their amalgams at low temperatures. M. Guntz proposes to study the heats of polymerisation of several metals, more especially of iron.

PROF. ARCIMIS informs us that the bearings he gave to the diagram (Fig. 1), which accompanied his description of the Madrid meteor (*ante* p. 395), were wrong. The south point should have been at the top of the diagram, and the east to the right.

THE additions to the Zoological Society's Gardens during the past week include three Punjaub Wild Sheep (*Ovis vignei*, ♂ ♀ ♀), from North-West India, presented by Captain R. A. Ogilby; a Vulpine Phalanger (*Phalangista vulpina*, ♂) from Australia, presented by Messrs. Multon and Wallis; a Fraser's Eagle Owl (*Bubo pœnsis*) from Ashanti, presented by Major H. M. Sinclair, R.E.; a Greater-spotted Woodpecker (*Dendrocopus major*), British, presented by Mr. W. H. St. Quintin; two Spiny-tailed Mastigures (*Uromastix acanthinurus*) from Biskra, Algeria, presented by the Lord Lilford; a Collar-

less Pheasant (*Phasianus decollatus*, ♂) from Northern China, a Spiny-tailed Mastigure (*Uromastix acanthinurus*) from Briskra, Algeria, deposited; a Rusty Urubitinga (*Urubitinga meridionalis*) from South America, a Peregrine Falcon (*Falco peregrinus*), British, purchased; a Canada Goose (*Bernicla canadensis*, ♂) from North America, received in exchange.

OUR ASTRONOMICAL COLUMN.

THE DIMENSIONS OF SATURN.—During the oppositions of 1894 and 1895, Prof. Barnard made a large number of micrometric measurements of Saturn with the Lick telescope, and as a result of his work he gives the following details as to the dimensions of the planet (*Monthly Notices*, vol. lvi. p. 163):—

	Miles.	Angle.
Equatorial diameter of Saturn ...	76,470	17″·800
Polar diameter of Saturn ...	69,770	16·241
Outer diameter of outer ring ...	172,310	40·108
Inner diameter of outer ring ...	150,560	35·046
Centre of Cassini division ...	——	34·517
Outer diameter of inner ring ...	146,020	33·988
Inner diameter of inner ring ...	110,200	25·647
Inner diameter of crape ring ...	88,190	20·528
Width of Cassini division ...	2,270	0·529
Diameter of Titan	2,720	0·633

The angular measurements given above are reduced to the mean distance of the planet from the sun, which is taken as 9·538861 astronomical units. In computing the linear dimensions, the sun's mean distance from the earth has been taken to be 92,879,000 miles.

The value of the polar compression of the planet deduced from the measures is 1/11·42. Prof. Barnard's results show a close agreement with those obtained by Prof. Hall in 1884–87. The mean difference between the two sets of measures is only 0″·034, but in the case of the outer diameter of the outer ring, Prof. Barnard's measure is less by 0″·34; it is possible that this may be due to eccentricity of the outer ring. The small amount of detail on the planet seen with the great telescope has given rise to considerable discussion; but observations of Jupiter and Mars have convinced Prof. Barnard that the instrument is capable of showing anything that can be seen in smaller telescopes, and more.

THE SURFACE OF MARS.—A preliminary note regarding his observations of Mars during the opposition of 1894 is given by Prof. Barnard in the paper to which reference is made in the preceding note. The detail observed with the 36-inch refractor was so intricate and abundant that it baffled all attempts to delineate it.

The so-called "seas" were especially rich in markings, which are likened to the aspect of a mountainous country as seen from a great elevation. There was no suggestion that the view was one of seas and oceans, but exactly the reverse. This appearance was especially noticed in the equatorial part of the Hour-glass Sea.

On the "continental" regions irregular features represented by delicate differences of shade were noticed, but no straight sharp lines were seen on these surfaces. In the region of the Solis Lacus some short and rather irregular hazy lines were observed, running between several of the small black spots which abound there. Further details of the observations are promised, and as they seem to suggest a possible change in our ideas as to what represents land and water on Mars, they will be looked forward to with interest.

THE ECLIPSOSCOPE.—Many attempts have been made to devise a spectroscope capable of showing the whole of the sun's chromosphere and prominences at a glance, but they have only been partially successful, although the introduction of the spectroheliograph has made it easy to register the appearances photographically. Another effort to secure visual observations of the entire chromosphere has been made by C. V. Zenger, Director of the Prague Observatory, and with the instrument he has invented—the eclipsoscope—he claims to be able to see the corona as well as the chromosphere and prominences (*Bull. Soc. Belge d'Ast.* No. 1–2). A cone of crown glass or quartz is symmetrically enclosed in a zinc cylinder, which is closed at the ends with glass plates, and the space between the cylinder and cone is filled with anethol (oil of aniseed). This new form of prism is equivalent to an infinite number of prisms, free from prismatic aberration, and giving direct vision for the yellow rays. The end of the cylinder in juxtaposition with the apex of the cone is covered with a piece of tinfoil, in which a circular slit 2 to 3 mm. wide is cut out with the apex as its centre. A telescope provided with a Barlow lens forms an image of the sun on the slit plate, the disc being of the same size as the central disc of the circular slit. Each point of the sun's limb thus gives a rectilinear spectrum, and all the points together produce a circular spectrum, which can either be viewed with a suitable eyepiece, or projected on a screen by means of a photographic lens. On interposing a cell containing a solution of aniline-violet and aniline-green, the red light alone is transmitted, and the chromosphere and prominences become visible in red light. Replacing this absorbing medium by another consisting of a solution of chromic acid and sulphate of copper, green light is transmitted, and the brightest parts of the corona are stated to become visible.

AUSTRALIAN LONGITUDES.—The whole of the existing materials bearing on the subject of Australian longitudes has been examined by Mr. Pietro Baracchi, in order to determine the most probable values of these longitudes, which may claim as their basis the full amount of evidence made known to the present time. The conclusion he draws from the discussion is "that the longitudes of the Australian Observatories may be accepted as true only within one second of time; and those of the boundary lines of South Australia with Victoria and New South Wales, within 1500 feet."

INVESTIGATIONS ON RÖNTGEN RAYS.[1]

I HAVE the pleasure to communicate briefly to this Academy the results of some investigations I have made on the Röntgen rays.

The theoretical part of these investigations aims at determining whether the rays are a form of light, in the sense of being vibrations in the ether; it is known that Röntgen, in his memoir, suggests that they are longitudinal waves in the ether. However, on reading Röntgen's paper, I concluded from the facts he had established, and more especially from the fact that the rays were propagated with the same velocity in different transparent media, and that a body is more transparent the less its density, that the rays might be considered as highly rarefied matter projected from the Crookes' tube, matter to which lighter bodies would be more permeable. Bodies would be traversed more or less easily by the small particles, in the same way that a sieve more or less fine would be by a stream of small shot. This suggestion I had mentioned privately, and was, unknown to me, reported in a correspondence in a political journal.

From a short account of the conference held at Pisa, by Prof. Garbasso, I gathered that this idea was shared by him and the well-known savant Battelli, and that their researches on the subject tended to confirm it. At that time I had already made experiments in the same direction. Till now all attempts to discover if bodies transparent to the Röntgen rays show any phenomena analogous to the different colours of ordinary light have yielded negative results. Not having, however, at my disposal a sufficient number of metals in thin sheets, I cannot state definitely that such a colour-effect does not exist. The absence of any such effect would, when more fully established, certainly speak in favour of the hypothesis I suggested above—that of rarefied matter projected from the tube. Of what nature could this matter be? Evidently, either ordinary matter—that constituting the Crookes' tube (the glass, electrodes, or gas in the tube); or an imponderable matter—the ether. If it were ordinary matter projected *from* or *through* the Crookes' tube, it appears probable that it could be electrified; powerful electrostatic charges should then deviate the rays. I have started some experiments with the view of testing this, but have encountered difficulties which I shall probably be unable to overcome with the few appliances at my disposal. I shall make known to the Academy any results I may obtain.

I shall now speak of my endeavours to facilitate the applications of Röntgen's discovery.

[1] By Prof. E. Salvioni. Translated from the *Proceedings* of the Accademia Medico-Chirurgica di Perugia, vol. viii. No. 1-2. Feb. 6, 1896.

First, I have the honour of laying before the Academy some photographs taken by the well-known method indicated by Röntgen; for, besides being excellent photographs, they show some new features. The photographs are:—

(1) Those of various metals (magnesium, aluminium, iron, lead, zinc, copper, palladium, silver, gold, and platinum) photographed together on the same plate. They confirm the relation found by Röntgen between the transparency and density.

(2) Photographs of the same metals, and further a *scale of transparency*, obtained by photographing the shadow of a thin rectangular slab of aluminium having one side tapered. These photographs are those I took in seeking for a possible colour-effect, placing between the Crookes' tube and the metal sheets various substances, such as cardboard, aluminium, sheets of gold and silver, &c. In spite of these being interposed, the photographs, when compared with the scale of transparency, show the same relative intensity.

(3) A photograph of the shadow of my hand. This kind of picture shows, as is well known, the bones, and not only the phalanges of the fingers but also the whole metacarpus is seen. It is noticeable that the cartilages are far less transparent than they appear in the pictures published in the journals, and, on the contrary, *the spongy parts of the phalanges are more transparent.*

(4) A photograph of the shadow of the œdematous hand of a corpse (that of a woman aged fifty-nine); in the second phalange of the index-finger was fixed an iron nail; that of the middle finger was broken by a hammer; in that of the third was introduced a small drop of mercury; finally, the palm of the hand was pierced with a needle, which was entirely hidden in the flesh. In the photograph these details are all clearly shown. Besides all the phalanges of the fingers and the metacarpus, which are clearly visible with all the joints, the carpus can just be distinguished. Here also may be noticed that the cartilages are not very transparent, *and the spongy parts of the phalanges show up well.*

(5) A photograph of the same hand; besides the phalanges of the fingers and metacarpus may be seen *clearly defined the small bones of the carpus with their details, and further the portion photographed of the radius and the cubitus.* The peculiarities shown by the cartilages and spongy parts are repeated also in this example.

(6) Two photographs of an artifically paralysed frog, *taken with very different exposures.* I would call attention to one point,—not hitherto noticed, as far as I know—which may interest this Academy of Medicine; in one of these photographs may be seen, besides the bone structure, the two lungs; in the other, *besides the lungs, the heart, and another internal organ, which I conclude is the spleen.* As might be expected, the lungs appear the more transparent.

I shall now relate the observations I have made by eye.

First I propose to consider the reason that the human eye is not directly sensitive to the Röntgen rays. *A priori* there is no impossibility in these rays exciting a luminous sensation. The phenomenon of persistence of vision with ordinary light may be attributed to a fluorescence of the retina or optical system of the eye. Now, Röntgen has found that to a certain extent bodies fluorescent to ordinary light are so also to his rays. Were this the case with the retina, it is obvious that the rays could give a luminous sensation, since they would produce actual light on the retina. With this idea I made some experiments on a retina taken from the eye of a living rabbit. Observations made with this living retina showed that, while somewhat fluorescent to the direct light issuing from a Crookes' tube, it gave no indication of fluorescence with the Röntgen rays. I should mention, however, that my two observations are not sufficient absolutely to exclude such a property from the living retina, as the phenomena shown by the Crookes' tube, with which I have hitherto worked, are not very intense.

I next examined photographically the transparency to Röntgen rays of the crystalline lens of the eye, and I obtained the result that the lens, together with the various media forming the optical system of the eye, intercept the rays to approximately the same extent a sa sheet of glass one millimetre thick; that is to say, *they are only slightly transparent.* Trials of the separate portions of the eye showed that the crystalline lens was the most opaque part, while the cornea was the most transparent. The conclusion I derive from these results is that, though the retina may be fluorescent to the Röntgen rays, as is the glass of the photographic plate, it is hardly probable that it could see objects directly through layers of wood, aluminium, flesh, &c. This, however, does not exclude the possibility of seeing them indirectly, by transforming, so to say, the Röntgen rays into ordinary luminous rays before they reach the eye. I have made a simple arrangement by means of which I can distinctly see the shapes of bodies enclosed in boxes of cardboard, aluminium, &c. This *cryptoscope*, which I have the honour of showing to the Academy, consists of a small cardboard tube about 8 centimetres high. One end is closed by a sheet of black paper, on which is spread a layer of fish-glue and calcium sulphide (there being no barium and platinum cyanide at hand); this substance I have found to be very phosphorescent under the action of Röntgen rays. Within the cardboard tube, at the other end, at which the eye is placed, is fixed a lens, giving a clear image of the phosphorescent paper. On looking through this *cryptoscope* one can see, even in a light room, the shape and position of metallic bodies enclosed in boxes of cardboard, wood, aluminium, and within the flesh. Its action is obvious; the fluorescent paper under the action of the rays is illuminated only in those portions which receive rays, consequently the silhouettes of the objects intercepting the rays appear dark. In this there is, of course, nothing new which could not have been deduced from the original experiments of Röntgen; the novelty, if indeed it is so, consists merely in making use of the known facts to design the arrangement. It seems to me that, in a more perfected form, it might be of extensive use in surgical and medical science. The sulphide of calcium may be replaced with advantage by the cyanide of barium and platinum. It is further clear that when, by a camera or other means, not only the shadows, but also the images, can be photographed (which, I believe, Profs. Battelli and Garbasso, of Pisa, have already succeeded in doing) the same *cryptoscope* will render visible also the images of bodies enclosed in boxes of wood or other materials.

As soon as possible I shall communicate the results of experiments I have begun with the view of shortening the necessary exposure by means of sensitive plates containing phosphorescent substances, or sensitive films backed by phosphorescent papers.

Finally, I wish to offer my warmest thanks to my honoured colleague G. Pisenti, Professor of Pathology, and Rector of the University, who has given me every possible assistance, and himself prepared the various portions of the eye with which I made the experiments.

THE LONDON CITY COMPANIES' GRANTS TO SCIENCE AND EDUCATION.

IT is well known that some of the London City Livery Companies make liberal grants for the purposes of education and research. In order to elicit information as to the extent and amount of such grants, we communicated a few months ago with the chief London Companies, and succeeded in obtaining several valuable statements. A few of the Companies sent us complete accounts of what they have done and are doing for the promotion of education and scientific investigation, but others only gave information concerning some of the grants made. The facts which follow do not, therefore, represent a complete statement of the assistance rendered by the Livery Companies, but they will serve to show the extent of the gifts. The Companies are mentioned in the order of civic precedence.

The Grocers' Company, in addition to making large annual grants for general educational purposes, established in 1883, and still maintain, three scholarships of the value of £250 a year for the encouragement of original research in sanitary science. Among the names of those who have held these scholarships are Dr. Wooldridge, Dr. Woodhead, and Dr. MacFadyen. Further, in 1894, the Company gave the sum of £10,000 to the British Institute of Preventive Medicine.

It is almost impossible to give an adequate idea of the educational work done by the Drapers' Company. For several years the Company have been deeply impressed with the importance of encouraging education, and especially of assisting clever children among the poorer classes to obtain higher education. With this view they established in the year 1875, and have annually given since that date, five scholarships, each of the value of £30 per annum, and tenable for four years at places of education higher than elementary. These scholarships are offered for competition by boys and girls attending metropolitan public elementary schools. In the year 1889, the Company

further established fifty scholarships tenable at the Company's school at Woodford in Essex, a first grade modern school, and offered them for competition by boys attending metropolitan public elementary schools. They co-operated in the conversion of one of their charities, now known as the Sir Wm. Bowman's Foundation, Greenwich, by means of which one hundred boys, selected by competition from public elementary schools in Greenwich, are now receiving gratuitously education in the Upper School of Greenwich Hospital. They have established scholarships in connection with the People's Palace Technical Day School, and some two hundred boys from metropolitan public elementary schools are now receiving gratuitous education there of a character to fit them to take their place as apprentices and improvers in workshops and manufactories. These scholarships are also offered for public competition.

In the year 1888 the Company, recognising the value of manual training as an adjunct to the general education of boys and girls, voted £1000 towards the cost of introducing and carrying on such training in metropolitan elementary schools for one year. The grant has annually been renewed since that date, and the manual classes are largely maintained by means of this grant. To places of higher education, both in London and the provinces, the Company have for many years past, and are still voting assistance. They established the spinning department of the Belfast Technical School; the engineering department of the University College of South Wales, Cardiff; the coal-mining department of the Yorkshire College of Science, Leeds; and they were the principal contributors to the establishment of the department of technical education in the University College of Nottingham. They have also made large grants for buildings and apparatus to many other educational institutions. During the year 1892, they expended no less than £26,000 in the promotion of education.

Since 1893, the Drapers' Company have very largely extended the educational work of the People's Palace; in fact, they have contributed about £100,000 to that institution. They have also increased their grants to the various provincial institutions mentioned in the foregoing, and assisted several others. Their School Board scholarships have been annually renewed, and they are maintaining their subscription of £1000 a year to the manual training classes in London elementary schools. About two years ago they established six scholarships with the view to enabling certain selected pupil-teachers from elementary schools to proceed to one of the universities. This scheme is working successfully, and will no doubt be developed. At present the Company are subscribing £400 to £500 per annum for these scholarships. They are also contributing a somewhat similar amount for the apprenticeship of boys to handicraft trades. The foregoing refers to work done by the Company in its corporate capacity. As trustees, they administer several important educational and apprenticeship endowments, and for the most part free of all expense to the charity.

The Fishmongers' Company have contributed a total sum of £68,760 to the City and Guilds Institute, £525 to the Borough Road Polytechnic, £340 to the North London Polytechnic, £52 10s. to the Wandsworth Technical Institute, £210 to the Baltimore Fishery School, £4300 to the Marine Biological Association, Plymouth, and £105 to the British Institute of Preventive Medicine. They also grant a scholarship of £60 to a student of the Finsbury Technical College, to be held at the City and Guilds Institute. The Company also grant eighteen exhibitions of £40 each to students of the Universities, and four exhibitions of £20 each to Masters of Arts, four scholarships of £50 each to the City of London School, and four of £50 each to the Central Foundation Schools, besides the large sums expended in the inspection of fish and the protection of salmon.

The Goldsmiths' Company, unlike some of the other great Companies, have no educational trust; but they spend a large proportion of their corporate funds upon technical, scientific, and general education. The Company was one of the first of the Companies to take up the subject of technical education, and they have been connected with the City and Guilds of London Institute from its inception; and to this Institute the Company have been the largest donors, their contributions to the present date exceeding £80,000, in addition to which they give an annual subscription of £4000. The Company have also, at their sole cost, established and endowed their Technical and Recreative Institute at New Cross. The capital expenditure upon the site, buildings, and equipment of this Institution amounts at this date to very little less than £100,000; and the Company have also assigned to it a minimum endowment of £6000 per annum. As regards general education, the Company have established seventy exhibitions of £50 per annum each for poor students at Oxford and Cambridge. These exhibitions are awarded solely for merit, coupled with a careful consideration of the pecuniary needs of the candidates. The Company also contribute to Newnham and Girton Colleges for poor lady students; and they make considerable occasional grants to other educational Institutions. A short time ago the Company granted £1000 to the Royal Institution, for the furtherance of Prof. Dewar's researches at low temperatures; and £1000 to the Imperial Institute, for research work in connection with Indian and Colonial products; and they have also recently given £1000 for the prosecution of research work in connection with the anti-toxin treatment of diphtheria. Altogether, a careful examination of the Company's expenditure during the past ten years shows that during that period thirty per cent. of the *gross* corporate income of the Company has, on an average, been devoted to educational purposes, and, as above mentioned, all this expenditure is made out of the Company's private funds.

The Skinners' Company give £2000 per annum to the City and Guilds Institute and contribute towards the support of the Northampton Institute at Clerkenwell—the chief of the three members of the City group of Polytechnics. Many other grants have been made from time to time for educational and other purposes, scientific and recreative.

The Merchant Taylors' Company expend out of their corporate income between £7000 and £8000 a year on their school at Charterhouse Square, grant £2000 a year to the City and Guilds of London Institute, and make other grants of considerable sums for educational purposes, the total annual average expenditure on general education amounting to 28 per cent. of the net corporate income.

The Haberdashers' Company's donations and grants are, we are informed, mainly devoted to general education; but no specific information has been furnished us with reference to them.

The Salters' Company have founded the following scholarships and Fellowships for the promotion of science, viz.:—£100 per annum to the Pharmaceutical Society of Great Britain for higher scientific research. £100 per annum to St. Thomas's Hospital for a like object. £150 per annum to the City and Guilds Institute for research in chemistry in its relation to manufactures (towards the general objects of which Institute the Company also subscribe nearly 1000 guineas per annum). The Company have founded Natural Science Exhibitions in connection with the City of London School and King's College School, London, which exhibitions are of the annual value of £80 each, as well as scholarships of lesser value at the Guildhall School of Music and the Royal Naval School, and, although perhaps not of a scientific nature, scholarships have been founded in connection with the Philological School in Marylebone Road, and Trent College, Nottingham. In addition to the above, the Company contribute to many objects of acknowledged public utility, the amount of which contributions, in 1894, was some £5000.

The Clothworkers' Company have very generously contributed towards the advance of technical education in London and the provinces, as will be seen from the subjoined statement of grants. The Company have also established a research laboratory in connection with the Clothworkers' Textile, Dyeing, and Design Departments of the Yorkshire College, Leeds. Numerous papers descriptive of work done in this laboratory have been contributed to the Chemical Society and the Society of Chemical Industry. The Company's grants to scientific institutions in London are:—City and Guilds of London Institute (£3500 per annum), £68,250; Imperial Institute, £2500; King's College (Scholarships not exceeding £225 per annum), £2000; King's College (Kensington Branch for the Higher Education of Women), £500; University College (Scholarships, £60 per annum), £650; Northern (Islington) Polytechnic, £17,500; People's Palace Polytechnic, £1000; Borough Road Polytechnic, £1000; Regent Street Polytechnic, £500; South-Western Polytechnic, £100; Finsbury Polytechnic, £100; North-West London Polytechnic, £50; City of London College, £600; Birkbeck Institution, £205; Marine Biological Association, £500; British Institute of Preventive Medicine, £100; London Society for

Extension of University Teaching, £1100; Middle-Class Schools Corporation (now Central Foundation Schools of London), £2500; National Association for Promotion of Technical Education, £150; Bedford College (Physical and Chemical Laboratories), £125; Toynbee Hall, Whitechapel, £125; Society of Arts, £504; Royal Architectural Museum and School of Art, £142; Bethnal Green Free Library, £141; Recreative Evening Schools Association, £340; Froebel Educational Institute, £100; Parmiter Foundation School, £100; University Settlement, Bermondsey, £25; Palæontographical Society, £21; Onslow College of Science, £250—making a total of £101,178. To scientific institutions in the provinces the grants for building equipment and general purposes amount to :—Yorkshire College, Leeds (textile industries, dyeing, and art departments, wholly founded and maintained by the Company), £34,000; Bradford Technical College, £4350; Huddersfield Technical School, £2000; Halifax Technical School, £2100; Keighley Technical School, £1300; Dewsbury Technical School, £825; Salt Science and Art Technical School, Shipley, £825; Bingley Technical School, £350; Batley Technical School, £250; Holmfirth Technical School, £250; Ossett Technical School, £200; Wakefield Technical School, £100. In addition to this, the Company grant to these institutions annually for maintenance a sum amounting to about £4000.

It is interesting to compare with the grants named in the foregoing, the estimate which the Technical Education Board of the London County Council have just submitted to the Finance Committee of the Council, as to the sum required by them for the year ending March 31, 1897. The net probable expenditure will amount to £120,000, of which £9000 is for the equipment and £16,000 the maintenance of technical departments of polytechnics. The other items are £9680 for Shoreditch, Wandsworth, and other technical schools, £20,000 for technical departments of public secondary day schools (including allowance for the fees of the Board's county scholars £70,500), £4000 for higher education, £26,070 for county scholarships, £14,440 for art teaching (including art scholarships), £8985 for science teaching (including science exhibitions and pioneer lectures, technology, and manual instruction), £4200 for domestic economy, £1500 for commercial subjects, £1000 for museums, and £5550 for expenses of administration (including cost of inspection). In 1893–94 the Board's expenditure was £46,000, in 1894–95 £63,000, and in 1895–96 £91,000. The chief causes of the increase are assigned to the development of the board's scholarship system, which has nearly reached its limit, and is costing nearly £40,000 per annum; the increase in the amount of evening educational work carried on in accordance with the Board's regulations, and therefore eligible for the Board's grants; the very great increase in the number of students who are studying science practically, as shown by the recent report of the Board's science inspector, and the consequent expenditure incurred in equipping and maintaining laboratories; the opening of new polytechnics, and the development of the technical departments of other polytechnics, and the establishment of new institutions.

In one respect the Livery Companies are in advance of the Technical Education Board, and that is in the encouragement given to research. The funds of the Technical Education Board are used to create and foster classes and institutions concerned with technical instruction, and probably the Board does not feel at liberty to give any direct assistance to research in the way that some of the Companies are doing. But, at the same time, the Board is doing work which should eventually result in an increase in the ranks of investigators, and it is to be hoped that the time is not far distant when the polytechnics will make those contributions to knowledge which are the only sure indications of scientific advancement.

ZOOLOGICAL NOMENCLATURE.

AT the meeting of the Zoological Society on Tuesday, Mr. P. L. Sclater, F.R.S., introduced a discussion on the following rules for the scientific naming of animals, compiled by the German Zoological Society.

A. General Rules.

(1) Zoological nomenclature includes extinct as well as recent animals, but has no relation to botanical names.

(2) Only such scientific names can be accepted as are published in print, in connection with a clear description either by words or figures.

(3) Scientific names must be in Latin.

(4) Names of the same origin and only differing from each other in the way they are written are to be considered identical.

(5) Alterations in names otherwise valid are only permitted in accordance with the requirements of Sections 13 and 22, and further for the purpose of purely orthographical correction when the word is without doubt wrongly written or incorrectly transcribed. Such alterations do not affect the authorship of the name.

(6) Of the various permissible names for the same conception only the one first published is valid (Law of Priority).

(7) The application of the Law of Priority begins with the tenth edition of Linnæus's "Systema Naturæ" (1758).

(8) When by subsequent authors a systematic conception is extended or reduced, the original name is nevertheless to be regarded as permissible.

(9) The author of a scientific name is he who has first proposed it in a permissible form. If the author's name is not known, the title of the publication must take its place.

(10) If the name of the author is given it should follow the scientific name without intervening sign. In all cases in which a second author's name is used a comma should be placed before it.

(11) Class (*classis*), Order (*ordo*), Family (*familia*), Genus (*genus*), and Species (*species*) are conceptions descending in rank one after the other, and are to be taken in the order here given. These terms should not be employed in a contrary or capricious relation or order.

B. Rules for Designating Species.

(12) Every species should be designated by one generic and one specific name (binary nomenclature).

(13) The specific name, which should be treated always as one word, should depend grammatically upon the generic name.

(14) The same specific name can only be used once in the same genus.

(15) In the case of a species being subdivided, the original name is to be retained for the species which contains the form originally described. In doubtful cases the decision of the author who makes the separation shall be followed.

(16) When various names are proposed for the same species nearly at the same date, so that the priority cannot be ascertained, the decision of the first author that points out the synonym should be followed.

(17) In the case of species with a cycle of generation of different forms, the specific term must be taken from an adult form capable of reproduction. In these cases, as also in species in which polymorphy occurs, the Law of Priority must be observed.

(18) The author of the specific name is the author of the species.

(19) The author's name should be placed in brackets when the original generic name is replaced by another.

(20) Hybrids should be designated either by a horizontal cross between the parents' names, or by these names being placed one above the other with a line between. The parents' sexes should be stated, when known. The name of the describer of the hybrid should be added, preceded by a comma.

C. Rules for the Names of Subspecies and other Divergences from Typical Species or Subspecies.

(21) When constant local forms, varieties, strains, &c., require special names, these names should be placed after the specific name. The rules for such names are the same as those for specific names.

D. Rules for Generic Names.

(22) Names of genera should be substantives, and of the singular number. They should be one word and be written with a large initial letter. If a subgenus is used, its name (which follows the same rules as a generic name) should be given in brackets after the generic name.

(23) A generic name is only valid when a known or a sufficiently characterised species (or several species) is referred to it, or when a sufficient diagnosis of it is given.

(24) The same generic name can only be employed once in

zoology. Nor can names already proposed as subgeneric be employed also as generic names in another sense.

(25) When several generic names are proposed for a genus at nearly the same date, so that their priority cannot be settled, the name for which a type-species is given is to be preferred. In all uncertain cases the decision of the author who first arranges the synonymy is to be followed.

(26) When a genus is separated into several genera the old name must be retained for the type-species. If this cannot be positively ascertained, the author who splits up the genus must select one of the species originally in the genus as the type. When a subgenus is raised to generic rank the subgeneric name becomes the generic name.

E. RULES FOR THE NAMES OF THE HIGHER SYSTEMATIC GROUPS.

(27) Names for higher systematic groups of animals must have a plural termination.

(28) Names of families and subfamilies must henceforth be taken from the name of one of the genera belonging to the group, and formed from the stem of that name, with the addition of *-idæ* (plural of *-ides* [Gr. *-ειδης*], masc.) for the families and *-inæ* (fem.) for the subfamilies.

Mr. Sclater pointed out the principal points in which these rules conflict with the Stricklandian Code commonly used in this country. These were three in number, namely :—

(1) The German Rules (Sect. 1) disclaimed any relation to botany, so that, according to them, the same generic names might be used in zoology and botany. This was contrary to the Stricklandian Code (Sect. 10).

(2) Under Sect. 5 of the German Rules the same term was to be used for the generic and specific name of a species. if these names had priority. This was contrary to the Stricklandian Code (Sect. 13).

(3) The German Rules (Sect. 7) adopted the tenth edition of the "Systema Naturæ" (1758) as the starting-point of zoological nomenclature, whereas the Stricklandian Code (Sect. 2) adopted the twelfth (1766).

After a few remarks from the President (Sir W. H. Flower), Mr. Hartert spoke in favour of the modifications proposed in the German Rules. The debate was continued by Prof. Lankester, Mr. H. J. Elwes, Dr. D. Sharp, Mr. Blanford, Dr. H. O. Forbes, and others, but no final resolution was adopted.

SCIENCE IN THE MAGAZINES.

THE eleventh instalment of Mr. Herbert Spencer's admirable series of papers on "Professional Institutions" appears in the *Contemporary*, the profession of which he traces the development this month being that of the painter. Mr. Spencer does not concern himself with the rude drawings made by prehistoric man, but deals rather with the development of pictorial art from the point at which the early civilised stage is connected with the uncivilised, illustrating his arguments by reference to the remains and records of historic peoples. The first step in the development appears to have been the painting of the image of a dead man, to be placed on his grave. Priests painted as well as carved these effigies : in fact, an examination of available evidence shows that "pictorial art in its first stages was occupied with sacred subjects, and the priest, when not himself the executant, was the director of the executants." Painting was originally subordinated to sculpture, which fact accounts for its relatively slow development. It became secularised in the later stages of Grecian life. Mr. Spencer traces these changes, as well as the differentiation of the lay painter from the clerical painter, and the differentiation of lay painters from one another.

Short descriptions of the chief discoveries of Edison and Tesla are given in *Scribner*, by Mr. E. B. Andrews, in the course of his "History of the Last Quarter-Century in the United States," his article being a continuation of previous ones contributed by him to the same magazine. "Edison," he remarks, "is famous less for originality than for dogged patience and subtle insight, enabling him to fructify others' devices. . . . A more original genius than Edison, veritably a wizard, is his young disciple, Nikola Tesla, who was born in Servia, and found employment with Edison on landing in America." *Scribner* also contains an illustrated article on "Carnations," by J. H. Connelly.

Under the title "Ways and Means in Arid America," Mr. W. E. Smythe contributes to the *Century* an account of the influence irrigation has exerted upon the development of Kansas and her sister States during the past fifteen years. The adoption of irrigation in a territory which had hitherto depended entirely upon the rainfall "extended the known limits of arid America hundreds of miles to the eastward [of Garden City] and more than one thousand miles north and south, thus adding to the empire of irrigation all the western portions of the Dakotas, Nebraska, Kansas, Oklahoma, and Texas, together with eastern Colorado." Mr. Smythe's description of what has been achieved during the past few years in these States, and in several widely separated localities in America, is a valuable object-lesson for farmers and fruit-growers.

The following are among other articles of scientific interest in the reviews and magazines received :—"The Increase of Insanity," by Mr. W. J. Corbet, in the *Fortnightly*, and an article in the *Humanitarian*, on "The Multiplication of the Unfit," by Mr. Arnold White, having much the same teachings ; "The Baltic Canal, and how it came to be made," by Mr. W. H. Wheeler, in *Longman's* ; "The Development of Dodos," in the *National*, in which Miss Mary Kingsley shows some of the effects of European culture on the West African, her paper supporting the views expressed at the British Association meeting last year, when a formal discussion took place on the results of interference with the civilisation of native races ; "The Tintometer," and "An Old Geography," in *Chambers's Journal* ; "Niagara Falls and Water Power," by Mr. Alex. Richardson, in *Good Words*.

SMITHSONIAN INVESTIGATIONS.

MR. S. P. LANGLEY'S report of the operations of the Smithsonian Institution during the year ending with June 1895, has come to hand. The report includes a general account of the affairs of the Institution during the period it covers, and also descriptions of the work accomplished in the U.S. National Museum, the Bureau of Ethnology, the Bureau of International Exchanges, the National Zoological Park, and the Astro-physical Observatory. We extract from it the following brief statement with reference to three investigations carried on under the supervision of the Institution :—

The investigation of the infra-red spectrum has been continued in the Astro-physical Observatory during the past year with increased energy, and Mr. Langley says that though only provisional results have yet been published, which are intended merely to show the character and progress of the work, it is because the means of giving greater exactness are constantly growing, so that the result it is now hoped to present will be given with the aim of a still higher standard of precision ; an aim which it may be trusted will be considered a legitimate cause for the delay in the appearance of the final results.

It is stated that a larger number of bolographic records has been obtained than in any previous year, and that these continuous observations have been accompanied by further improvement in the apparatus, a higher standard of accuracy, and a nearer approach to the completion of the research ; but that they have also shown beyond a doubt that the limit of accuracy which is desirable can never be reached in the present most unsuitable, provisional site, which is subject to every kind of disturbance due to the neighbourhood of the streets of a busy city.

Prof. E. W. Morley's investigations on the density of oxygen and hydrogen, referred to in previous reports as aided in part by the Institution, have been completed, and his memoir has been published. The atomic weight of oxygen may be called the base upon which practically our entire system of atomic weights rests, and a small error in its measurement becomes large by multiplication in the higher parts of the atomic weight scale. Hence its accurate determination is of fundamental importance. In his investigation Prof. Morley has studied the problem by two methods : (1) By the synthesis of water, in which he, for the first time, has achieved completeness by actually weighing the hydrogen, the oxygen, and the water formed, whereas all his predecessors took one or another of these factors by difference. (2) By the density ratios between oxygen and hydrogen. In this method he has weighed the gases of greater purity and in larger quantity than hitherto, and he has in some instances operated without the intervention of stopcocks, and therefore with no possibility of error due to leakage. He has also, as a correction to the density ratio,

redetermined the composition of water by volume. By both methods he reaches the same result: O = 15·879, with variation in the fourth decimal place as between the two.

Dr. J. S. Billings and Dr. S. Weir Mitchell have completed the investigations begun by them in 1893, under a grant from the Hodgkins fund, to determine the nature of the peculiar substances of organic origin contained in the air expired by human beings.

In their report the investigators state that for a number of years prior to 1888 the prevailing view among physicians and sanitarians had been that the discomfort and dangers to health and life which had been known to exist, sometimes at least, in unventilated rooms occupied by a number of human beings were largely or entirely due to peculiar organic matters contained in air expired by these persons, and that the increase in carbonic acid due to respiration had but little effect in producing these results, its chief importance being that it furnished a convenient means of determining the amount of vitiation of the air. Recently, however, several experimenters have concluded that the organic matters in the exhaled breath are not harmful, at all events to animals, and the main object of the investigations was to determine the correctness of these conclusions.

The investigators found that the air in inhabited rooms, such as the hospital ward in which experiments were made, is contaminated from many sources besides the expired air of the occupants, and that the most important of these contaminations are in the form of minute particles or dust, in which there are micro-organisms, including some of the bacteria which produce inflammation and suppuration. It is probable that these dust particles were the only really dangerous elements in the air, and it appears improbable that there is any peculiar volatile poisonous matter in the air expired by healthy men and animals other than carbonic acid.

In concluding their report the authors state that the results of the investigations, taken in connection with the results of other researches summarised in the report, indicate that some of the theories upon which modern systems of ventilation are based are either without foundation or are doubtful, and that the problem of securing comfort and health in inhabited rooms requires the consideration of the best methods of preventing or disposing of dusts of various kinds, of properly regulating temperature and moisture, and of preventing the entrance of poisonous gases like carbonic oxide derived from heating and lighting apparatus, rather than upon simply diluting the air to a certain standard of proportion of carbonic acid present.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MISS HELEN M. GOULD has presented a scholarship of 7000 dols. to Wellesley College.

MRS. S. V. HARKNESS, of New York City, has given 50,000 dols. to the Women's College of the Western Reserve University at Cleveland, Ohio, to establish a chair of biblical literature.

MR. W. C. FLETCHER, master at Bedford Grammar School, has been appointed head master of the High School and Commercial School of Liverpool Institute.

A PARLIAMENTARY paper has just been issued containing a Treasury minute to the effect that the grant to King's College, London, which was suspended by the late Government owing to the retention of denominational tests by the college, shall be continued without any stipulation as regards tests. The college will therefore receive, as from April 1 next, an annual sum of £1700 during the remainder of the term of five years, for which period, beginning in 1894, the grant of £15,000 a year to university colleges in Great Britain was to be proposed to Parliament. The other colleges are also to be informed that the increase in their grants caused by the suspension of the grant to King's College will not be continued beyond the end of this month.

IT has been proposed in the Chamber of Deputies (says the Paris correspondent of the *British Medical Journal*) that from the unreclaimed sums of savings banks and other deposit sums to the amount of £10,000 should be paid to the different French laboratories, £2600 to the Pasteur Institute and to the laboratories of higher education in Paris, including the Val-de-Grâce Hospital laboratory and the Alfort School of Veterinary Medicine, for the purpose of aiding researches on contagious diseases, especially those in connection with serums and vaccines; £5000 to the medical school laboratories of Lyons, Bordeaux, Montpelier, Toulouse, Lille, and Nancy, likewise to the veterinary schools of Lyons and Toulouse; also for the purposes of experimental research for contagious maladies, including the further study of serums and vaccines; and £2400 to the therapeutical, pharmacological, and medical chemistry laboratories of the medical faculties and pharmaceutical schools to be devoted to the study of the methods of treating contagious diseases, likewise of the drugs. Every year reports of the work done at these establishments are to be sent to the Minister of Public Instruction. The Minister will afterwards send them either to the Academy of Sciences or Academy of Medicine.

THE views with reference to training in scientific method, which have been advocated with great persistence by Dr. H. E. Armstrong for some years, are beginning to bear fruit. Mr. A. B. Badger, in a scheme for technical education which he has drawn up for the Carnarvonshire County Council, devotes a section to pointing out the advantages of training in observing, experimenting, and reasoning by practice in the methods of science, and he urges the claims of such instruction to recognition. His remarks are so different from those of technical advisers and organising secretaries of most of the County Councils, that we are glad to quote them. "Throughout life we are largely engaged in exercising the faculties with a view to action. We ought, therefore, as early as possible, to be trained to see things as they are, to compare facts together, and to draw just conclusions; such training ought to form part of the fundamental education of all. The highest authorities are agreed that habits of observing accurately, experimenting exactly and reasoning logically, are best formed by practice in the methods of science. For years past science has been taught in schools, but far too often the pupils have only been lectured to and shown experiments, or if they have done practical work, it has been a kind which required the minimum of observation and deduction. Primarily, it is not knowledge of the facts of chemistry, or physics, or mechanics, which is wanted, but training in the methods by which these facts were discovered, thus developing the faculties by which, in every occupation of life, the facts necessary to it are ascertained, and their relative values determined." We trust that the suggestions contained in Mr. Badger's carefully-constructed scheme will be adopted by the Local Governors and Headmasters of the County Schools, who will consider them in conjunction with the Technical Education Committee of Carnarvonshire.

SOME of the tables which form the appendix to volume I. of the Report of the late Royal Commission on Secondary Education are of a most interesting and valuable nature. The first of these sets forth the amounts appropriated and spent during the financial year 1893–4 under the Local Taxation Act, 1890. We find the amount available for educational purposes in the counties was £595,838 16*s.* 6*d.*, of which £448,130 17*s.* 1*d.* was actually appropriated by the County Councils for this object, though only £396,143 6*s.* 2*d.* was really spent. This sum was disposed of as follows:—Grants to secondary schools, £17,168 17*s.* 10*d.*; to scholarships and exhibitions, £40,047 19*s.* 6½*d.*; to evening continuation classes, £13,921 14*s.* 10*d.*; special classes for elementary teachers, £22,781 9*s.* 6*d.*; technical and art schools and classes, £191,011 13*s.* 5½*d.* Of the last-mentioned amount no less than £134,578 1*s.* 9½*d.* went to "classes" of one sort and another. The amount available for county boroughs was £152,224 7*s.* 4*d.*, but owing to the accumulation of funds in the previous years the amount appropriated reaches £158,687 8*s.* In addition to this, the sum of £8,659 6*s.* 10*d.* was raised under the Technical Instruction Act. A consideration of the expenditure in the boroughs brings forcibly under our attention the part that the School Boards are allowed to take in the disposal of the funds, for we find £13,161 8*s.* was placed in their hands to be dealt with by them. Under the same headings as those used in speaking of county expenditure we find £9,190 17*s.* 1*d.* for secondary schools; £5,444 9*s.* 10*d.* for scholarships and exhibitions; £5,263 7*s.* 6*d.* for evening continuation classes; for technical and art schools and classes the amount reaches £102,147 7*s.* 6*d.* of which only £19,645 5*s.* is spent on more or less detached classes. While Preston devoted none of its share to the purposes of education, and Northampton, Reading, and Great Yarmouth only a part, Coventry, Hanley, Nottingham, Rochdale, Sheffield, and Worcester, not only appropriated the whole of the amounts allocated to them, but also levied rates under the Technical Instruction Act.

SCIENTIFIC SERIALS.

Wiedemann's Annalen der Physik und Chemie, No. 1, 1896.—Absorption and emission of electric waves by resonance, by Max Planck. When a secondary circuit is excited by waves of a period equal to that of the circuit, resonance takes place. Three stages may be considered. In the first, the circuit absorbs energy from the external wave system until it has acquired a maximum of oscillation. The next stage is stationary, the circuit absorbing as much energy as is necessary to compensate for energy radiated and converted into heat. The third stage represents the dying out of the oscillation after the primary wave has ceased. Maxwell's equation enables us to calculate the distribution of energy during each of these stages.—Propagation of electric waves in water, by E. Cohn and P. Zeeman. The method used is an improvement on the apparatus previously employed, the parallel wires being taken through the trough of water and passing beyond it direct into the bolometer. The most important results are that for frequencies ranging from 27 to 97 millions no dispersion is observable, and that the index of refraction for such vibrations equals the square root of the dielectric constant.—On the alleged dissipation of positive electricity by light, by J. Elster and H. Geitel. The illumination of the anode in a vacuum leads apparently to a dissipation of an electric charge similar to that observed when a liquid alkali alloy is illuminated as a kathode. This is, however, due to the effect of the light on the platinum kathode or the interior of the tube after it has acquired a slight coating of alkali metal vapour. When this is obviated, no dissipation takes place.—Change of resistance of a contact by electric irradiation, by V. v. Lang. When a rod of carbon is lightly stood upon a block of carbon, a certain sensitive degree of contact may be found which abruptly diminishes in resistance when electric waves are produced in the neighbourhood, say by an influence machine or even an electrophorus. Any slight concussion tends to restore the original resistance. Similar results are obtained with zinc and aluminium, but the very least shock spoils the experiment in this case.—Longitudinal light, by G. Jaumann (see p. 374).—On the electric arc, by L. Arons. It is well known that an alternate current arc light is much more difficult to produce between metallic than between carbon electrodes. This may be due to the lower thermal conductivity of the carbon, which enables it to retain its heat while the current passes through wires, or to the volatile gases which are always given off by carbon, or to the oxidation of the metals during the passage of the current.

Symons's Monthly Meteorological Magazine, February.—The mild winter, by the editor. Figures are given to show that, though mild, there has been nothing very exceptional in the present winter, although it bears a great contrast to the severe frost of 1895. The temperature of December last in London was only about 1° above the average; the temperature of January 1896 was about 3° above the average, but it has been exceeded in eleven years out of the last thirty-six. In January 1884, the lowest air temperature was 32°·2, and the whole month was 3° warmer than January 1896.—The high monthly mean pressure in January. The mean for the month in Camden Square was 30·360 inches. This has only been exceeded twice since the Camden Square record began in 1858, viz. in January 1880, when the mean was 30·370 inches, and in February 1891, when it was 30·472 inches. A table is given showing the high monthly pressures of 30·360 inches or upwards in the vicinity of London since 1779. This value has only been reached or exceeded on nine occasions, and the mean of February 1891, above quoted, is the highest.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 16.—"Memoir on the Theory of the Partitions of Numbers." Part I. By Major P. A. MacMahon, R.A., F.R.S.

This memoir presented is a natural sequel to the memoirs of 1891, 1893, and 1894, published *in extenso* in the *Philosophical Transactions*. In fundamental idea it is graphical, resting, on the one hand, upon the method of the memoir on the "Compositions of Numbers," of 1893, and, on the other, upon Sylvester's graphical method, set forth in his "Constructive Theory of Partitions," of 1882, published in vol. v. of the *American Journal of Mathematics*.

The memoir is divided into four sections. In § 1 the author gives new notions concerning the partitions of ordinary unipartite numbers, and shows that the theory of the separations of a partition necessitates the consideration of the partitions of multipartite numbers. The two theories proceed in parallel paths. One-to-one correspondence can be established at any point.

In § 2 he is engaged with the graphical representation of unipartite partitions. The graph that, in the memoir of 1893, was employed to denote a principal composition of a bipartite number is shown to be the graph also of a unipartite partition.

A new theory of unipartite partitions is evolved with algebraical developments in correspondence.

In § 3 he investigates a similar correspondence between the compositions of tripartite numbers and certain regularised partitions of bipartite numbers.

The method is of general application, and indicates a one-to-one correspondence between the compositions of $m+1$-partite numbers and contain regularised partitions of m-partite numbers.

In § 4 he takes up the question of the graphical representation of completely regularised multipartite numbers. He follows Sylvester, proceeding from two to three dimensions. Whereas Sylvester employed nodes in a two-dimensional corner, the author employs nodes piled up in a three-dimensional corner. Sylvester obtains a two-fold correspondence from the permutations of his axes x, y. The author obtains a six-fold correspondence from the permutations of the three axes x, y, z. Even Sylvester's two-dimensional graphs permit of six interpretations when viewed from the three-dimensional standpoint.

Physical Society, February 28.—Prof. John Perry, Vice-President, in the chair.—Sir D. Salomons showed some experiments with incandescent lamps. A large electro-magnet is excited by means of a continuous current, while an alternating current is passed through an incandescent lamp. On bringing the lamp near the magnet the filament is set in vibration, which, if the lamp is brought sufficiently near the magnet, is sufficiently intense to break the filament. The number and position of the nodes formed in the vibrating filament are found to be independent of the natural period of the filament, but depend on the frequency of the alternating current. Prof. S. P. Thompson asked whether it was not found that the number of segments into which the filament divides, depended to some extent on the natural period of the filament. Prof. Ayrton said that the magnetic leakage was very large with the arrangement adopted, and he would like to know whether this method was a more sensitive one for mapping out the field than those ordinarily employed. In an instrument designed by Prof. Perry and himself, an alternating current was passed through a wire stretched between the poles of a magnet, and the tension of the wire was altered till the vibrations set up were a maximum. The natural period of the wire, and hence the frequency of the alternating current, was then deduced from the tension, &c. In Prof. Ewing's magnetic curve tracer, on the other hand, the natural period of the stretched wire was made as different as possible from the period of the alternations which were to be observed, so that the natural vibrations of the wire did not influence the results. The author's arrangement appeared to him (Prof. Ayrton) to be intermediate between these two, and it would seem that the natural period of the filament would to a certain extent influence the results. Prof. Perry suggested that the lamp might be held in a very steady support, so that after the large vibrations due to the natural period of the filament had died out, the vibrations of the period of the alternations alone could be observed. Sir D. Salomons, in his reply, said that the arrangement was not intended for making *measurements*. A lamp had been fixed in a steady clamp, and the current passed for many hours, but the character of the vibrations remained unaltered. He had found the vibrating filament useful for microscope work where a surface rather than a line of light was required.—Prof. Fleming read a paper by himself and Mr. Petavel, on an analytical study of the alternating current arc. The first part of the paper consisted of an analytical study of the distribution of light throughout the various radiating regions in the arc, when supplied with electric power of known constant amount, the periodic variations of the current through the arc and of the potential difference between the carbons being at the same time recorded. The power was measured by means of a bifilar watt-meter; while by means of a series of mirrors and a rotating disc carried by a synchronising alternate current motor, the mean value of the light taken from any part of the arc was compared with the instantaneous

value of the light taken from the same part of the arc, and taken at any assigned instant during the period. Thus the arc itself was its own standard, and difficulties due to slow variations in the mean light of the arc disappear. The facts observed may be summed up as follows :—The purple light of the true arc undergoes a periodic variation, and, as far as the eye can judge, is completely extinguished for a certain interval during the phase ; it has equal maxima values during the period, at instants slightly lagging behind the instants of maximum power expenditure in the arc. On the other hand, the illuminating power of the carbon crater varies between a minimum value and two unequal maxima ; the greater maximum occurring when the carbon is positive, and an instant slightly lagging behind the instant of maximum power expenditure in the arc. The second part of the paper consisted of a comparison of the efficiency of the alternate current arc regarded as a light-giving agent, as compared with that of a continuous current arc taking the same mean power. Using two arcs, which may be regarded as typical of those used in practice, the mean spherical candle-power was compared for equal expenditure of power in the arcs ; and it was found that for the alternating current arc employed the total mean spherical candle-power was always less than that of the continuous current arc. Lowering the frequency seemed to decrease the efficiency of the alternating current arc. Prof. Ayrton said the behaviour of the alternate current arc was of great interest, for the power supplied could not be measured by simply multiplying the current by the electro-motive force, since the current lags behind the volts. The resistance, *i.e.* the ratio of the current to the E.M.F., also lags, but the authors do not appear to have made any attempt to measure the *true* resistance. The authors were to be congratulated on the guarded tone they had adopted as to the bearing of these experiments on the question of the relative efficiency of the alternating and continuous current arcs. In a previous communication, one of the authors had stated that the alternating current arc must necessarily be a less efficient light-producing agent than the continuous current arc. Although the last set of curves given in the paper might appear to support this supposition, he (Prof. Ayrton) felt that the difference obtained was probably due to the fact that the alternating current arc was not being worked under proper conditions. The quality of the carbons and the length of the arc have a most important influence on the efficiency of an arc. At present our knowledge is not sufficient to allow of our stating definitely whether or not an alternating current arc can be made as efficient as a direct current arc, but there is no doubt that it will be possible to get much better results than are at present attainable. Prof. S. P. Thompson said that when the fact of the existence of the difference in phase between the current and volts in an alternating arc was first published, he had made some experiments which showed that there was a lag and not a lead, *i.e.* that the arc acted as if it possessed self-induction. The resistance also lagged, and he thought this lag might be due to a thermal lag. The temperature of the arc will lag behind the current, both when it is increasing and when it is decreasing, and if the resistance of the arc depends on the temperature of the vapour in the arc, then the resistance would also lag behind the current. It was not possible from *à priori* reasoning to say whether or no an alternating current arc could ever be obtained of an efficiency equal to that of the direct current arc. With suitable carbons, length of arc, current and volts, it seemed to him that it might be possible to obtain an equal efficiency. The light-giving process in an arc is not merely an irreversible degradation of electric energy into heat, for the difference of potential between the carbons may be written $V = a + bl$, where a may be regarded as a back electro-motive force and bl as a true resistance. The first term of this expression does not vary with the length of the arc (l), but the second term does. Multiplying through by the current (C), the equation : Watts expended $= Ca + Cbl$, is obtained. It is the first of the terms on the right-hand side, which is a reversible effect, and corresponds to the power expended in driving the current against a back electro-motive force, on which the light given out chiefly depends, due to something occurring at the crater surface. Mr. Blakesley asked whether Prof. Thompson's idea of the light being due to the reversible part of the process was not a strong argument in favour of the direct current arc. Prof. Ayrton said that in two communications made to the congress held at Chicago, it was shown that even with direct current arcs there was a certain length of arc for which the efficiency was a maximum. Mrs. Ayrton had quite recently found that the efficiency of arc-lamp carbons altered with time. Prof. Thompson's suggestion as to a thermal lag was a valuable one. Prof. Fleming, in his reply, said that when comparing two agents where there were so many variables it was practically necessary to restrict the investigation. In their case they had kept the mean power constant, and had left the other variables to take care of themselves.—The Society then adjourned till March 13.

PARIS.

Academy of Sciences, February 24.—M. A Cornu in the chair.—On partial differential equations of the second order with imaginary characteristics, by M. E. Picard.—On the radiations emitted by phosphorescence, by M. H. Becquerel. An experimental proof of the fact that light emitted by phosphorescent substances possesses the power of affecting a photographic plate through a screen which is opaque to sunlight.—On the carbide of manganese, by M. H. Moissan. This carbide, Mn_3C, which is easily prepared in the electric furnace from Mn_3O_4 and sugar charcoal, differs from other metallic carbides in the simplicity of its reaction with water, which proceeds thus,

$$Mn_3C + 6H_2O = 3Mn(OH)_2 + CH_4 + H_2.$$

Neither acetylene nor liquid hydrocarbons being formed.—Study of the borides of nickel and cobalt. The borides, NiB, CoB, are easily obtained in the crystalline state from the metal and boron at 1200°, their properties being very similar to those of the iron boride previously described.—On the estimation of arsenic, by M. A. Gautier. A criticism of a paper by MM. Engel and Bernard upon the same subject.—On a colloidal substance elaborated by the lymphatics in the normal state, by M. L. Ranvier.—The relation between muscular work and the albuminoid materials of the body, by M. A. Chauveau.—An experimental study of the question as to whether albuminoids take part in the production of external work. The results show that the amount of nitrogen secreted is practically the same whether the animal is doing external work or not, and thus confirming the conclusion drawn by the author from previous experiments, that it is by the combustion in the muscle of carbohydrates that the energy necessary for external work is produced.—On the corals of the Gulf of Lyons, by M. de Lacaze-Duthiers. A communication from the Arago Biological Laboratory.—On the method employed for conferring immunity from the venom of serpents, from documents furnished by M. de Serpa Pinto, by M. d'Abbadie. A question of priority.—Observations of Venus on Mount Mounier, by M. Perrotin. The results of these observations, which were made under very favourable conditions at a height of 9000 feet above sea-level, are consistent with the slow rotation discovered by M. Schiaparelli.—On the conversion of dextro-rotatory camphoric acid into dextro-rotatory camphor, by M. A. Haller.—Analysis, by volumetric methods, of a mixture of chlorides, hypochlorites, and chlorates, by M. A. Carnot.—Analysis of a mixture of chlorides, chlorates, and perchlorates, by M. A. Carnot.—Observations on the new Perrine comet (1896, Feb. 15) made at the Observatory of Lyons, by M. G. Le Cadet.—Observations on the same, made at the Observatory of Toulouse, by M. F. Rossard.—On the production of Röntgen silhouettes, by M. C. V. Zenger.—On the action of the X-rays on the diamond, by MM. A. Buguet and A. Gascard. The transparency of the diamond and of jet to the Röntgen rays renders it very easy to distinguish them from their imitations, the latter being opaque.—On the cause of the invisibility of the Röntgen rays, by MM. Dariex and de Rochas. It was found that the media of the eye, although perfectly transparent to ordinary light, are nearly opaque to the X-rays.—On the Röntgen rays, by M. G. Meslin.—On some properties of the X-rays of M. Röntgen, by M. H. Dufour. The phenomena are compared to the silent discharge.—On the emission of the Röntgen rays by a tube containing a fluorescent substance, by M. Piltchikof. The length of exposure may be much reduced under these conditions.—On some properties of dark light, by M. G. Le Bon.—On photography through opaque bodies, by MM. A. and L. Lumière. The authors, in attempting to repeat the experiments of M. G. Le Bon, obtained entirely negative results.—On the properties of metals extracted from their amalgams, by M. Guntz (see Note, p. 423).—Action of some hydrogen compounds on sulphuryl chloride, by M. A. Besson. The reactions with hydrogen sulphide, bromide, iodide and phosphide were studied.—On the dry distillation of wood by

M. E. Barillot.—On the temperature of the sparks produced by uranium, by M. Chesneau.—On a new mode of formation of nitroprussides, by MM. C. Marie and R. Marquis. A mixture of an alkaline ferrocyanide and nitrite is treated with carbon dioxide.—On a crystallised ammonio-chromous carbonate, by M. G. Baugé.—On veratrylamine, by M. C. Moureu.—Thermochemical study of orthochlorobenzoic acid and some of its derivatives, by M. P. Rivals.—Conversion of formaldehyde solution into vapour for disinfecting purposes, by M. A. Trillat.—On the Cretaceous fossils of Madagascar, by M. C. Deperet.—Modifications in the structure of some Arthropods induced by their living in caves, by M. A. Viré.—On phagocytosis in the oyster, by M. J. Chatin.—On the combined action of light and water in the disengagement of the perfume of plants, by M. E. Mesnard.—Method for preventing the darkening of cider, by MM. L. Dufour and L. Daniel.

DIARY OF SOCIETIES.

LONDON.

THURSDAY, MARCH 5.

ROYAL SOCIETY, at 4.30.—Contributions to the Mathematical Theory of Evolution. Note on Reproductive Selection: Prof. Karl Pearson.—On the Diurnal Periodicity of Earthquakes: C. Davison.

ROYAL INSTITUTION, at 3.—Masters of Modern Thought. I. Voltaire: Rev. William Barry.

LINNEAN SOCIETY, at 8.—Segmentally-disposed Thoracic Glands in the Larvæ of Trichoptera: Prof. Gustav Gilson.

CHEMICAL SOCIETY, at 8.—On the Explosion of Cyanogen: H. B. Dixon, E. H. Strange, and E. Graham.—On the Mode of Burning of Carbon: H. B. Dixon.—On the Detonation of Chlorine Peroxide: H. B. Dixon and J. A. Harker.—The Constitution of a New Acid resulting from the Oxidation of Tartaric Acid: H. J. H. Fenton.

SOCIETY OF ANTIQUARIES, at 8.30.

FRIDAY, MARCH 6.

ROYAL INSTITUTION, at 9.—The Tunnel under the Thames at Blackwall: A. R. Binnie.

ROYAL GEOGRAPHICAL SOCIETY, at 4.30.—A Plan for the Geographical Description of the British Islands on the Basis of the Ordnance Survey: Dr. Hugh Robert Mill.

GEOLOGISTS' ASSOCIATION, at 8.—"Pebbly Gravel" from Goring Gap to the Norfolk Coast: A. E. Salter.—On some Pleistocene Ostracoda from Fulham: Frederick Chapman.

QUEKETT MICROSCOPICAL CLUB, at 8.

SATURDAY, MARCH 7.

ROYAL INSTITUTION, at 3.—Light: Lord Rayleigh, F.R.S.

SUNDAY, MARCH 8.

SUNDAY LECTURE SOCIETY, at 4.—The New Far East; the War between China and Japan: its True Meaning and its Results: Arthur Diósy.

MONDAY, MARCH 9.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—On the Country of the Shans: Colonel R. G. Woodthorpe, C.B., R.E.

TUESDAY, MARCH 10.

ROYAL INSTITUTION, at 3.—The External Covering of Plants and Animals: Prof. Charles Stewart.

SOCIETY OF ARTS, at 8.—English Book Illustrations, 1860-70: Joseph Pennell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Paper to be further discussed: On Littoral Drift in relation to River-Outfalls and to Harbour-Entrances: W. H. Wheeler.—Papers to be read, time permitting: The Lixiviation of Silver Ores: J. H. Clemes.—Mining and Treatment of Copper Ore at Tharsis, Spain: C. F. Courtney.—Tin Smelting at Pulo Brani, Singapore: Messrs. J. McKillop and T. Flower-Ellis.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—Some Account of the Shans and Hill Tribes of the States on the Mekong: Colonel R. G. Woodthorpe.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Notes on Medical Photo-micrography: Edmund Roughton and Charles Cosens.

ROYAL VICTORIA HALL, at 8.30.—Railways and Railway Men: Sidney H. Wells.

KING'S COLLEGE FREE LECTURES, at 8.—Romance of Plant Life: Prof. Bottomley.

WEDNESDAY, MARCH 11.

SOCIETY OF ARTS, at 8.—Peasant Life and Industries in Ireland: Prof. A. C. Haddon.

GEOLOGICAL SOCIETY, at 8.—On an Alpine Nickel-bearing Serpentine with Fulgurites: Miss E. Aston, with Petrographical Notes by Prof. T. G. Bonney, F.R.S.—The Pliocene Glaciation, Pre-Glacial Valleys, and Lake-Basins in Subalpine Switzerland: Dr. C. S. du Riche Preller.—Notes concerning certain Linear Marks in a Sedimentary Rock: Dr. J. E. Talmage, F.R.S.

PHARMACEUTICAL SOCIETY, at 8.30.

THURSDAY, MARCH 12.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: Observations upon Isolated Nerve: Dr. A. D. Waller, F.R.S.

MATHEMATICAL SOCIETY, at 8.—On the Enumeration of Groups of Totitives: Prof. Lloyd Tanner.—(1) The Catenary on the Paraboloid and Cone; (2) The Motion of the Top: Prof. Greenhill, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—High-Voltage Lamps and their Influence on Central Station Practice: G. L. Addenbrooke.

SOCIETY OF ANTIQUARIES, at 8.30.

FRIDAY, MARCH 13.

ROYAL ASTRONOMICAL SOCIETY, at 8.

PHYSICAL SOCIETY, at 8.

MALACOLOGICAL SOCIETY, at 8.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Tests of Centrifugal Pumps: J. C. Cornock.

SATURDAY, MARCH 14.

ROYAL INSTITUTION, at 3.—Light: Lord Rayleigh, F.R.S.

ROYAL BOTANIC SOCIETY, at 3.45.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Annuaire de l'Observatoire Royal de Belgique, 1896 (Bruxelles).—Elements of Botany: J. Y. Bergen (Ginn).—The Geology and Scenery of Sutherland: H. M. Cadell, 2nd edition (Edinburgh, Douglas).—A Contribution to our Knowledge of Seedlings: Sir J. Lubbock, popular edition (K. Paul).—Life, Letters, and Works of Louis Agassiz: J. Marcou, 2 Vols. (Macmillan).—Grundriss der Psychologie: W. Wundt (Leipzig, Engelmann).

PAMPHLETS.—Report on the Scientific Study of the Mental and Physical Conditions of Childhood (London).—Esperienze coi Raggi di Roentgen: J. Vicentini and G. Pacher (Venezia).—Hermann von Helmholtz's Untersuchungen über die Grundlagen der Mathematik und Mechanik: Dr. L. Koenigsberger (Leipzig, Teubner).—Travaux du Réseau Météorologique du Sud-ouest de la Russie, 1894: A. Klossovsky (Odessa).—Annales de l'Observatoire Météorologie de l'Université Impériale de Odessa, 1894: A. Klossovsky (Odessa).

SERIALS.—Journal of the College of Science, Imperial University, Japan, Vol. viii. Part 2; Vol. ix. Part 1 (Tōkyō).—Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie, Einundzwanzigster Band, 4 Heft (Leipzig, Engelmann).—Himmel und Erde, February (Berlin, Paetel).—Bulletin de la Société Imperiale des Naturalistes de Moscou. 1895, No. 3 (Moscou).—The Photographic Times, February (New York).—Sunday Magazine, March (Isbister).—Good Words, March (Isbister).—Longman's Magazine, March (Longmans).—Quarterly Journal of Microscopical Science, February (Churchill).—Chambers's Journal, March (Chambers).—National Review, March (Arnold).—Century Magazine, March (Macmillan).—Natural Science, March (Rait).—Humanitarian, March (Hutchinson).—Zeitschrift für Physikalische Chemie, xix. Band, 2 Heft (Leipzig, Engelmann).—Transactions of the American Microscopical Society, January (Buffalo).—Contemporary Review, March (Isbister).—Scribner's Magazine, March (S. Low).—History of Mankind: F. Ratzel, translated, Part 6 (Macmillan).—Bulletins de la Société d'Anthropologie de Paris, 1896, Fasc. 5 (Paris, Masson).—Fortnightly Review, March (Chapman).

CONTENTS.