THURSDAY, FEBRUARY 13, 1890.

RELIGIOUS INSTITUTIONS OF THE SEMITES.

Lectures on the Religion of the Semites. The Fundamental Institutions. By W. Robertson Smith. (Edinburgh: Black, 1889.)

THE volume before us contains the first series of lectures on "the primitive religions of the Semitic peoples, viewed in relation to other ancient religions, and to the spiritual religion of the Old Testament and of Christianity," which the Trustees of the Burnett Fund asked Prof. Robertson Smith to deliver at Aberdeen in the year 1887. As may be readily imagined, the selection of Prof. R. Smith as lecturer on the subject which, of all men in England, he had made peculiarly his own, was approved of by Semitic scholars and by the more liberal-minded of the clergy of all denominations. There were and are, of course, many who will view the publication of these lectures in a book form with anything but favour; still it is quite certain that they must, if honestly read and candidly thought over, bring many of this class over to the view, which is gaining ground with great rapidity, that, if the Hebrew Scriptures are to be properly understood by us, and their value accurately gauged, we must bring to their consideration the same amount of common-sense, the same critical investigation, and the same weighing of evidence, which we should bring to bear upon any piece of general history. The Bible is a unique work, and is the production of many writers who lived at different periods. In it we have a mixture of historical facts fused with legend, poetry, folk-lore, stories, and traditions, deeply devotional religious hymns, prophecies, and descriptions of scenes in the life and history of the sons and descendants of Abraham. Anyone who knows the Oriental character will understand at once why the book is such a favourite with the Eastern Semites, and will see that it is precisely the kind of work which their writers could not help producing; it is the greatest mistake possible, however, to assume that the book could only be the production of a certain branch of the Semitic race. This is what has been thought for centuries by clergy and laity alike, and as a result its value has been much underrated and its evidence only partly understood; also, for hundreds of years the value of the Hebrew text from the point of view of comparative philology was rendered useless because a powerful section of the Church declared that the vowel-points were an integral part of the text itself, and not an addition to it made by the Rabbis of Tiberias because the true pronunciation of the language was dying out and was not generally understood. The Bible has lost nothing in the eyes of scholars because it has been proved that the vowel-points are not fourteen hundred years old, and that the learned men who added the points made mistakes themselves! It is hard to say what provoked the intense opposition of certain sects of the Church a few years ago to historical research as applied to the New Testament. It may be that the *manner* in which the German philologists and commentators carried on their investigations, and expressed their opinions, caused the narrow-minded, and we may add unlearned, theologians of the English Church to abhor and detest all such works; nevertheless, we venture to believe that, in spite of all the so-called destructive criticism of Kuenen and Wellhausen, the Bible has gained more by the labours of the critical school, of which these two scholars are brilliant examples, than it has lost. It is but a few years since Prof. Robertson Smith defended his views on historical research as applied to the Old Testament before the courts of his Church, in which bigotry and ignorance of modern research were curiously blended, and in a very few years it will be difficult to believe that such a trial—the only result of which was the loss to his Church of its most learned member—ever took place.

The lectures printed in the first volume of Prof. Robertson Smith's work are eleven in number, and they relate to the fundamental institutions of the Semitic race as a whole, viz. sanctuaries, sacrifices, first-fruits, tithes, the blood covenant, fire sacrifices, sacrificial gifts, &c. The introductory lecture explains clearly the method of inquiry into the subject, and states the lines upon which this inquiry is to be based. Practically speaking, Prof. Robertson Smith says:—We have the Bible with its remarkable accounts of the institutions of the ancient Jews, and of the ancestors of these Jews. We want to find out a great deal more about them than is stated in it, because the writers, taking for granted that its readers would understand not only their arguments but the facts which led up to them, and the history and manners and customs of the race to which they belonged, only made sufficient reference to them to make the point under discussion perfectly clear. The Jews were a small nation, belonging to the great Semitic race, which had a great deal in common with the other peoples of the race, viz. Assyrians, Babylonians, the dwellers of Syria, &c., whom we have been taught to look upon as heathen outside the pale of the salvation of the Jewish God. Now the Jews have left behind them fewer remains than any other nation belonging to the great Semitic race; the other nations of this race, however, have left behind them inscriptions, buildings, books, &c., the study of which will cast much light upon the manners and customs of the peoples described in the Old Testament. The last sixty years have made us acquainted with the languages which these people spoke, we have learned the relationships of these nations to each other, we have certain fixed points in their chronology, and we know a great deal about their religion and their public and private life. Let us then compare the records of all these various families of the Semitic race, and see how much they have in common, where they differ, and if possible let us try and find out how they differ. With a mind well stocked by the study of the native records of the great Semitic nations, Prof. Robertson Smith begins this difficult task. At the outset he distinguishes between Judaism, Christianity, and Islam, which he calls *positive* religions, and the systems of ancient heathenism. Each of the positive religions, however, was built upon the beliefs and customs of ancient heathenism, and we can only understand a system of positive religion when we understand the principles of the religion which preceded it. The Hebrews had many religious conceptions and usages in common with many kindred peoples; and as the matter is pithily put by

Prof. Robertson Smith, "those who had no grasp of spiritual principles, and knew the religion of Jehovah only as an affair of inherited usage, were not conscious of any great difference between themselves and their heathen neighbours, and fell into Canaanite and other foreign practices with the greatest facility. . . . Traditional religion is handed down from father to child, and therefore is in great measure an affair of race. Nations sprung from a common stock will have a common inheritance of traditional belief and usage in things sacred as well as profane, and thus the evidence that the Hebrews and their neighbours had a large common stock of religious tradition falls in with the evidence which we have from other sources, that in point of race the people of Israel were nearly akin to the heathen nations of Syria and Arabia." Prof. Robertson Smith, in common with the general opinions of the best scholars, is inclined to place the original home of the Semitic race in the Arabian peninsula, and it is pretty certain that, from time immemorial, the tract of land bounded by the Mediterranean on the west, Persia on the east, the Armenian mountains on the north, and the Indian Ocean on the south, was peopled by tribes who spoke Semitic dialects. It must not be forgotten that the so-called Babylonians had their territory invaded by a horde of warlike but intelligent men from the east who eventually succeeded in imposing upon them the cuneiform writing. After all the nonsense which has been talked during the last few years about the so-called "Hittites" being identical with the Hittites of the Bible, it is refreshing to find a scholar like Prof. Robertson Smith stating plainly that the "Hittites of the Bible . . . were a branch of the Canaanite stock, and that the utmost concession that can be made to modern theories on this subject is that they may for a time have been dominated by a non-Semitic aristocracy." It is as well to say at once that no successful attempt has yet been made to decipher the "Hittite" inscriptions, and none can be made until a bilingual inscription has been found. The "boss" of Tarkondemos is, no doubt, a forgery; but, even granting that it is not, no one can certainly say what or how many of the signs in the centre of the "boss" represent one of the words in cuneiform around it.

Prof. R. Smith is quite right not to place too much trust in the traditions of the Babylonian religion as made known to us by the cuneiform inscriptions. It is true that these are the oldest Semitic inscriptions known to us, but it is to be remembered that the writing itself and many of the religious myths and traditions known to the Babylonians were either forced upon them by, or borrowed from, their conquerors from the east. Just as the Arabic language is the right point to start from in the study of comparative Semitic mythology, so the traditions of the old, heathen inhabitants of Arabia are those which must form the ground-work of any comparative inquiry into the traditions of Semitic religion generally. The remainder of the first lecture is occupied with general statements of an important nature, which no reviewer could do justice to in an ordinary review. Lecture II. describes the primitive Semitic society and its religion; the oldest Semitic communities and their gods; the fatherhood of the gods, and the kinship of gods and men; monarchy and monotheism, &c. Lecture III. discusses the gods, jinn, totems, and Semitic totemism; Lecture IV., holiness, taboo, the sanctuary, and the jealousy of the god; Lecture V., sanctuaries, holy waters, trees, caves and stones; Lecture VI., sacrifice in all its various forms; Lecture VII., first-fruits, tithes, and sacrificial meals; Lecture VIII., the original significance of animal sacrifice; Lecture IX., the sacrificial efficacy of animal sacrifice, the blood covenant, &c.; Lecture X., the development of sacrificial ritual and fire sacrifices; Lecture XI., the special ideas involved in piacular sacrifices. A series of "additional notes" (A—N) and a good index complete the volume. Prof. Robertson Smith's arguments are sound, and they are carefully reasoned out; but as new material comes to hand some of the details may require alteration. The work deserves the careful study of all scholars who are anxious to meet with a straightforward, unbiassed statement upon the difficult subject of ancient Semitic religion; where it has been necessary to combat opposite opinions, the discussion is carried on with fairness to the scholars concerned, and consequently with credit to the author of these lectures. The works of Kuenen, Wellhausen, and Goldziher, repel, rather than attract, many readers; we do not imagine that any honest seeker after truth, be he theologian or lay reader, will turn away from the perusal of these lectures, having once begun to read them. It is to be hoped that Bible commentators will at once embody in their works the explanations of the large number of Scriptural passages which have, up to the present, been simply not to be understood. It is also to be hoped that Prof. R. Smith will soon be enabled to give to the world the concluding part of his valuable work, the publication of which is a sign of the times in England.

ALGEBRA.

Algebra: an Elementary Text-book for the Higher Classes of Secondary Schools and for Colleges. By G. Chrystal, M.A. Part II. (Edinburgh: Adam and Charles Black, 1889.)

THE work before us is the realization of the hope with which we concluded our notice of the first part (NATURE, vol. xxxiv. p. 614).

The author apologizes for the delay in its appearance. The occupation of a busy life would be to most men a sufficient *raison d'être* for such delay, and to this has been added a further source of delay arising from circumstances of a private character. Students, however, have gained hereby, for the work has grown in the progress of its construction. It has not, "as some one prophesied, reached ten volumes," for this is the concluding volume; but it has, we are told, cost the writer infinitely more trouble than he expected. The first instalment extended to 542 pages; this one, with answers and index of names (which we are glad to have), is comprised in 588 pages. The prominent features of the exposition as to its "singular ability and freshness of treatment" are as conspicuous here as in Part I., and we need not repeat the praise which we accorded to it (*l.c.*).

Let us hearken to Prof. Chrystal, for he always writes to the point:—

"The main object of Part II. is to deal as thoroughly as possible with those parts of algebra which form, to

use Euler's title, an 'Introductio in Analysin Infinitorum.' A practice has sprung up of late (encouraged by demands for premature knowledge in certain examinations) of hurrying young students into the manipulation of the machinery of the differential and integral calculus before they have grasped the preliminary notions of a *limit* and of an *infinite series*, on which all the meaning and all the uses of the infinitesimal calculus are based. Besides being to a large extent an educational sham, this course is a sin against the spirit of mathematical progress. The methods of the differential and integral calculus, which were once an outwork in the progress of pure mathematics, threatened for a time to become its grave. Mathematicians had fallen into a habit of covering their inability to solve many particular problems by a vague wave of the hand towards some generality, like Taylor's theorem, which was supposed to give 'an account of all such things,' subject only to the awkwardness of practical inapplicability. Much has happened to remove this danger and to reduce d/dx and $\int dx$ to their proper place as servants of the pure mathematician. . . . For the proper understanding of this important branch of modern mathematics [*i.e.* function-theory], a firm grasp of the doctrine of limits and of the convergence and continuity of an infinite series is of much greater moment than familiarity with the symbols in which these ideas may be clothed. It is hoped that the chapters on inequalities, limits, and convergence of series [chapters xxiv.–xxvi.], will help to give the student all that is required both for entering on the study of the theory of functions and for rapidly acquiring intelligent command of the infinitesimal calculus. In the chapters in question, I have avoided trenching on the ground already occupied by standard treatises: the subjects taken up, although they are all important, are either not treated at all or else treated very perfunctorily in other English text-books."

No student who masters the present treatise will pass such judgment upon these chapters, or, indeed, upon any part of the work. What the writer aims at, and succeeds in achieving, is thoroughness.

The first part occupied twenty-two chapters; the second part occupies chapters xxiii.–xxxvi.

Following on the lines of our previous notice (*l.c.*), we give a brief analysis of the chapters:—23, permutations and combinations (with applications to binomial and multinomial theorems, distributions and derangements, and the theory of substitutions); 24–26, see extract above; 27, binomial and multinomial theorems for any index: 28, exponential and logarithmic series (with an account, and applications, of Bernoulli's numbers); 29, 30, summation of the fundamental power-series for complex values of the variable, and general theorems regarding the expansion of functions in infinite forms—these are two splendid chapters, which the author says

"may be regarded as an elementary illustration of the application of the modern theory of functions. They are intended to pave the way for the study of the recent works of Continental mathematicians on the same subject. Incidentally, they contain all that is usually given in English works under the title of analytical trigonometry. If anyone should be scandalized at this traversing of the boundaries of English examination subjects, I must ask him to recollect that the boundaries in question were never traced in accordance with the principles of modern science, and sometimes break the canon of common-sense. . . . The timid way, oscillating between ill-founded trust and unreasonable fear, in which functions of a complex variable have been treated in some manuals, is a little discreditable to our intellectual culture. Some expounders of the theory of the exponential function of an imaginary argument, seem even to have forgotten the obvious truism that one can prove no property of a function which has not been defined."

Chapter 30, moreover, closes with "a careful discussion of the reversion of series and of the expansion in power-series of an algebraic function—subjects which have never been fully treated before in an English text-book, although we have in Frost's *curve-tracing* an admirable collection of examples of their use" (this is a work often referred to with high commendation in the text). To resume our analysis, chapter 31 is on the summation and transformation of series in general; 32–34 gives a thorough discussion of continued fractions and their applications; 35 gives numerous general properties of integral numbers; and 36 is on probability, or the theory of averages. In this last chapter the author has "omitted certain matter of doubtful soundness and of questionable utility; and filled its place by what I hope will prove a useful exposition of the principles of actuarial calculation."

The student of the present day knows that "things are not always what they seem," so when he hears that an elementary text-book of algebra occupies more than a thousand octavo printed pages, he is prepared to find that the "elementary" is comparative, and the "algebra" comprises some other subjects, in ordinary parlance, called by other names. He will find the present work most readable, provided he comes to the perusal with the requisite knowledge and ability, and when he has got to the end of the course he will have an excellent foundation for all his after mathematical reading. Prof. Chrystal gives good advice, which we copy. "When you come on a hard or dreary passage, pass it over; and come back to it after you have seen its importance or found the need for it further on. To facilitate this skimming process, I have given, after the table of contents, a suggestion for the course of a first reading." There are numerous "historical notes," which form a conspicuous and useful feature of the whole work.

The author uses the expression (see above) "dreary passage": we have not come across these, but we can certify with regard to the first part, that we have taken it up again and again, and have always found it difficult to rest contented with a brief glance, and the part before us appears, in some respects, to be even more attractive.

FERMENTATION WITH PURE YEAST.

The Micro-organisms of Fermentation, practically considered. By Alfred Jörgensen. Edited from the German by G. Harris Morris, Ph.D., F.C.S., F.I.C., &c. With an Introduction by Horace T. Brown, F.C.S., F.I.C. (London: F. W. Lyon, 1889.)

DURING the past ten years in which the investigation of micro-organisms and their functions has been so actively pursued there has been a conspicuous absence of any work dealing with the progress made in our knowledge of those particular forms which are of industrial importance. Thus whilst numerous text-books in various languages have appeared embodying the latest discoveries in the relationship of micro-organisms to disease, the only noteworthy treatise on the technological side of

bacteriology since Pasteur's "Etudes sur le Vin, le Vinaigre, et la Bière," the last of which was published in 1876, is Alfred Jörgensen's "Micro-organismen der Gährungsindustrie" (1886), of which the volume before us is an edited translation. This lack of text-books is doubtless in great measure due to the industrial aspects of micro-organisms having been comparatively neglected during the time that Pasteur, Koch, and their numerous disciples have been busily engaged in the investigation of questions of still more absorbing human interest. But whilst the great majority of bacteriologists have during this past decade been thus occupied in establishing or endeavouring to establish the connection between numerous diseases and specific organisms, a few more silent workers have been patiently engaged upon the less sensational though no less arduous task of placing the fermentation industries on a more scientific basis, adding in fact to the structure which had been commenced by Pasteur in his "Etudes" referred to above. The foremost in this field of research has unquestionably been Christian Hansen of the now world-famed Carlsberg Laboratory near Copenhagen, and to a concise and most lucid description of whose successful labours the present volume is chiefly devoted. The principal addition which has been made to our knowledge of the fermentation organisms by Hansen has been the precise characterization of a number of different "races" of yeast and the determination of the specific features of the fermentation induced by each particular race. Thus whilst Pasteur attributed the various diseases in wine and beer to the presence of organisms other than yeast, Hansen has shown that certain races of yeast itself are capable of bringing about most serious disturbances in the fermentation process. The lines on which Hansen has differentiated these several races of yeast, and the methods by which their pure culture may be effected are clearly though briefly described in this work, with which latest developments of brewing technology, both the author and translator have already identified themselves in the past.

The influence which has been exerted by the researches of Pasteur and Hansen on the practical conduct of the fermentation industries is quite analogous to that which has resulted in surgery from the investigations of Lister and Koch, in both cases the principle of rigid scientific cleanliness has become the order of the day. Thus we read, "the air in the fermenting-room may contain a world of germs which, in the fermentation industries, bring with them the most calamitous results; it is, however, possible to obtain air free from these invisible germs, and it admits of no doubt that, on the one hand, the purification of the air in the fermenting-room by passing it through a salt-water bath, and, on the other hand, the most rigidly executed order and cleanliness in the cellars of the Old Carlsberg brewery, stand in direct relation to the results."

From a practical point of view, the chief merit due to Hansen is that he has not only shown how pure growths of yeast may be obtained in the laboratory, but that he has further devised methods by which these pure cultures may actually be employed on the largest brewery scale. This brewing with pure yeast has already assumed very large dimensions on the Continent where a continually increasing number of breweries receive regular supplies of pure material. We have ourselves visited the laboratories of the Wissenschaftliche Stationen für Brauerei und Brennerei at Berlin and at Munich, and can testify to the impressiveness of witnessing the careful preparation on the manufacturing scale of different forms of pure yeast, each possessed of specific fermenting properties, which are then transmitted to various parts of Europe according to the special requirements of different breweries. These experimental brewing-stations, like so many other similar institutions on the Continent, are directly or indirectly subsidized by the State and number amongst their staff men of universal reputation in their particular departments. As we should anticipate, this method of scientific brewing with pure yeast has so far taken no root in this country, although we are glad to know that the translator, along with Mr. Horace Brown, has for some time past been engaged upon its experimental trial, and we learn from the latter in his introduction to this book "that, in a more or less modified form, pure yeast culture will play a very important part in the brewing of the future in this country."

This little work, which is condensed into 166 pages, and profusely illustrated and provided with an admirable bibliography, should receive the most careful attention from practical men, for whom it is mainly intended. Even the purely scientific student will find much in its pages that should prove of service to him.

PERCY F. FRANKLAND.

OUR BOOK SHELF.

An Epitome of the Synthetic Philosophy. By F. Howard Collins, with a Preface by Herbert Spencer. (London: Williams and Norgate, 1889.)

THE aim and scope of this work cannot be more tersely or more accurately conveyed than by quoting *in extenso* the "compiler's preface."

"The object of this volume is to give in a condensed form the general principles of Mr. Herbert Spencer's Philosophy as far as possible in his original words. In order to carry out this intention each section (§) has been reduced, with but few exceptions, to one-tenth; the five thousand and more pages of the original being thus represented by a little over five hundred. The Epitome consequently represents 'The Synthetic Philosophy' as it would be seen through a diminishing glass: the original proportion holding between all its varied parts.

"Should this volume lead the general reader to a better acquaintance with Mr. Spencer's own works, I shall feel amply repaid for my labour.

"My warmest thanks are due to Mr. Spencer for his invaluable preface; and also to Miss Beatrice Potter, and Mr. Henry R. Tedder, F.S.A., the able and accomplished secretary and librarian of the Athenæum Club, for their valuable suggestions while the work has been in progress."

The desirability of such an undertaking, supposing it to have been successfully accomplished, is both manifest and manifold. Mr. Spencer's works are so voluminous that it is impossible to acquire a knowledge of his system of philosophy as a whole without devoting to it an expenditure of time which is practically impossible for most men who are not specially engaged in philosophic studies. Moreover, even to a reader who is thus specially engaged, and who therefore desires fully to master this system, no small difficulty is experienced from the fact that hitherto there has not been so much as an index to guide his

studies through these reams and reams of paper. Consequently, the first class of readers have hitherto for the most part been satisfied to gain their knowledge of Spencer through the "Cosmic Philosophy" of Fiske, while the latter class have experienced a hitherto hopeless difficulty in refreshing their memories upon particular points, or in finding passages to which they may wish to refer in publications of their own. Speaking for ourselves, we are conscious of often having done a negative injustice to Mr. Spencer on this account, simply because, in order to avoid the possibility of any positive injustice in the way of misrepresentation, we have deemed it wisest not to allude to him at all.

Now, the epitome which Mr. Howard Collins has supplied so admirably satisfies all the requirements of the case that henceforth the general reader will be able to acquire a clear knowledge of Mr. Herbert Spencer's philosophy in one-tenth of the time that it has hitherto been necessary to expend, while—as Mr. Spencer himself observes in his highly commendatory preface—more serious students will find that "a clear preliminary conception is more readily obtained from a small outline-map than from a large one full of details." Lastly, for all purposes of reference, this epitome leaves nothing to be desired; for not only does it run parallel with the original—chapter by chapter and section by section—but it is also furnished at the end with an alphabetical index of subject-matter: so that, if a man is writing upon any of the innumerable topics which Mr. Spencer has handled, he can immediately ascertain all that Mr. Spencer has said with regard to them.

For these reasons we cordially recommend this most painstaking epitome to every class of readers; and we cannot doubt that its publication will greatly promote the diffusion of Mr. Spencer's thought in all the English-speaking communities of the world. G. J. R.

The Earth and its Story. Edited by Robert Brown, Ph.D., F.L.S. (London: Cassell and Co., 1889.)

THE continued publication of good and popularly written scientific works is one of the most gratifying signs of the times; it testifies, in no uncertain manner, to the growth of a taste for scientific knowledge in the mind of the general public, and hence is a matter of congratulation.

Of all the sciences none may perhaps be made more interesting than physical geography, or its modern equivalent physiography. The desire to know something about the earth's position in the universe, its formation, and its inhabitants, is and always has been innate in man, and we are glad, therefore, to welcome works that may satisfy this craving after light. The one before us deals in a comprehensive manner with the geographical distribution of plants and animals, and the agents concerned in their dispersion; with the physics of the sea, waves, currents, and tides; with terrestrial magnetism; climate and the causes affecting its distribution; rainfall and precipitation in general. A considerable amount of space is given to descriptions of geological formations and the fossils they contain, whilst ideal landscapes with restored animals are plentifully figured. We regret, however, that only a very meagre description is given of the earth as a planet. It must be remembered that astronomy is a very important part of physiography, even when looked at from a utilitarian point of view. The reason why the movements of the heavenly bodies have been studied from time immemorial is that a knowledge of them was necessary in order to meet the vicissitudes of life, and even before primitive man had inquired into the constitution of the earth he had arrived at crude conceptions as to the constitution of the universe from uncritical observations of celestial phenomena. The priority of these conceptions demonstrates their importance, and therefore, in a work intending to convey earth knowledge, the verification of the earth's rotation and revolution and the determination of its true size and shape should certainly be included. The measurements of arcs of meridian, whereby the exact size and shape of the earth may be found, are easy to describe, and preferable to the proofs of the earth's rotundity known in the time of Peate; besides which, such investigations essentially belong to physical geography. But, excepting these omissions, the work is one of sterling value; it is profusely illustrated, each of the two volumes containing twelve coloured plates and about 270 woodcuts, and the explanatory text is very readable and interesting throughout. Such a production will naturally gravitate to the free public libraries and similar institutions, and will be of great use in extending scientific knowledge.

Steam. By William Ripper, Professor of Mechanical Engineering in the Sheffield Technical School. (London: Longmans, Green, and Co., 1889.)

THIS volume consists of an elaboration of notes of lectures given by the author to an evening class of young mechanical engineers. For its size, it contains much useful information; and the simplicity of expression, and the absence of elaborate calculation, throughout the chapters help to make it suitable for elementary classes. The author gives special prominence to the principles involved in the economical use of steam. This part of the book is particularly lucid and concise, being perfectly clear to the average student. He also describes well the compound, triple, and quadruple expansion engines, especially dealing with the general idea of the expansion and course of the steam through the cylinders on its way to the condenser, as well as with the general laws regulating the volumes of the cylinders. Although the subject is treated in an elementary manner, there is much sound work in the book. Text-books on steam have greatly improved of late years from an engineer's point of view, and the present volume is a good example of the way in which the subject should be handled for the benefit of budding engineers.

The illustrations and diagrams are good, the former being taken from engines in actual practice. Fig. 134, however, does not represent particularly good practice. The flat crown of the fire-box of locomotive type of marine boilers is probably seldom stayed after the manner shown; the crown stays being generally screwed through the shell of the boiler, and either rivetted over or fastened with a nut and a copper washer. Assuming that these stays are screwed through the fire-box crown sheet, it would be interesting to know how the author proposes to place them in position, as shown in the figure. Fig. 137 represents a Ramsbottom locomotive safety valve. Although correct in principle, it is quite a curiosity in point of design, the valve in general use being very different in appearance, as the reader may observe by referring to the one shown on the locomotive boiler illustrated in Fig. 132. We may say in conclusion that a fuller index would have added considerably to the value of the book. N. J. L.

Australia Twice Traversed. By Ernest Giles. In Two Vols. (London: Sampson Low and Co., 1889.)

THE narrative presented in these volumes has been compiled by Mr. Giles from the journals written by him during five exploring expeditions into and through central South Australia and Western Australia from 1872 to 1876. The materials of the book are not, therefore, very fresh, but this ought not to detract much from their interest, as hitherto only fragmentary accounts of Mr. Giles's travels have been printed. It must be admitted that records of wanderings in the interior of Australia are not usually very fascinating. Mr. Lumholtz's book, which we lately reviewed, is a brilliant exception to the general rule. We cannot say that Mr. Giles's work rises to an equal height above the ordinary level; for it lacks that fine insight into

native life and temperament which is the special and most valuable characteristic of the Danish explorer's record. Moreover, Mr. Giles had to pass through much desert country, the description of which could have been invested with charm only by a writer of genius. The book, however, shows that he has the courage, resource, and spirit of enterprise which are absolutely essential to an explorer, and here and there his story is lighted up by what he has to say about the few well-watered and pleasant tracts of land through which he passed during his various journeys. His explorations were necessary links in the chain of Australian geographical research, and he has acted wisely in preparing a full and accurate account of them. The value of the work is considerably increased by maps and illustrations.

New Zealand for the Emigrant, Invalid, and Tourist. By John Murray Moore, M.D. (London: Sampson Low and Co., 1890.)

DR. MOORE spent nine years in New Zealand, and not only enjoyed his stay, but derived from it renewed health and vigour. When, therefore, he began to set down the results of his observation and experience, he was in the right mood for the production of a genial and appreciative record; and his book ought to be of considerable service to each of the three classes mentioned on the title-page. The most original parts of the work are two chapters, in one of which he indicates the various climatic zones into which New Zealand as a health-resort is divisible, while in the other he presents a full account of the characters and therapeutic achievements of the principal thermal springs of the North Island. Both of these chapters will be read with interest by medical men, and by invalids who may feel disposed, as the author puts it in the rhetorical style he sometimes affects, to "fly on the wings of steam to the realm of the Southern Cross." He gives a good description of Auckland, "the Naples of New Zealand," and sets forth pleasantly and effectively the impressions produced upon him during excursions to the hot lakes and terraces, and to the west coast Sounds. An instructive chapter is devoted to the volcanic eruption of Mount Tarawera, and Dr. Moore offers much valuable information about self-government in New Zealand, and the settlement of the land; and about social life, public works and institutions, productions and industries. The volume includes several maps, in one of which are shown New Zealand's climatic zones.

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.*]

A Key to the Royal Society Catalogue.

IN his anniversary address to the Royal Society, the President, referring to the great catalogue of scientific papers, used these words:—"The utility of the work would obviously be much increased if it could be furnished with some sort of key, enabling persons to find what had been written on particular subjects. I am not without hopes that this very desirable object may yet be accomplished, notwithstanding the magnitude of any such undertaking." Almost everyone engaged in scientific research must have felt the want of such a key, and will join in the President's hopes. My present object is to suggest a scheme for supplying the want at comparatively little trouble and expense.

A complete subject index, arranged in alphabetical order, would indeed be a great undertaking. The subdivisions being minute, most of the papers would have to be catalogued more than once, and, even if the references were only to the name of the author and the number of the paper in the present catalogue, the new catalogue would probably be as large as the old. The key that I suggest would be much smaller, and yet in many cases more convenient. The proposal can hardly be novel, but its advantages may not have been fully realized. Divide up the whole of science into some 5000 heads, classified in their natural order underthe various branches—pure mathematics, astronomy, physics, chemistry, &c. Under each head place the names of the writers who have treated of the subject, with the dates of their earliest and latest papers thereon. If the heads are skilfully selected it will seldom be necessary to classify a paper under more than one head.

Some idea of the size of the suggested work may be gained from the following considerations. In the eight volumes of the catalogue at present published (1800–63 and 1863–73) are the names of about 57,000 authors, treating the names in the second part as entirely new. Of these, about 30,000 have only one paper each, and the remaining 27,000 average about eight papers each. In view of the tendency of all writers to devote themselves to special subjects, three heads seem a fair allowance for the papers of each of the 27,000 authors. We have thus 111,000 authors' names to be catalogued under 5000 heads, giving an average of about 22 names to each head. Such a list, printed in the style of the present catalogue, but with three columns instead of two in a page, would fill a volume of about 800 pages. Each of the present volumes contains about 1000 pages, and is sold at 20*s.*, which we are told covers the cost of the paper and printing. If the sections devoted to the various sciences—chemistry, geology, &c.—were published separately, the sale would probably be large.

With regard to the use of this list, the labour of looking up 20 or even 50 names in the main catalogue would generally be trifling compared with the unavoidable labour of reading the actual papers when the references had been found. In many cases the dates would show at once that certain authors need not be referred to. Even if we had a complete alphabetical subject index, it would be necessary to think of every possible word by which the particular subject in question might be denoted, so that the classified list, though more troublesome at first, would often prove more satisfactory in the end. With 5000 heads for the whole of science, perhaps 750 might be allotted to physics, and of these, 150 to light. This would admit of such subdivisions as velocity of light, colour sensation, fluorescence, selective reflection, magnetic rotation of the plane of polarization, &c. Those subdivisions should be selected, into which the actual papers most naturally fall, rather than those which seem ideally correct.

The labour of preparing such a list as I propose would be in itself considerable, but, compared with the colossal enterprise which the Royal Society has already carried out, it would be small, and the service to science would be great.

Hotel Buol, Davos. JAMES C. MCCONNEL.

Osteolepidæ.

THE letter of your correspondent "R. L. + E." somewhat misses the issue raised in the passage to which he refers. In that passage the question was not raised whether or no we are right in making family names from the inflected form of the generic ones, the sole contention being for uniformity in this respect. Thus, if we are right in making *Rhizodontidæ* (and not *Rhizodidæ*) from *Rhizodus*, we clearly ought to have *Osteolepididæ* (and not *Osteolepidæ*) from *Osteolepis*, both these generic names being precisely analogous compounds. If, on the other hand, your correspondent is right in saying that we should regard all such names as adjectival, then we ought at once to abolish family names like *Macropodidæ*, *Dasypodidæ*, *Octodontidæ*, &c., in favour of *Macropidæ*, *Dasypidæ*, and *Octodidæ*. R. L.

THERE can be no question that "R. L. + E." is himself mistaken in his arbitrary assumption of a rule for the formation of compound adjectives in Greek. Sometimes the lengthened genitive is used as the stem, as in δισώματος ("disomatus"); sometimes the short nominative stem is employed, as in δίστομος ("distomus"); and sometimes both forms occur side by side, as φιλαίματος ("philæmatus") and φίλαιμος ("philæmus"), the former seeming to be preferred. These are words actually in use in Greek writers, and any lexicon will give plenty of other instances. But his whole argument is beside the point; the question is not whether an adjective is formed from the lengthened genitive, but whether an adjective, formed from a noun

which lengthens its genitive, lengthens its own genitive. It does so in every instance; *e.g.* we have καλλίθριξ with genitive καλλίτριχος, μικροπτέρυξ with genitive μικροπτέρυγος. Hence, in the Lepidoptera, we rightly call the family, of which *Micropteryx* is the type, the *Micropterygidæ*.

Osteolepis, though not occurring in Greek writers, is not "of questionable form," but as good a word as φιλόπολις and φιλόπατρις; and just as the latter actually forms a genitive φιλοπάτριδος, so also ὀστεόλεπις would form ὀστεολέπιδος, and the family name would be *Osteolepididæ*. Finally, it is to be remembered that the family name is not formed from a "possible" generic name, but from an existing one; so that *Ostiolepus* is out of the question, and indeed is only "possible" because there happens to be a word λέπος from which it can be derived.

I must apologize for troubling you at this length, but my fellow-workers in science are not unfrequently so hazy on the subject of classical nomenclature that there is a need for the setting forth of sound doctrine. E. MEYRICK.

The College, Marlborough, January 25.

As to the facts of word-formation in Greek, Mr. Meyrick is, as was indeed to be expected, quite right, and might have put the case even more strongly. The short forms, like πολύστομος, are much rarer than those in which the full stem is found, like πολυσώματος. They are, indeed, unless I mistake, found only with the neuter stems in -αT-, as in δερμα(τ-), στομα(τ-), σωμα(τ-), αἱμα(τ-), σπερμα(τ-), and appear to be a speciality of that class of nouns, where they occur beside, but not to the exclusion of, the full normal forms. There is no ground for thinking that a derivative form in *-lepos* could be formed from the noun λεπις, λεπιδ-, or a derivative in *-ornos* from ὀρνις, ορνῖθ-. **Osteolepus* and its alleged pl. **Osteolepi*, may certainly be pronounced impossible on Greek analogies; and could not even be grounded on the by-form of the noun, λέπος, stem λεπε(σ)-, since the adjective from that *-os*, *-es* stem, would necessarily end in -λεπης, -λεπες. As, therefore, *Osteolepid-* is the stem of the noun, the name of the family, on Greek analogies, is necessarily *Osteolepid-idæ*.

But I do not myself think that it is *always* necessary to conform to Greek analogies; I think that the convenience of English needs is also to be considered. In *Osteo'lepis*, *Osteo'lepi'didæ*, I think English needs are fairly answered; but it is not always so; some formations of the kind are hardly pronounceable, or when pronounced, through shifting of accent, presence of mute letters, pronunciation of *c*, *sc*, as *s*, and the like, do not in the least suggest their meaning.

Indeed, I think it very desirable that the Linnean and other learned Societies should establish a Committee of Nomenclature, who should consider every new name proposed, and pass or reject it, after taking into consideration not merely etymological correctness of formation, but what I think far more important, capability of being pronounced, distinctness from other existing names, and fitness for yielding derivatives, if needed. I entirely disagree with the notion that every discoverer of a genus has a right to confer a *name* upon it which he himself has never considered how to pronounce. I have had occasion repeatedly to ask inventors of such names, how they pronounced them, and have more than once been told that they had never thought of that, only of getting the Greek form right, and that I, forsooth, must settle the pronunciation! Such men were, of course, utterly unfit to confer names, however eminent as scientists. Every name that does not lend itself to a distinct and easy pronunciation, or which, when pronounced, is undistinguishable from some other word spelt quite differently (*e.g.* words in *cæno-*, *cæno-*, *sceno-*, *seno-*, &c.), ought to be rejected. Better invent new words off at the ground, having *no etymology*, than put together Greek roots in combinations unsuitable for modern mouths and modern ears. Why must modern knowledge be confined within the swaddling-bands of a nomenclature 2000 years younger? J. A. H. MURRAY.

Oxford, January 28.

Compounds of Selenium.

IN your issue of the 23rd ult. (p. 284) you insert a paragraph describing experiments by M. Chabrié on compounds of selenium. While fully acknowledging the value of his work on the phenyl derivatives of selenium, I think it right to state that much of M. Chabrié's investigation has been anticipated by Mr. F. P. Evans and myself as long ago as 1884; and that several of his assertions are incomplete and incorrect. The tetrachloride, $SeCl_4$, as we then showed, exists in vapour as such between 180° and 200°; with rise of temperature it dissociates, but even at 360°, dissociation is incomplete. In our paper (*Trans. Chem. Soc.*, 45, 62) the progress of the dissociation is followed.

We do not agree with M. Chabrié's suggestion that the products of dissociation are the other chloride, Se_2Cl_2, and chlorine, for the very good reason that Se_2Cl_2 itself is an extremely unstable body. Instead of, as he asserts, having a constant boiling-point at 360°, it begins to boil at 145°; and temperature rises to 173°, while a mixture of Se_2Cl_2 and $SeCl_4$ distils over, leaving a residue of selenium. The vapour-density of Se_2Cl_2 was found by us apparently normal; but this is caused in reality by the fact that it also dissociates completely on vaporization into selenium and chlorine without change of volume, according to the equation $Se_2Cl_2 = Se_2 + Cl_2$.

A revision of the experimental work of previous investigators is obviously to be desired; but it should be undertaken as a revision, else inaccurate conclusions may be drawn from incomplete work, as they have been in this case.

Perhaps I may be allowed to take this opportunity of inquiring by what reaction selenophenol, C_6H_5SeH, is produced from the red oil, $Se_2(C_6H_5)_2C_6H_4Cl$, out of which it is said to deposit on standing? WILLIAM RAMSAY.

University College, Gower Street, February 3.

Royal Victoria Hall and Morley Memorial College.

I HAVE only just read the article on Polytechnics for London in your number for January 16 (p. 242). I hope it is not too late to offer a few words of comment on it. Nothing is said of that part of the Commissioners' scheme which applies to the Royal Victoria Hall and Morley Memorial College, probably because the amount intended for them is comparatively small—£6000 down for structural alterations, and £1000 a year to be divided between Hall and College. But it derives an importance beyond what is due to the amount of the grant, from the fact that it is no castle in the air, but a going concern, and had begun its useful life long before the Commissioners had planned their scheme. Moreover, many of your strictures do not apply to this particular part of it. You say there will be, under the new scheme, "no People's Palaces—only *Young* People's Institutes." You object to limitation of age, and to smoking being forbidden, and you conclude by urging most truly that "life should come first, then buildings," for life develops from within.

May I therefore, in as few words as possible, give an account of the history and present position of the Hall and College, with the object of showing that the truths you urge have been already laid to heart?

The Hall (formerly the "Old Vic." Theatre) was opened 9 years ago as a temperance music hall, to compete with the degrading attractions of ordinary music halls, about which there was less stir in those days than now. At first we had variety entertainments every night, but before long the experiment was tried of introducing something better on certain nights. There is no need to enter into the ups and downs through which experience was gained; suffice it to say that we still have "variety" pure and simple on Saturdays, when our gallery boys, as well as well as their elders, enjoy themselves to their hearts' content, to the number of 1800 or so; and a modification of this kind of entertainment takes place before a much smaller audience on Mondays and Wednesdays. But on Tuesdays (as your readers know from the occasional notes which appear in your paper) we have popular illustrated lectures from many of our leading scientific men, who continually express their gratification at the appreciative attention of the audience. On Thursdays we have ballad and operatic concerts, at which (interspersed among operatic selections) tableaux, representing scenes from operas, are given. And on Fridays there are temperance entertainments.

All this will be left unchanged by the new scheme; and is not this something very like a "Palace of Delight"? Smoking is and will be freely carried on (except in certain parts of the house on concert nights), and anyone, without distinction of age, can come in by payments ranging from twopence on Thursdays and Saturdays, and from a penny other nights.

But this is not all. A little more than four years ago, classes were started in the unused dressing-rooms at the back of the stage, in response to a demand for more systematic instruction from some of those who had attended the lectures. The first

class began with four students, but soon the number was as great as the rooms could conveniently accommodate, and excellent work was done in spite of many inconveniences, one of the greatest of which was the impossibility of excluding the sounds of the entertainments in the Hall. From time to time *soirées* were held, and the students informally consulted as to what additional classes they wished for. Where a demand existed, every effort was made to obtain the supply.

Then came the offer of the Commissioners to meet a subscription with an equivalent endowment, and the freehold was bought, in memory of one of the truest friends of the work, Mr. Samuel Morley. Finally, the waste space which had been occupied by dressing-rooms and stores of old scenery was cleared of its dangerous wooden staircases, a sound-proof, fire-proof wall was built to divide it from the theatre, and large convenient classrooms were built; and on the last day of September the Morley Memorial College was opened, for working men and women; Miss Goold (the well-known head of the Queen Square College) having consented to take the office of Principal here also.

Already there are 680 students on the books. Many criticisms may be made on the arrangements, but no one can say that there is a want of life in the place. The builder's men are hardly yet out of it, and the fittings are at present of the scantiest (the result of want of funds, for the delay in passing the Commissioners' scheme through Parliament has caused unlooked-for and very embarrassing delay in the receipt of the help expected from that quarter) but the enclosed prospectus will show ample signs of life. Admission to the gymnasium, smoking, and recreation rooms can only be gained by *bonâ fide* attendance on at least one class, a rule which the Committee consider very important, and which they adopted in consequence of their experience with a club which met at one time in some of the old rooms belonging to the Hall. No new students are admitted under 17, for the simple reasons that it does not answer to mix boys and men, and that the boys are provided for by the Recreative Evening Schools Association; but there is no limit of age at the other end. When the Borough Road Polytechnic is started, the College will probably take those students who want advanced literary and scientific teaching, excluding "technological classes," for which neither space nor funds would suffice. In fact, the College will be in all probability the advanced branch of the Polytechnic. At all events, it is intended that the two institutions should play into each other's hands and avoid overlapping.

You say most truly that life develops from within. I would go further, and say that "*omne vivum ex vivo*" is as true of moral and social as it is of organic life. No institution can grow and flourish unless life has been given in its service, and this is emphatically the case with that of which we are speaking. To mention names would not interest outsiders, and to those who have watched the Hall from its very beginning, nine years ago, it is well known whose heart work as well as head work has been devoted to it and kept it alive through its troubled infancy. This it is which has drawn other workers to help in doing what one alone could never accomplish, and given spirit to the whole. They have allowed life to develop from within, watching for what was practicable instead of airing preconceived theories, and this is why so little has had to be done twice over. Help of all kinds is greatly needed, for the concern is only in its early childhood yet, but one thing is certain—whatever wants have to be supplied and defects remedied, this is *not* an "architectural white elephant." Probably that could never be true of any institution which had so much heart as well as head devoted to it, but let those who doubt come and see for themselves!

February 5. A MEMBER OF COMMITTEE.

Galls.

IN NATURE of November 28, 1889 (p. 80), Prof. G. J. Romanes speaks of galls as "unequivocal evidence of a structure occurring in one species for the exclusive benefit of another," and states that "it is obvious that natural selection cannot operate upon the plants directly." Nevertheless, there is one way in which galls may be supposed to have been evolved as beneficial—or rather, less harmful—to the plants. Every farmer is aware of the great loss to vegetation caused annually by larvæ of insects boring within the branches and twigs of trees. Now suppose that all internal plant feeders were originally borers or leaf-miners—and this is highly probable,—but that some had a tendency to cause swellings in which they fed. These latter would be less injurious to the plants, and the greater the vitality of the plants the more nourishment for them; and so by degrees the globular and other highly specialized and least harmful galls would be developed, by natural selection, for the benefit not only of the insect, but also of the plant. And known galls, which I need not here enumerate, furnish us with all the steps of this evolution. T. D. A. COCKERELL.

West Cliff, Colorado, U.S.A., January 23.

Foreign Substances attached to Crabs.

THE Compound Ascidian referred to by Dr. R. v. Lendenfeld in yesterday's NATURE (p. 317) is one of the Polyclinidæ, and probably a new species. It belongs to the genus *Atopogaster*, and is closely related to *A. informis* (*Challenger* Report, Part ii. p. 171).

I have before me now five good specimens of the crab and Ascidian (the crab in this case is *Dromia excavata*, Haswell), dredged in Port Jackson, and sent by the Australian Museum, Sydney; they measure as follows:—

Specimen.	Crab (greatest diameter). cm.	Ascidian (length, breadth, and height). cm. cm. cm.
A	4	10 × 8 × 5
B	3·5	10 × 6 × 5
C	2·5	8 × 6 × 5·5
D	2·5	6 × 6 × 5
E	2·5	5·5 × 4·5 × 3

In the largest of them the Ascidian seems to be quite twenty times the size of the crab.

I notice in these specimens that the last pair of thoracic legs in the crab, which are much larger than the preceding pair, are turned up dorsally, and are so firmly embedded and attached by their sharp claws in the test of the Ascidian that it is easier to disarticulate them than to loosen their hold.

To those who dredge much round our coasts, a crab covered with foreign substances is no unusual sight. Specimens of *Hyas* are often found so overgrown with Algæ, Sponges, Zoophytes, and Polyzoa that almost the whole of the body and legs is hidden, and the animal is scarcely recognizable except by its movements. W. A. HERDMAN.

Liverpool, February 7.

The Ten and Tenth Notation.

IT is no doubt difficult for anyone to really conceive enormously great or infinitely small quantities. This difficulty is, however, much minimized by the ten and tenth notation. Indeed, if systematically used, I believe one's mental power of estimation would be practically perfect. But is it so used? I have before me three books—I only take this as an example of what frequently occurs—in which Joule's equivalent is given is—

$$\left.\begin{array}{l} 42 \times 10^6 \\ 4{\cdot}2 \times 10^7 \\ 0{\cdot}42 \times 10^8 \end{array}\right\} \text{respectively.}$$

B. A. MUIRHEAD.

Pall Mall Club, Waterloo Place, S.W., February 8.

P.S.—The natural uniform notation, at any rate for text-books, seems obvious.

EARTH TREMORS FROM TRAINS.

AMONG the writings of those who love to speculate on the future of our planet there is probably somewhere (though we have not had time to discover it) an essay on the cosmical changes which man will be able to produce in the earth. The data for solving this problem are striking. In a few centuries man has acquired all those powers over large and solid objects represented by his knowledge of explosives, and his use of steam. Multiply the centuries, and with them the history, by convenient figures (a familiar process in this kind of problem) and there is no reason why the earth's axis of rotation should not be shifted considerably by human agency.

For the present, however, we are concerned with a more

modest inquiry—to wit, how far the railways which jar the nerves of Mr. Ruskin so terribly, are desirable neighbours for anyone who prefers the earth under his feet to be firm and steady, as it was aforetime, and as it is now sometimes in remote parts of the country on Sundays. We have all noticed, when standing near a passing train, the vibration of the ground under our feet. Though this vibration decreases as we recede from the train, and may at a distance of 50 or 100 yards become insensible to such a coarse test as the actual jarring of our body, we can understand that it may be sufficient to disturb delicate instruments at a considerable distance; and thus affect the use of instruments requiring a steady foundation. Pre-eminent among such are astronomical instruments, and it was very early in the history of railways that astronomers found themselves compelled to fight for the retention of that steadiness of ground in their neighbourhood which is of vital importance to them, and with which no human agency had previously suggested an interference. It was in 1835 that the question of taking a railway near an Observatory was first raised, in connection with the Royal Observatory, Greenwich; and an animated discussion resulted in the defeat of the railway company.

But they have several times since returned to the charge, for Greenwich has always been an attractive centre for excursions, and there are many reasons why railway companies find it continually cropping up in their schemes; indeed, it is only a few months ago that the latest application of the kind was refused by Parliament.

On June 19, 1835, the Secretary of the Admiralty wrote to the Astronomer-Royal, Mr. Pond, asking for his comments on the proposed scheme for a Greenwich-Gravesend railway, passing in a tunnel under a part of Greenwich Park, in which the Royal Observatory is situated. Mr. Pond replied that he had no experience in such matters; but "the most important observations made at the Royal Observatory are those in which the stars are seen by reflection from a horizontal surface of mercury. It appears to me highly probable, by what I have experienced from slighter causes, that the passage of heavy carriages, even at the distance of the intended tunnel, might produce sufficient tremor on this surface to destroy the accuracy of these observations." On receiving this reply, Captain Beaufort, then Hydrographer to the Admiralty, wrote to a friend, Commander Denham, asking him to make experiments near one of the few existing lines of railroad—that between Liverpool and Manchester—with a sextant and artificial horizon. After explaining the object of the experiments, he says:—"It would be childish to be guided by opinions and suggestions, when the facts can be distinctly ascertained by means of the Liverpool and Manchester Railroad, and I therefore want you to take your artificial mercury horizon to that railroad, and watch the contact of a star or the sun in altitude with a telescope when the train is passing, at two or three different distances, till you come to the outer limit of vibration, or, in other words, to the distance at which the mercury is no longer affected. After you have tried this on the surface, I wish you would then try the same experiment in the neighbourhood of the tunnel, as I presume that the results will be very different."

Commander Denham's reply is as follows:—"I find the vibration of trains of 120 tons, at a speed of 25 miles an hour, affect the mercury as far as 942 feet laterally with the rails, on the same level, and on equal substratum; but vibration perfectly ceases at 1110 feet, whilst directly over the tunnel no vibration is detectable at 95 feet distance, though quite discernible at 65 feet vertical distance. . . . I am indebted to the co-operative accommodation of the directors, who allowed trains of extra weight, and at extra speed, to pass down at night hours when the busy hum (of carting carriages and bustle) was completely suspended."

In the printed report of this correspondence the Hydrographer notes on this letter: "It is proper to remark on the above that Commander Denham's experiments depended on observations with a sextant, and that the limits of tremors in the mercury would be far more extensive if viewed by the high magnifying powers used with the mural circle."

We have quoted this case in detail not only because it was the first experiment of the kind, but because the accuracy of the results, as interpreted by the Hydrographer's note, has been confirmed by later experiments. This report was adverse to the railway company, who wished to approach within 650 feet of the Observatory; but they did not relinquish their scheme at once. They suggested various plans—of running trains at slow speeds, or stopping them altogether if the Royal Observatory signalled that an important observation was just going on, and so forth—all of which were open to the objection of looking too well on paper. Meanwhile Mr. Pond had been succeeded by Mr. (afterwards Sir George) Airy, who, in 1836 January, repeated Commander Denham's experiments in the Glebe Meadow, near the Greenwich Railway, but using a small telescope instead of a sextant. He found that "a disturbance in the clearness of the image (in mercury) was perceptible when the train was 1106 feet from the mercury, and the image was almost lost from the violence of the agitation when the train was about 700 feet from the mercury. When the train was 500 feet from the mercury it was impossible to know whether there ought to be any object visible at all."

The question was ultimately resolved into a decision upon the minimum distance from the Observatory at which a railway could be allowed; and under strong pressure, Sir George Airy was induced to define this distance as something over 700 feet; but the position to which the line was thus removed was found to bring it near other buildings, and the project was ultimately shelved. The Astronomer Royal's troubles were, however, only just commencing. In 1840 the London and Chatham Railway Company asked for leave to go through the Park; being promptly followed by a similar application from the South-Eastern Company; and he must needs repeat his experiments and protests.

His experiments in March 1846 near the Kensal Green tunnel showed that tremor was sensible in the compact clay of Kensal Green to a distance of 1700 feet, but that the tremor was very much diminished where the railway enters a tunnel. Dr. Robinson, of Armagh, made independent experiments on the Dublin and Kingstown Railway. He mounted a mural circle on an ash post driven deeply into the ground, at a distance of 1655 feet from the nearest point of the line; and found that the vibration of passing trains gradually shook the instrument away from any position in which it was clamped, so that an object would not remain bisected by the cross wires. His reflection observations were numerous, and he sums them up as follows: "On these facts it is, I presume, unnecessary to offer any comment, except the simple remark that they show clearly that, in a soil such as I have described, a train of no uncommon weight or velocity can produce, at an oblique distance of two miles, such disturbance as ought never to be tolerated in an Observatory."

Sir James South also made experiments, and concludes his report to the Admiralty thus:—"To the observations of *right ascension made by reflection*, the more immediate object of this communication, let me then entreat your Lordships' serious attention, convinced, as I am, that, did they stand *alone*, they would justify your Lordships in saying to *present* as well as to *future* railroad applicants, 'WITHIN THIS PARK STANDS THE ROYAL OBSERVATORY OF ENGLAND, AND WITHIN THIS PARK'S WALLS A RAILROAD SHALL NEVER COME.'" (The italics and capitals are as in the original.)

These strong protests had the desired effect for the time being, and it was not till 1853 that another attempt was made to bring a railway within the Park. This was by the South-Eastern Company, and being postponed for a year, was not heard of again. In 1863, however, the London, Chatham, and Dover Company proposed a line from Dulwich to Epsom passing within 700 feet of the Observatory; and the South London, Greenwich, and Woolwich Railway another passing within 600 feet. Sir George Airy was at first inclined to think that, if these railways were laid in tunnels, they might be permitted. But as facilities for making experiments had meantime increased with the multiplicity of lines, he renewed his investigations at the suggestion of the Hydrographer, and found that the protection of the tunnel was by no means established; and in other respects he had been if anything too lenient in assigning minimum distances. His conclusions from the experiments were:—

"I. It is indispensable that the railway pass through the Park in a covered tunnel.

"II. It is indispensable that its minimum distance from the transit circle of the Royal Observatory exceed 1000 feet."

The result of all these independent experiments seem to be that even with small instruments, such as a sextant or a small telescope, vibration is sensible at 1000 feet distance; and that though a tunnel may be a protection in some cases (we shall presently find reason to question this more seriously) the reasons are not sufficiently understood to enable us to predict the influence of individual tunnels. All the observations, except one of Dr. Robinson's, have reference to reflection observations; but it does not follow that these are the only observations disturbed, as is made abundantly clear by the single observation of Dr. Robinson's referred to, where the telescope was practically shaken to another position against the clamp. It is in reflection observations that the vibration is most easily discernible, but errors introduced into other observations are no less serious because they are not readily detected. Observation with mercury is a delicate test, but it is quite possible that we may very soon find even a more delicate test necessary. We are, for instance, only on the threshold of photographic experiments for which the most perfect steadiness is essential; and it is of the utmost importance to make sure that our large Observatories are so protected as to be available for such work as is gathering shape in the mists of the near future. If any mistake has been made in dealing with railway proposals, it has been that of being too lenient; firstly, from the desire to yield as far as possible in matters affecting public convenience; and, secondly, perhaps from not fully appreciating the remark of Captain Beaufort in 1835, that the results obtained with small instruments must be properly magnified for dealing with large ones. This point has been made clear by the last case we shall quote, also from the history of the Royal Observatory. Proposals for an adjacent railway were renewed, as we have said above, in 1888. It had been already noticed that the lines which had been permitted were not sufficiently remote to prevent disturbance, and accordingly experiments were now made with the transit circle itself instead of with a small instrument. An observer was stationed at the transit circle prepared for a nadir observation, and for an hour noted the times when the images were steady, when partially disturbed, and when so agitated as to prevent observation. These times were noted carefully by a standard clock to within a few seconds. Other observers were furnished with watches set to standard time, and travelling on the various lines of railway in the neighbourhood noted the exact times of stopping and starting of all trains, entries into tunnels, &c. The observations were made near midnight when other traffic was stopped. On the following day the independent records of the transit circle observer and the train observers were compared. These operations were repeated on five separate nights. The result of the series of observations may be gathered from the following extract from the Report of the Astronomer-Royal to the Board of Visitors, 1888 June 2:—

"It resulted from these experiments that trains on the Greenwich-Maze Hill Railway caused great disturbance during their passage, not only on the section between Greenwich and Maze Hill, the nearest point of which is 570 yards from the transit circle, but also on the line beyond Greenwich on the London side, and beyond Maze Hill on the Woolwich side. The distances of the Greenwich and Maze Hill Stations from the Observatory are about 970 and 670 yards respectively . . . The disturbance was very great during the passage between Greenwich and Maze Hill, the reflected image being invisible while the train was in the tunnel, at a minimum distance of 570 yards, and there was considerable disturbance during the passage of trains through the Blackheath-Charlton tunnel, at a distance of a mile, the reflected image becoming occasionally invisible."

It thus appears that the tunnels increased rather than diminished the disturbance; and that the minimum distance for insensible tremor had been considerably underestimated. But the interference with the work of the Observatory is not serious. By the vigorous action of Sir George Airy and his successor the national Observatory has been saved from the misfortunes which have befallen Paris and Berlin, where traffic has been allowed to make certain classes of observation impossible.

H. H. TURNER.

TITANOTHERIUM IN THE BRITISH MUSEUM.

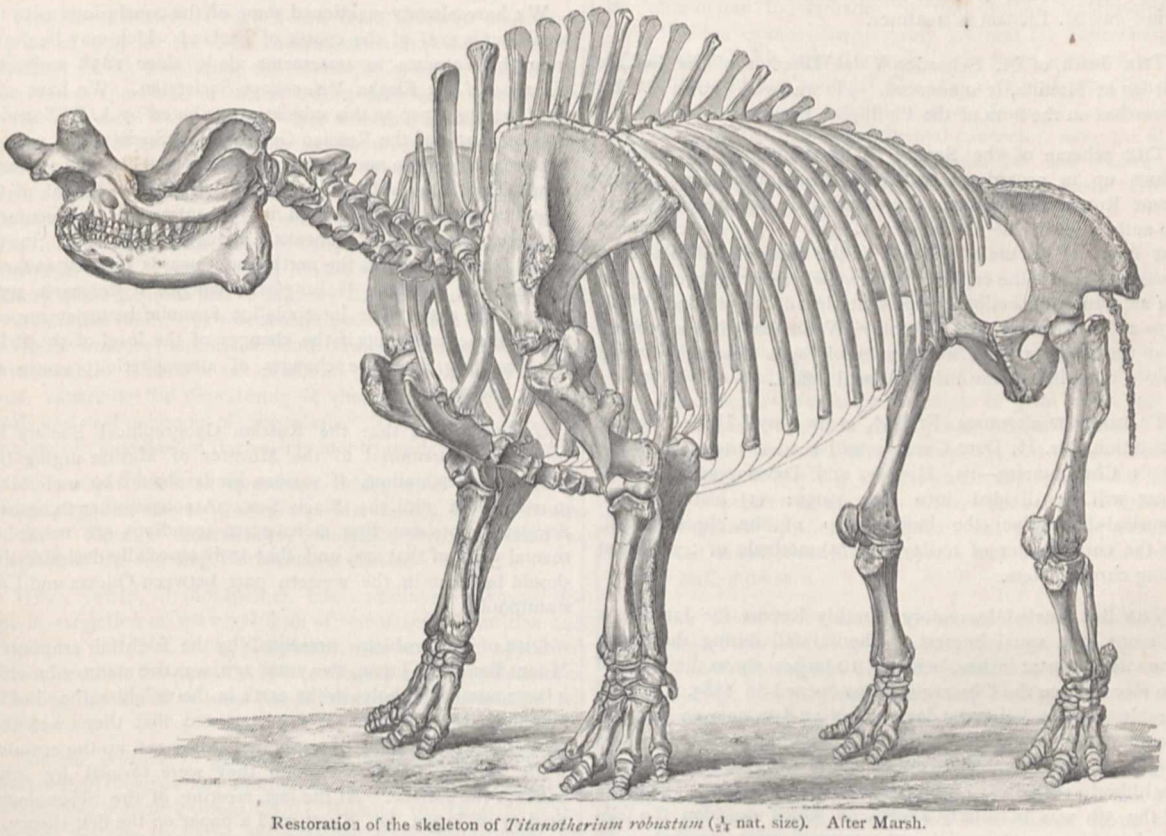
TO those English zoologists who have not had the good fortune to visit the palæontological museums of the United States the huge Miocene mammals forming the family *Titanotheriidæ* have been hitherto known only by description and small-sized figures of the skull and skeleton, which, however excellent they may be, afford but a very inadequate idea of the proportions of these most remarkable Perissodactyle Ungulates. Recently, however, Prof. O. C. Marsh, of New Haven, to whose generosity our National Museum is already much indebted, has presented that institution with a beautifully executed model of the skull of one of these mighty brutes, which is now exhibited in the front palæontological gallery, below the head of the skeleton of the Kentucky mastodon. By singular good fortune the Keeper of the Geological Department of the Museum has been enabled at the same time to purchase associated examples of the teeth of another member of the family, which are placed alongside of the cast, and thus enable us to see the actual state of preservation in which the remains of these creatures are found.

The *Titanotheriidæ* were first made known to science from the evidence of specimens of the dentition described years ago by the French naturalist Pomel, by whom the name *Menodus* was proposed for their owner. Unluckily, however, this name was preoccupied by the earlier *Menodon*; and we are therefore compelled to adopt for the type member of the family the name *Titanotherium*, which is the first of the numerous terms proposed by American writers. The species of which the skull has been presented to the Museum is made by Prof. Marsh the type of a distinct genus under the name of *Brontops*. The chief distinction of this form from the type of *Brontotherium*, which seems inseparable from *Titanotherium*, appears to be the reduced number of incisors, but if writers like the Director of the Museum are right in regarding such variations in the allied group of the

Rhinoceroses as of not more than specific importance, this species should be included in the type genus.

These Titanotherioids appear to have been most nearly allied to the Rhinoceroses among existing forms, as is at once apparent from the contour of the skull. According to Prof. Marsh they were larger than the Dinocerata of the Eocene, and nearly equalled in size the existing elephants. The skull differs from those of the rhinoceroses, however, in that instead of having one or two horns placed in the middle line of the nasal region and having no sort of bony connection with the skull itself, it has two large processes of solid bone in a transverse line immediately over the nose, which were probably invested with a horny sheath.

The molar teeth are, moreover, unlike those of the rhinoceroses, having excessively low crowns, and an arrangement of the tubercles and ridges very similar to that obtaining in the Tertiary genera *Limnohyus* and *Chalicotherium*; the first of which is certainly, and the latter probably, a Perissodactyle, although the recent dis-



Restoration of the skeleton of *Titanotherium robustum* ($\frac{1}{24}$ nat. size). After Marsh.

covery that the peculiar claws upon the evidence of which the supposed Edentate genus *Macrotherium* was founded are referable to it, render it a most aberrant type.

The skeleton to which the original of the cast presented to the Museum pertains was found in 1874 by the donor in those beds of the Dakota Miocene known as the Brontotherium beds, and it appears to be the best preserved example yet known. A restoration is given in the accompanying woodcut. According to Prof. Marsh these deposits are several hundred feet in thickness, and may be separated into horizons, characterized by peculiar species of *Titanotheriidæ*. The remains of several hundred individuals of this exclusively American group have already been secured by the palæontologists of New Haven, and their English *confrères* look forward to the publication of the sumptuous monograph in which Prof. Marsh promises to illustrate these specimens with much interest.

NOTES.

THERE is some talk of a Committee of the Royal Society being appointed to investigate the subject of colour-blindness, and the proper methods of testing the colour-vision of *employés* on railways.

WE may remind our readers that all applications for assignments from the Government Grant must be sent to the Assistant Secretary of the Royal Society on or before the last day of February. Applications received after that date will not be considered by the Committee of this year.

AN influential Committee has been formed for the purpose of securing that the scientific and other friends of the late Dr. McNab, Professor of Botany in the Royal College of Science, Dublin, shall have an opportunity of expressing their appreciation of his work and their respect for his memory. Through no fault of his own, Prof. McNab was unable to make adequate provision for his wife and five children; and it is proposed that the memorial shall consist of a fund, sufficiently large to be of real service to his family. A good many subscriptions have already been received or promised, and we hope that many more may be forthcoming. Mr. Greenwood Pim, Easton Lodge, Monkstown, Co. Dublin, acts as hon. secretary; Prof. W. N. Hartley, F.R.S., Royal College of Science, Dublin, as hon. treasurer. As Prof. Hartley has been obliged to leave Dublin for some time, all communications should be addressed, and cheques made payable, to the hon. secretary.

WE have already (p. 207) called attention to the fact that a committee has been formed in Paris for the purpose of making arrangements for the erection of a statue of the late M. Boussingault. His work marked an era in the history of the agricultural sciences, and we have no doubt there will be a prompt and liberal response to the committee's appeal for subscriptions. M. Pasteur is the honorary president of the committee. The acting president is M. Schlœsing, and the following are the vice-presidents: MM. Berthelot, Duchartre, Laussedat, Peligot, Risler, and Tisserand. MM. Müntz and Sagnier are the secretaries, and M. Liébaut is treasurer.

THE death of M. Sébastien Vidal, Director of the Botanic Garden at Manilla, is announced. He was well known for his researches on the flora of the Philippine Islands.

THE scheme of the Senate of the University of London, drawn up in accordance with the recommendations of the recent Royal Commission, does not at all commend itself to the authorities of the provincial Colleges. They are convinced that it would be most injurious to the interests of places of education outside the capital. This view was strongly expressed last autumn at a meeting of representatives of the provincial Colleges at Birmingham, and yesterday (Wednesday) it was pressed upon the attention of Lord Cranbrook by a deputation which waited upon him at the Privy Council Office.

TO-MORROW afternoon (Friday), at the Royal United Service Institution, Mr. H. Dent Gardner will read a paper on "The Ship's Chronometer—its History and Development." The paper will be divided into four parts: (1) historical, (2) historical-descriptive (the building up of the chronometer), (3) the chronometer of to-day, and (4) methods of testing and rating chronometers.

THE Ben Nevis Observatory Monthly Report for January is of more than usual interest. The rainfall during the month amounted to 29·42 inches, being 15·10 inches above the mean of the month since the Observatory was opened in 1883. A measurable quantity fell every day, and on 11 days over an inch was recorded each day, while on the 14th, 3·88 inches fell. The total bright sunshine amounted to only 4 hours, being the smallest number hitherto recorded. Lightning occurred on 5 days. The storm of the 5th was peculiarly severe, on which occasion the telegraph cable was damaged and communication stopped. St. Elmo's Fire was seen on the 21st and 25th, under the same relations to the cyclones then passing over North-Western Europe as described recently in NATURE.

WE have received from Mr. C. L. Wragge, Government Meteorologist of Queensland, his first Annual Report of the Meteorological Branch of the Post and Telegraph Department for the year 1887. It is divided into three sections. Section 1 gives an account of the organization, inspections, &c., containing a list of the recommendations originally made by Mr. Wragge, and a general statement as to how far each of them has been carried out. This synopsis shows that, while he has accomplished much during the year 1887, more still remains to be done. Section 2 contains abstracts of reports for each month from the rainfall stations, with climatological and other tables from the stations which are supplied with instruments. These abstracts contain very interesting data upon the state of the country, and will become more valuable in proportion as the number of verified instruments to be supplied year by year increases. As Mr. Wragge himself points out, any conclusions from so short a series of observations would be premature. Section 3 contains a graphic record of the chief meteorological elements for Brisbane, with seasonal wind charts and cloud charts for Queensland, and specimen wind charts for Australasia. These form the most interesting portion of the Report, and give promise of valuable materials for scientific study. In Western Australia, however, the weather charts show that there are vast tracts of country with apparently no meteorological stations.

THE last issue of the *Memoirs* of the Tashkent Observatory (Part 3) contains a most valuable magnetical map of part of Central Asia, based on the recent measurements of MM. Sharnhorst and Schwarz.

WE have already mentioned some of the conclusions as to the secular upheaval of the coasts of Finland which may be drawn from the accurate measurements made since 1858 under the direction of the Finska Vetenskaps-Societeten. We have now an elaborate paper on this subject, contributed by A. R. Bonsdorf to the *Izvestia* of the Russian Geographical Society (vol. xxv. 5). It appears from the mathematical analysis to which the measurements have been submitted that the average upheaval of the coasts of South-West Finland is 55 centimetres per century; and that the rate of upheaval increases from Ut-ö (in the Åland Islands) towards the north, and towards the east as far as Porkala (not far from Helsingfors), whence it decreases again towards the east. The interpolation formulæ better correspond to actual measurements if the changes of the level of the Baltic Sea resulting from the changes of atmospheric pressure are taken into account.

Globus reports that the Russian Geographical Society has presented a memorial to the Minister of Marine urging that scientific investigations of various kinds should be undertaken in connection with the Black Sea. Amongst other things, the Society points out that more exact soundings are needed in several parts of that sea, and that it is especially desirable they should be taken in the western part between Odessa and Constantinople.

ONE of the problems presented by the frightful eruption of Mount Bandai in Japan, two years ago, was the manner in which a large number of holes in the earth in the neighbourhood of the mountain were formed. It was suggested that they owed their existence to the falling of rocks and stones cast up the eruption, while another theory was that they were formed by forces beneath the surface. At the last meeting of the Seismological Society of Japan, Dr. Knott read a paper on the first theory, in which he demonstrated that it was quite insufficient to account for the phenomena. Prof. Milne, it may be added, has expressed the same view from the beginning.

LAST Friday a valuable paper on "The Utility of Forests and the Study of Forestry" was read before the Indian Section of the Society of Arts by Dr. W. Schlich, Professor of Forestry at the Royal College of Engineering, Cooper's Hill. In the course of his remarks Dr. Schlich gave an account of the instruction in forestry at Cooper's Hill, and mentioned that the authorities were thinking of appointing a second professor of the subject, and thus doubling the amount of instruction now given. After the reading of the paper Major-General Michael, C.S.I., who presided, made some interesting observations. No one, he said, who had visited the great forest regions of Germany, Austria, and France could fail to be impressed with the visible effects of good management, and to wish they were more generally apparent in England and Scotland. There were signs that the education and practical training of foresters were being more thought of at the present time in England, and he ventured to predict that Dr. Schlich would shortly have a good many students under him who were destined for home employment and not for India only. Personally he knew more about the value of forestry and the life of a forester in India, having spent seven or eight of the happiest and perhaps the most useful years of

his youth as a forest officer. That was more than 40 years ago, before the time arrived for experts like Dr. Schlich and his distinguished predecessor Sir Dietrich Brandis to come to the country. He could therefore tell any of Dr. Schlich's students who might be present that the life of a forester in India was not only a career of importance, but that it was one full of interest and of real enjoyment. The formation of the department in which they would serve had justly been characterized by Sir Richard Temple as one of the greatest achievements effected in India during the Queen's reign.

THE Royal Society of New South Wales offers its medal and a prize of £25 for the best commnication (provided it be of sufficient merit) containing the results of original research or observation upon each of the following subjects:—(To be sent in not later than May 1, 1890)—The influence of the Australian climate (general and local) in the development and modification of disease; on the silver ore deposits of New South Wales; on the occurrence of precious stones in New South Wales, with a description of the deposits in which they are found. (To be sent in not later than May 1, 1891)—The meteorology of Australia, New Zealand, and Tasmania; anatomy and life history of the Echidna and Platypus; the microscopic structure of Australian rocks. (To be sent in not later than May 1, 1892) —On the iron ore deposits of South Wales; on the effect which settlement in Australia has produced upon indigenous vegetation, especially the depasturing of sheep and cattle; on the coals and coal measures of Australasia. The competition is not confined to members of the Society, nor to residents in Australia.

M. LIGNIER has been appointed Professor of Botany to the Faculty of Sciences at Caen; and Mr. G. C. Druce, author of the "Flora of Oxfordshire," succeeds Dr. Schönland as Curator of the Fielding Herbarium at Oxford.

HERR JADIN, of Montpellier, has undertaken a voyage for the investigation of the algal flora of the islands Mauritius and Réunion; and Prof. P. L. Menyhardt, who has been appointed to a mission on the Zambesi, is intending to make a collection of plants in the region between the Zambesi and the sources of the Congo.

FOR the purpose of growing plants under more natural conditions than those usually afforded by the soil and surroundings of ordinary botanic gardens, M. G. Bonnier, the Director of the Botanic Garden in Paris, has obtained from the Director for Higher Education in Paris the grant of a piece of land in the Forest of Fontainebleau, as an annexe for experimental culture. It has been placed under the special charge of M. Cl. Duval.

AT the meeting of the Royal Botanic Society on Saturday a sweet-scented fern, from the Society's garden, was exhibited. The perfume, which closely resembles that of fresh hay, is retained after the frond is dry, and lasts for many months, if not years, imparting its fragrance to anything in contact with it. The secretary thought it might be grown as a source of perfume by amateurs, if not commercially. As yet it appeared to be little known in collections of exotic ferns. Some fine blooms of scarlet anemone, gathered from plants growing in the open air in Rutland, were shown by Mr. T. H. Burroughes.

IT is a good sign that the present building of the Bethnal Green Free Library has become quite inadequate for the needs of the institution, and that much larger premises are, if possible, to be erected. The sum of £20,000 is required, and many donations have already been received or promised. We may note that a largely attended meeting at the Bethnal Green Free Library lately started as tudents' union, for the study of various branches of science and art, in connection with the evening classes.

IN his "History of Barbados," published in 1848, Sir Richard Schomburgk says of the Barbados monkey that it was found in large numbers by the first settlers. From the appearance of a living specimen he considered it "to be *Cebus capucinus*, Geoff., the Sai or Weeper, or a very closely allied species." In the current number of the *Zoologist* Col. H. W. Feilden presents a wholly different view. He asserts that the Barbados monkey is an Old World form, the Green Monkey, *Cercopithecus callitrichus*, Is. Geoffr., and that its original habitat is West Africa. "This," he says, "undoubtedly proves its introduction to Barbados by the Guinea trading-ships." Col. Feilden cannot discover any warrant for Schomburgk's statement that this animal was found in large numbers by the first settlers on their arrival. The subject is interesting because of its bearing on the general view set forth by Col. Feilden, that Barbados has had no continental connection since the introduction of its present flora and fauna, but has received its terrestrial animals and plants from the effects of ocean currents, winds, accidental occurrences, or by the agency of man.

THE Council of the Ceylon Asiatic Society, in its last Report, urges on the Government the importance of systematically collecting, transcribing, and publishing the manuscripts of the ancient literature of the island which are scattered about in the libraries of temples, as well as in private houses. The researches which have already been made by individuals, or on behalf of the Government, show that manuscripts of great value may be found. During the last three years, private exertions have secured 69 of these; but what is needed is that the work should be undertaken as carefully and systematically as in India, where the duty of preserving the ancient literature of the country has been recognized by the Government, and where the collection of ancient manuscripts has for years past been conducted by a large staff of officers.

SUGAR seems to be losing its attractions for Lepidoptera. Mr. Joseph Anderson writes to the *Entomologist* from Chichester that his experience agrees with all that has been written on this subject lately. In the trees surrounding his house, and in those of his neighbour's garden, he has good sugaring grounds, and in former years they brought him a satisfactory return for the trouble expended on them, his captures numbering about fifty different species. "Now," he says, "for three or four years past, night after night, sugaring has been almost of no avail. Can it be a case of inherited instinct? And are the rising generation of moths getting too wise to be trapped by the sugaring baits?"

WITH the aid of an apparatus called a *periscope*, the submarine boat *Gymnote* was lately, it will be remembered, piloted safely in Toulon harbour. This enables the officer directing the movements to have a wide view around; and it consists of a vertical telescopic arrangement, with a lenticular total reflection prism at the top held between the tube and a cover above. After reflection in the prism, the rays converge at a certain point, and are received by a lens, the principal focus of which coincides with this point; thus a vertical cylindrical beam is formed, which meeting a mirror below, inclined at 45°, is directed horizontally to the eye-piece. A diaphragm, having a small radiating tongue, and moved by a tangent screw, enables one to intercept the view of the vertical plane in which the sun is, the tongue being brought to coincide with the plane. The system is said to work admirably.

EXPERIMENTING lately on the sense of smell, Dr. Zwardemaaker, of Utrecht, devised an olfactometer, which consists simply of a glass tube with upward curving part to be inserted in the nostril. A short movable cylinder made of some odoriferous substance fits over the outer straight end of the tube.

On inhaling, one perceives no odour so long as this cylinder does not project beyond the inner tube; but the further it is pushed out, the larger is the scented surface presented to the entering air, and the stronger the odour perceived. The author studies mixture of odours by applying a cylinder saturated with a scented body to the end of the olfactometer, and varying the length of the two odoriferous substances. But he considers a double olfactometer better (one tube for each nostril). With this, one may easily experience how one odour will overwhelm another; rubber, *e.g.*, causing the smells of paraffin, wax, and tolu to disappear. Even with very strong excitants, there is never a mingling of sensations. Either the one or the other odour is perceived, till by careful equilibration of the two, no sensory effect at all is perceived. Sensibility is quite eliminated.

THE Verein für Erdkunde, of Halle, is arranging for a hydrographical and zoological investigation of the Lake of Ploen, in Holstein.

VIENNA and Berlin will shortly be connected by telephone.

A PRETTY and convenient celluloid paper knife is being sent by Messrs. Woodhouse and Rawson United, Limited, to their clients. No one who uses it can doubt that celluloid may for some purposes be a very good substitute for ivory.

MESSRS. WILLIAM WESLEY AND SON have issued No. 99 of their "Natural History and Scientific Book Circular." It consists of a list of works in astronomy, mathematics, and physics.

A PAPER upon phosphorus trifluoride is contributed by M. Moissan to the February number of the *Annales de Chimie et de Physique*. In a previous communication it was shown that this interesting gas could be obtained either by heating a mixture of lead fluoride and copper phosphide, or by the action of arsenic trifluoride upon phosphorus trichloride. Since that time it has been found that a regular and more rapid evolution of phosphorus trifluoride occurs when a mixture of zinc fluoride and phosphorus tribromide is gently warmed, and this appears to be by far the most convenient way of obtaining the gas in quantity. Zinc fluoride reacts much more rapidly than lead fluoride, and is best prepared by the action of pure hydrofluoric acid upon zinc carbonate. The insoluble fluoride thus obtained is washed with distilled water and dried at 200° C. It is important not to raise the temperature beyond this point, as further heating renders it much less easily attacked by phosphorus tribromide. The dry zinc fluoride is then placed in a brass tube closed at one end and fitted at the other with a double bored ordinary cork, well paraffined, and through which pass two tubes, one a delivery tube of lead, and the other a kind of dropping funnel, from which the tribromide of phosphorus is allowed to slowly fall upon the gently warmed fluoride of zinc. As soon as the temperature of the latter has begun to rise, the action becomes very energetic, and in a few moments several litres of the gas may be collected. In order to free the phosphorus trifluoride from admixed vapour of phosphorus tribromide, it is quite sufficient to allow it to bubble through a little water contained in a small wash bottle, after which it may be dried by passing through tubes containing pumice, which has been boiled in strong oil of vitriol, and heated until only the minimum quantity of sulphuric acid remains adhering to it, inasmuch as the strong acid absorbs a notable quantity of phosphorus trifluoride. The gas is finally collected over mercury. The reaction occurring during the preparation is stated to be as follows:—

$$3ZnF_2 + 2PBr_3 = 2PF_3 + 3ZnBr_2.$$

Gaseous trifluoride of phosphorus as thus prepared possesses a very sharp odour, but does not fume in the air. It is very slowly absorbed by water, but is decomposed immediately by solutions of chromic acid or potassium permanganate. As the above reaction appears to yield the gas in a very pure state, M. Moissan has made determinations of its density, and finds it to be 3·03. The calculated density of PF_3 is 3·08. When a measured quantity of the gas is heated over mercury in a closed glass vessel, it is totally decomposed by the silica of the glass, and the volume diminishes by one-fourth, four molecules of PF_3 becoming converted into three molecules of gaseous silicon tetrafluoride, SiF_4.

THE additions to the Zoological Society's Gardens during the past week include a Ring-tailed Lemur (*Lemur catta*) from Madagascar, presented by the executors of Dr. Allen; a Vulpine Phalanger (*Phalangista vulpina* ♀) from Australia, presented by Mr. W. H. Seward; a Hamster (*Cricetus frumentarius*) from Russia, presented by Mr. Harold Hanauer, F.Z.S.; an Alligator (*Alligator mississippiensis*) from Florida, presented by Mr. A. B. Archer; a Hoffmann's Sloth (*Cholopus hoffmanni*) from Panama, deposited.

OUR ASTRONOMICAL COLUMN.

OBJECTS FOR THE SPECTROSCOPE.

Sidereal Time at Greenwich at 10 p.m. on February 3 = 7h. 35m. 32s.

Name.	Mag.	Colour.	R A. 1890.	Decl. 1890.
			h. m. s.	° ′
(1) G.C. 1546	—	—	7 29 42	+35 28
(2) DM. + 14° 1729...	6	Yellowish-red.	7 35 51	+14 28
(3) β Geminorum ...	2	Yellowish-white.	7 38 36	+28 18
(4) α Canis Minoris ...	1	Bluish-white.	7 33 30	+ 5 31
(5) 89 Schj.	7	Yellowish-red.	7 2 55	- 11 47
(6) S Hydræ	Var.	Reddish-yellow.	8 47 50	+ 3 29

Remarks.

(1) The General Catalogue description of this nebula is as follows:—"Pretty bright; considerably small; round; very gradually a very little brighter in the middle; mottled as if with stars; almost planetary." The spectrum of the nebula has not yet been recorded.

(2) Dunér describes the spectrum of this star as a very fine example of the Group II. type. He states that all the bands 2–8 are wide and dark, especially 2 and 3, and that the whole spectrum is well developed. No mention is made of the presence or absence of absorption lines, but there is little doubt that some will be found if looked for, the predominance of the bands 2 and 3 probably indicating that the star belongs to a later species, and is therefore approaching Group III., in which line absorption is predominant. Observations of the green and blue carbon flutings are also suggested (see p. 305).

(3) This star has hitherto been described as having a spectrum of the solar type. The usual observations, as to whether the temperature of the star is increasing (Group III.) or decreasing (Group VI.) are required.

(4) Gothard classes Procyon with stars of Group IV., but the Henry Draper Memorial photograph of the spectrum seems to indicate that it would be more properly described as an early stage of Group V., differing from the solar spectrum in having the hydrogen lines more developed and the metallic lines slightly thinner. Further observations of the visible spectrum are suggested.

(5) According to Dunér the spectrum of this star belongs to Group VI., and shows the usual three absorption bands of carbon. Band 6, which appears to be the most variable, is stated in this case to be very dark, and the question is, Are there any other variations in the spectrum accompanying the condition in which band 6 is dark? It seems probable that the number and intensities of the secondary bands will be found to vary with band 6, and these should, therefore, receive special attention.

(6) This variable has a spectrum of the Group II. type, but Dunér does not give a complete description, as he probably did

not observe it at maximum. A further examination is therefore required. Bright lines should also be carefully looked for, in order to determine whether the appearance of bright lines at the maxima of stars of Group II. is general. The period is given by Gore as 256 days, and the range as from 7·5–8·5 at maximum to < 12·2 at minimum. The maximum will occur on February 24. A. FOWLER.

SPECTRUM OF THE ZODIACAL LIGHT.—In this month's *Observatory*, Mr. Maxwell Hall gives the results of a series of observations of the zodiacal light made at Jamaica. The observations are divided into three groups, according to the angular distance from the sun of the part of the zodiacal light observed. With respect to the first group, made at a distance of 50° from the sun, it is noted that the spectrum was seen as a faint white continuous band, commencing suddenly at λ 561, and extending as far as G, where it died out very gradually. The limit was well determined by comparison with the carbon flutings at λλ 470, 517, and 564. The result of the second group of observations, made at a distance of 22° from the sun, showed that the spectrum commenced at λ 561, but not so suddenly; its feeble maximum was transferred to about λ 517; from thence it was tolerably uniform to about λ 497, and then it gradually diminished and faded away at G.

The observations made at a distance of 15° from the sun gave λ 562 for the limit of the red end of the spectrum, and G as before for the violet end. But the spectrum did not commence at all suddenly: the stronger maximum was still at λ 517: it was fairly uniform from thence to λ 497, and then faded away.

Observations of twilight are needed to determine whether, as it grows more and more faint, the maximum appears to shift towards the red end of the spectrum or not; if not, the change in intensity of portions of the spectrum of the zodiacal light as observations are made at varying distances from the sun are peculiar to it, and need further investigation.

SOLAR AND STELLAR MOTIONS.—Prof. J. R. Eastman, in his address as retiring President of the Philosophical Society of Washington, delivered December 7, 1889, gave an exhaustive account of the investigations that have been made to determine the co-ordinates of the solar apex and the annual value of the motion of the solar system. His investigations into the relation between stellar magnitudes, distances, and motions, show that, in opposition to the assumption generally accepted, which asserts that the largest stars are nearest the solar system, there is an almost uniformly *increasing* proper motion as the stars grow fainter. Forty-six stars, that is, practically all those whose parallaxes have been well determined, have been tabulated and arranged in five nearly equal groups according to the magnitude of their proper motion. The following table gives the mean results found for each of the groups:—

	Number of Stars in Group.	Mean Magnitude.	Mean Proper Motion.	Mean Parallax.
			″	″
1st Group ...	9 ...	5·57 ...	4·93 ...	0·32
2nd ,, ...	9 ...	5·59 ...	2·33 ...	0·20
3rd ,, ...	9 ...	3·37 ...	1·04 ...	0·20
4th ,, ...	9 ...	2·36 ...	0·38 ...	0·16
5th ,, ...	10 ...	2·84 ...	0·06 ...	0·13

The mean magnitude of the first two groups is 5·58, and the mean proper motion is 3″·63. Of the last three groups the mean magnitude is 2·86, and the mean proper motion is 0″·49.

If the 46 stars investigated be arranged according to the magnitude of their parallaxes, it is found that 18 of them have a parallax greater than 0″·2. The mean magnitude of these stars is 5·56, and the mean parallax is 0″·34. Of the remaining 28 stars the mean magnitude is 2·89, and the mean parallax is 0″·11. From this it would appear that, if any law can be formulated from the observed data, it must be that the fainter rather than the brighter stars are nearest the solar system.

DUN ECHT OBSERVATORY.—The Earl of Crawford, in a circular issued on the 29th ult., expresses his thanks for the hearty co-operation he has met with at all hands in his endeavours to advance the science of astronomy. Although some little time will elapse before all the instruments can be removed from Dun Echt to the Royal Observatory at Edinburgh, the former observatory must be looked upon as closed, and the generous donor trusts that the astronomical friends who have for years continued to enrich the library at Dun Echt Observatory with donations of books and pamphlets will extend their liberality to the new home of the collection at Edinburgh. The important astronomical work done by the Earl of Crawford personally, and at his observatory, has contributed, in no slight degree, to the progress of astronomy, and the very generous gift to the nation of the entire contents of the observatory at Dun Echt is worthy of the man, and appreciated by all friends of the science throughout the world.

MELBOURNE OBSERVATORY.—We have received from Mr. Ellery the volume containing the results of transit circle observations made from the beginning of 1881 to the end of August 1884. The separate results for R.A. and N.P.D. have been taken directly from the transit books, and also the observer's estimates of the magnitude. The places and magnitudes of the stars given in the annual catalogues have been derived from these separate results by taking their arithmetical mean.

GEOGRAPHICAL NOTES.

AT the meeting of the Royal Geographical Society on Monday, Mr. Douglas W. Freshfield read a most interesting paper on "Search and Travel in the Caucasus: an account of the discovery of the fate of the party lost in 1888." He began by acknowledging his obligations to M. de Stael, the Russian Ambassador to the Court of St. James's, the officials at Vladikavkaz, and more particularly to MM. Jukoff and Bogdanoff, of the Russian Survey, for the facilities and assistance given to him and his companions in carrying out the object of his journey. The topographical information accumulated by the surveyors had been placed at his disposal with the greatest readiness, and part of the result might be seen in the great map (6 inches to the mile) of the central group hung on the wall. The heights of the principal peaks were now ascertained. There were eight higher than Mont Blanc, and fifteen of over 15,000 feet. The four highest are Elbruz, Koshtantau, Shkara, and Dychtau. Ushba is 15,600 feet. Mr. Freshfield briefly described the new carriage pass, the Mamison, 9400 feet, from Vladikavkaz to Kutais. Its scenery is finer than that of the Dariel, and the road has been well engineered, but it will shortly fall into ruin unless a service is organized for its maintenance. He referred to the remarkable old Ossete sanctuary of Rekom, at the foot of the Ceja Glacier, and to the tombs found at Chegem, and exhibited a collection of metal and other objects discovered mostly at Styr Degir. In many villages small settlements of "Mountain Jews" were found. There were over 20,000 of this race in the Caucasus, and a work on them has lately been published at Moscow. The author, M. Mirimisoff, states that their beliefs and superstitions are singular, and show Persian influence, but they have had for centuries no connection with the rest of their race, from which they were probably separated at a very early date. The party had crossed five high glacier passes before reaching Suanetia. Here Mr. Freshfield and Captain Powell were the guests of Prince Atar Dadish Kilia, the representative of the family who once ruled Lower Suanetia. He now spends a few months in the summer at his house at Ereri, dispensing hospitality in feudal fashion among his retainers. The population assembles every Sunday for games on the green, and the women sing ballads recounting incidents in local history or tales of love and revenge. The Leila peaks (13,400 feet) south of Suanetia were ascended for the first time. They are pre-eminent in forests and flowers. One of the glaciers falls over a cliff in avalanches into a glen which is a bed of wild roses and yellow lilies, growing often with fourteen blooms on one stalk. From Suanetia to Sukhum Kaleh the travellers forced a way with mules through an almost trackless forest, and down the deserted valley of the Kodor, the region that was once Abchasia. Strange tales are told of the forest, even by Russian officials, who declared that a wild race, without villages, arms, or clothes, haunted its recesses. No one was met, however, but a few hunters and shepherds. But considerable difficulty was met with in forcing a way through the tangle of fallen timber and finding a passage over the torrents, and the native guides employed deserted the travellers before they reached Lata, the first Russian station on the Kodor. Mr. Freshfield proceeded to relate in detail the incidents of the search undertaken by Mr. C. Dent and himself, with the aid of Mr. H. Woolley and Captain Powell, for traces of the fate of the mountaineers, Mr. W. F. Donkin, Mr. H. Fox, and two Meiringen guides, lost in August 1888. It was known, from a note in a diary left by Mr. Fox in a lower

camp with his heavy luggage, that the lost party had set out from the Dumala Valley in the Bezingi District, with the hope of climbing Dychtau, 16,880 feet, from the south-east. Karaoul, at the head of the Cherek Valley, was made, therefore, the head-quarters of the search party. They bivouacked under a rock beside the Tutuin Glacier, at a height of 9400 feet. Next morning (July 29) they started at dawn, and forced, not without difficulty, a passage through the monstrous *séracs* of the Tutuin Glacier. Above them they found a long snowy corridor leading to the base of Dychtau, and to the foot of a gap in its east spur, which they believed Mr. Donkin and his companions had crossed from the Dumala glen on the further side. Nothing was found at the foot of the steep rock wall, 1400 feet high, which protected the pass. The searchers therefore climbed the rocks leading to it, and when 1000 feet above the snow and some 400 below the ridge, the traces sought were met with. The leader at the rope's end suddenly stopped short and gasped, "See, here is the sleeping-place." Before our eyes rose a low wall of loose stones built in a semicircle convex to the lower precipice. A crag partially overhung it; any object dropped over the wall fell 1000 feet on to the snow plain below. The space, some 6 feet square, inside the wall, was filled with uneven snow or ice, from which portions of knapsacks and sleeping bags protruded. A black stew-pan, half full of water, in which a metal cup floated, lay against the rock; a loaded revolver was hung beside it. It cost more than three hours' hard work to dig out all the objects from the frozen stuff in which they were embedded. Only three could work at once in the narrow space, and Mr. Freshfield and Mr. Woolley went on to the ridge, where they found a small stoneman, but no written record. Some manuscript notes and maps of Mr. Fox's were found in the bivouac, but nothing written after leaving the lower camp. The whole of the cliff and cliff's foot were carefully searched with a strong telescope. Mr. Woolley and his guides twice passed along the cliff's foot on his ascent of Dychtau, and he made certain that the party had not climbed the peak—that the accident therefore had happened on the ascent. After the lecture, Mr. Freshfield showed in the lantern a series of views of the Caucasus, from photographs by Mr. Hermann Woolley and Signor V. Sella. A complete set of Signor Sella's views, embracing eight panoramas and 90 views, was shown in an adjoining room. The panorama from Elbruz shows the whole chain of the Caucasus above a sea of clouds, and is probably the finest mountain photograph yet exhibited.

THE last issue of the *Izvestia* of the Russian Geographical Society is more than usually interesting, as it contains detailed letters received from the members of the three Russian expeditions now engaged in the exploration of Central Asia. The letter of M. Roborovsky, dated August 16, and written in the highlands to the south of Yarkend, contains a most vivid description of the journey from the town Prjevalsk to Yarkend, across the passes of Barskaun and Bedel. M. Roborovsky knows Central Asia well, as he was Prjevalsky's travelling companion during three of his great journeys; and his descriptions of the country—its orography, climate, and flora—are full of most valuable information. Another letter is from M. Bogdanovitch, the geologist of the expedition, who joined it at Yarkend, after having crossed the Kashgarian Mountains on another route and explored the Mustagh-ata glaciers. That part of the Pamir border-ridge had already been explored by Stoliczka, but M. Bogdanovitch adds much new information. It appears—as might have been expected from the orography of the region—that there is no trace of mountains running north and south on the eastern edge of the great Pamir plateau. The Kashgar Mountains are an upheaval of gneisses, metamorphic slates, and Tertiary deposits, running from north-west to south-east. The limestones which Stoliczka supposed to be Triassic, proved to be Devonian. The most characteristic fossils of the Upper Devonian (*Atrypa reticularis*, *A. latilinguis*, *A. aspera*, *Spirifer Verneuli*, and several others) were found together with the corals (*Lithodendron*), Stromatoporæ and *Cerioporæ* described by Stoliczka. The Tertiary sandstones are broken through (as is often the case in Siberia) by dolerites of volcanic origin, at the very border of the plateau, on its slope turned towards Kashgaria. Another series of letters, the last of which is dated September 23, from the sources of the Aksu, is from Colonel Grombchevsky. The late spring delayed the advance of the expedition, which spent the first part of June in crossing the Alai Mountains. The great Alai Valley of the Pamir could be reached only on June 19, but the Trans-Alai Mountains were buried in snow; no passage was possible, and the explorer was compelled to march to the lower tracts of Karategin. He thence proceeded to Kala-i-khum, a little town situated on the Pendj, at a height of 4500 feet, and enjoying a relatively mild climate. From Kala-i-khum M. Grombchevsky succeeded in reaching the Vantcha river; but having met there the Afghan troops which were taking possession of the khanates of Shugnan and Rothan, he could not move further south, nor explore the western parts of the Pamir; so he proposed to continue the exploration of the eastern parts of the Roof of the World. Finally, the two brothers, Grum-Grzimailo, who are exploring the Eastern Tian-Shan from Kuldja to Urumtsi, give short news of their progress, and remark that our maps of Eastern Tian-Shan are quite incorrect—a circumstance which might have been guessed from the general orographical structure of Central Asia. The collections of vertebrates and insects which have been gathered by the two explorers are exceedingly rich.

A PERMANENT Marocco museum is to be established at the head-quarters of the Society of Commercial Geography at Berlin.

SMOKELESS EXPLOSIVES.[1]

II.

SO far as smokelessness is concerned, no material can surpass *gun cotton* pure and simple; but, even if its rate of combustion in a firearm could be controlled with certainty and uniformity, although only used in very small charges, such as are required for military rifles, its application as a safe and reliable propulsive agent for military and naval use is attended by so many difficulties, that the non-success of the numerous attempts, made in the first twenty-five years of its existence, to apply it in this direction, is not surprising.

Soon after its discovery by Schönbein and Böttger in 1846, endeavours were made to apply gun-cotton wool, rammed into cases, as a charge for small arms, but with disastrous results. Subsequently von Lenk, who made the first practical approach to the regulation of the explosive power of gun-cotton, produced small-arm cartridges by superposing layers of gun-cotton threads, these being closely plaited round a core of wood. Von Lenk's system of regulating the rapidity of burning of gun-cotton, so as to suit it either for gradual or violent action, consists, in fact, in converting coarse or fine, loosely or tightly twisted, threads or rovings of finely carded cotton into the most explosive form of gun-cotton, and of arranging these threads or yarns in different ways so as to modify the mechanical condition, *i.e.* the compactness and extent and distribution of enclosed air-spaces, of the mass of gun-cotton composed of them. Thus, small-arm cartridges were composed, as already stated, of compact layers of tightly-plaited, fine gun-cotton thread; cannon cartridges were made up of coarse, loose gun-cotton yarn wound very compactly upon a core; charges for shells consisted of very loose cylindrical hollow plaits (like lamp wicks), along which fire flashed almost instantaneously; and mining charges were made in the form of a very tightly twisted rope with a hollow core. While the two latter forms of gun-cotton always burned with almost instantaneous rapidity in open air, and with highly destructive effects if they were strongly confined, the tightly wound or plaited masses burned slowly in air, and would frequently exert their explosive force so gradually when confined in a firearm as to produce good ballistic results without appreciably destructive effect upon the arm. Occasionally, however, in consequence of some slight unforeseen variation in the compactness of the material, or in the amount and disposition of the air-spaces in the mass, very violent action would be produced, showing that this system of regulating the explosive force of gun-cotton was quite unreliable.

Misled by the apparently promising nature of the earliest results which von Lenk obtained, the Austrian Government embarked, in 1862, upon a somewhat extensive application of von Lenk's gun-cotton to small arms, and provided several batteries of field guns for the use of this material. The abandonment of these measures for applying a smokeless explosive to military purposes soon followed upon the attainment of unsatisfactory results, and was hastened by the occurrence of a very destructive

[1] Friday Evening Discourse delivered by Sir Frederick Abel, F.R.S., at the Royal Institution of Great Britain, on January 31, 1890. Continued from p. 330.

explosion at gun-cotton stores at Simmering, near Vienna, in 1862.

It was at about this time that the attention of the English Government, and through them of the lecturer, was directed to the subject of gun-cotton, the Austrian Government having communicated details regarding improvements in its manufacture accomplished by von Lenk, and results obtained in the extended experiments which had been carried out on its application to the various purposes above indicated, according to the system devised by that officer. One of the results of the lecturer's researches, subsequently carried on at Woolwich and Waltham Abbey, was his elaboration of the system of manufacture and employment of gun-cotton which has been in extensive use at the Government works with little if any modification for over eighteen years, and has been copied from us by France, Germany, and other countries. By reducing the partially purified gun-cotton fibre to pulp, as in the ordinary process of making paper, then completing its purification when in that condition, and afterwards converting the finely-divided explosive into highly compressed homogeneous masses of any desired form and size, very important improvements were effected in its stability, its uniformity of composition and action, and its adaptability to practical uses, a great advance being made in the exercise of control over the rapidity of combustion or explosion of the material.

No success had attended the experiments instituted in England with wound cannon cartridges of gun-cotton threads made according to von Lenk's plan; on the other hand, a number of results which at first sight appeared very promising were obtained at Woolwich in 1867–68 with bronze field-guns and cartridges built up of compressed gun-cotton masses arranged in different ways (with varied air-spaces, &c.) with the object of regulating the rapidity of explosion of the charge. But although the attainment of high velocities with comparatively small charges of the material, unaccompanied by any indications of injury to the gun, was frequent, it became evident that the fulfilment of the conditions essential to safety to the arm were exceedingly difficult to attain with certainty, and appeared indeed to be altogether beyond absolute control, even in so small a gun as the twelve-pounder. Military authorities not being, in those days, alive to the advantages which might accrue from the employment of an entirely smokeless explosive in artillery, the lecturer received no encouragement to persevere with experiments in this direction, and the same was the case with respect to the possible use of a smokeless explosive in military small arms, with which, however, far more promising results had at that time been obtained at Woolwich.

Abel's system of preparing gun-cotton was no sooner elaborated than its application to the production of smokeless cartridges for sporting purposes was achieved with considerable success by Messrs. Prentice, of Stowmarket. The first gun-cotton cartridge, which found considerable favour with sportsmen, consisted of a roll of felt-like paper composed of gun-cotton and ordinary cotton, and produced from a mixture of the pulped materials. Afterwards a cylindrical pellet of slightly compressed gun-cotton pulp was used, the rapidity of explosion of which was retarded, while it was at the same time protected from absorption of moisture, by impregnation with a small proportion of india-rubber. Neither of these cartridges afforded promise of sufficient uniformity of action to fulfil military requirements, but after a series of experiments which the lecturer made with compressed gun-cotton arranged in various ways, very promising results were attained, especially with the Martini-Henry rifle and a charge of pellet-form, the rapidity of explosion of which was regulated by simple means.

A sporting powder which was nearly smokeless had, in the meantime, been produced by Colonel Schultze, of the Prussian Artillery, from wood cut up into very small cube-like fragments, converted into a mild form of nitro-cellulose after a preliminary purifying treatment, and impregnated with a small portion of an oxidizing agent. Subsequently the manufacture of the Schultze powder was considerably modified; it was converted into the granular form, and rendered considerably more uniform in character and less hygroscopic, and it then bore considerable resemblance to the E.C. powder, a granulated nitro-cotton powder, produced, in the first instance, at Stowmarket, and consisting of a less highly nitrated cotton than gun-cotton (trinitrocellulose), incorporated in the pulped condition with a somewhat considerable proportion of the nitrates of potassium and barium, and converted into grains through the agency of a solvent and a binding material. Both of these powders produced some smoke when fired, though the amount was small in comparison with that from black powder. They did not compete with the latter in regard to accuracy of shooting, when used in arms of precision, but they are interesting as being the forerunners of a variety of so-called smokeless powders, of which gun-cotton or nitro-cotton is the basis, and of which those of Johnson and Borland, and of the Smokeless Powder Company, are the most prominent in this country.

In past years, both camphor and liquid solvents, such as acetic ether and acetone for gun-cotton, and mixtures of ether and alcohol for nitro-cotton, have been applied to the hardening of the surfaces of compressed masses or granules of those materials, by von Förster and others, with a view to render them non-porous, and in the E.C. powder manufacture the latter solvent was thus applied to harden the powder-granules. In the Johnson-Borland powder camphor is applied to the same purpose; in smokeless powders of French and German manufacture acetic ether and acetone have been used, and the solvent has been applied not merely to harden the granules or tablets of the explosive, but also to convert the latter into a homogeneous horn-like material.

Much mystery has surrounded the nature and origin of the first smokeless powder adopted, apparently with undue haste, by the French Government, for use with the Lebel magazine rifle. A few particles of the Vieille powder, or *Poudre B*, were seen by the lecturer about two years ago, and very small specimens appear to have fallen into the hands of the German Government about that time. They were in the form of small yellowish-brown tablets of about 0·07 inch to 0·1 inch square, of the thickness of stout notepaper, and had evidently been produced by cutting up thin sheets of the material. They appeared to contain, as an important ingredient, picric acid (the basis of "mélinite") a substance extensively used as a dye, and obtained by the action of nitric acid, at a low temperature, upon carbolic acid and cresylic acid, constituents of coal tar. Originally produced by the action of nitric acid upon indigo, and afterwards by similar treatment of Botany Bay gum, it was first known as carbazotic acid, and is one of the earliest of known explosives of organic origin. When sufficiently heated, or when set light to, it burns with a yellow smoky flame, and even very large quantities of it have been known to burn away somewhat fiercely, but without exploding. Under certain conditions, however, and especially if subjected to the action of a powerful detonator, it explodes with very great violence and highly destructive effects, as pointed out by Sprengel in 1873, and recent experiments at Woolwich have shown that it does this even, as in the case of gun-cotton, when it contains as much as 15 per cent. of water. It is no longer a secret that picric acid at any rate forms the basis of the much-vaunted and mysterious explosive for shells for which the French Government were said to have paid a very large sum of money, and the destructive effects of which have been described as nothing less than marvellous. M. Turpin patented, in 1875, the use of picric acid alone as an explosive for shells and for other engines of destruction, and whether or not his claims to be the inventor of mélinite are valid, there appears no doubt that his patent in France was the starting-point of the development and adoption of that explosive.

The attention thus directed in France to the properties of picric acid appears to have given rise to experiments resulting in its employment as an ingredient of the first smokeless powder (*Poudre B*) adopted for the French magazine rifle.

The idea of employing picric acid preparations as explosive agents for propulsive purposes originated with Designolle about twenty years ago, but no useful results attended the experiments with the particular mixtures proposed by him. It is certain that the recent adaptation of that substance in France was of a different character, and that, promising as were the results of the new smokeless powder, of which it formed an ingredient, and of which a counterpart was made the subject of experiments at Woolwich about three years ago, its deficiency in the all-essential quality of stability must have been at any rate one cause of its abandonment in favour of another form of smokeless powder, which there is reason to believe is of more simple character.

In Germany, the subject of smokeless powder for small arms and artillery was being steadily pursued in secret, while the sensational reports concerning *Poudre B* were spread about in France, and a small-arm powder, giving excellent results in regard to ballistic properties and uniformity, was elaborated at

the Rottweil powder-works, and appears to have been adopted into the German service for a time, but its first great promise of success seems to have failed of fulfilment through defects in stability.

Reference has already been made to the conversion of gun-cotton (trinitrocellulose), and to mixtures of it with less explosive forms of nitrated cotton (or nitrated cellulose of other description), by the action of solvents into horn-like materials. These are in the first instance obtained in the form of gelatinous masses, which, prior to the complete evaporation or removal of the solvent, can be pressed or squirted into wires, rods, or tubes, or rolled or spread into sheets; when they have become hardened, they may be cut up into tablets or into strips or pieces of size suitable for conversion into charges or cartridges. Numerous patents have been secured for the treatment of gun-cotton, nitro-cotton, or mixtures of these with other substances, by the methods indicated; but in this direction the German makers of the powder just now referred to seem to have secured priority. Experiments were made about a year and a half ago with powder produced in this way at Woolwich, and the Wetteren Powder Company in Belgium has also manufactured so-called paper powders, or horn-like preparations, of the same kind, which were brought forward as counterparts of the French small-arm and artillery smokeless powder.

Mr. Alfred Nobel, to whom the mining world is so largely indebted for the invention of dynamite, and of other very efficient blasting agents of which nitro-glycerine is the basis, was the first to apply the latter explosive agent, in conjunction with one of the lower products of nitration of cellulose, to the production of a smokeless powder. The powder bears great resemblance to one of the most interesting of known violent explosives, also invented by Mr. Nobel, and called by him blasting gelatine, in consequence of its peculiar gelatinous character. When the nitro-cotton is impregnated and allowed to digest with nitro-glycerine, it loses its fibrous nature and becomes gelatinized while assimilating the nitro-glycerine, the two substances furnishing a product which has almost the character of a compound. By macerating the nitro-cotton with from 7 to 10 per cent. of nitro-glycerine, and maintaining the mixture warm, the whole soon becomes converted into a plastic material from which it is very difficult to separate a portion of either of its components. This preparation, and certain modifications of it, have acquired high importance as blasting agents more powerful than dynamite, and possessed of the valuable property that their prolonged immersion in water does not separate from them any appreciable proportion of nitro-glycerine.

In the earlier days of the attempted application of blasting gelatine to military uses, in Austria, when endeavours were there made to render the material less susceptible of accidental explosion on active service (as by the penetration of bullets or shell fragments into transport waggons containing supplies of the explosive), this result was achieved by Colonel Hess by incorporating with the components a small proportion of camphor, a substance which had then, for some time past, played an important part in the technical application of nitro-cotton to the production of the remarkable substitute for ivory, horn, &c., known as xylenite. By incorporating with nitro-glycerine a much larger proportion of nitro-cotton than used in the production of blasting gelatine, and by employing camphor as an agent for promoting the union of the two explosives, as well as, apparently, for deadening the violence, or reducing the rapidity of explosion of the product, Mr. Nobel has obtained a material of almost horn-like character, which can be pressed into pellets or rolled into sheets while in the plastic condition, and which compares favourably with the gun-cotton preparations of somewhat similar physical characters just referred to, as regards ballistic properties, stability, and uniformity, besides being almost absolutely smokeless. The retention in its composition of some proportion of the volatile substance camphor, which may gradually be reduced in amount by evaporation, renders this explosive liable to undergo some modification in its ballistic properties in course of time; it is believed that this point has been dealt with by Mr. Nobel, and accounts from Italy speak favourably of the results of trials of his powder in small arms, while Mr. Krupp is reported to be carrying on experiments with it in guns of several calibres.

The Government Committee on Explosives, in endeavouring to remedy the above defect of Nobel's original powder, were led by their researches to the preparation of other varieties of nitro-glycerine powder, which, when applied in the form of wires or rods, made up into sheaves or bundles, have given, in the service small-bore rifle, excellent ballistic results. The most promising of them, which fulfils, besides, the conditions of smokelessness and of stability, so far as can be guaranteed by the application of special tests of exposure to elevated temperatures, &c., is now being submitted to searching experiments with the view of so applying it in the arm as to overcome certain difficulties attending the employment, in a very small-bore rifle, of an explosive developing much greater energy than the black-powder charge, which therefore gives very considerably higher velocities even with much smaller charges, and consequently heats the arm much more. Thus, the service black-powder charge furnishes, with the small-bore rifle, an average (and variable) velocity of 1800 f.s., together with pressures ranging from 18 to 20 tons per square inch; on the other hand, with considerably less of the powder referred to, there is no difficulty in securing a very uniform velocity of about 2200 f.s. with pressures not exceeding 17 tons, while velocities as high as 2500 f.s. are obtainable with pressures not greater than the maximum allowed with the black-powder charge.

It is obvious, from what has already been said respecting the causes of the erosive action of powder in guns, that comparatively considerable erosive effects would be expected to be produced by powders of high energy as compared with black powder. Moreover, the freedom of the products of explosion from any solid substances, and consequently the absence of any fouling or deposition of residue in the arm, causes the heated surfaces of the projectile and of the interior of the barrel to remain clean, and in a condition, therefore, very favourable to close adherence together. If to these circumstances be added the fact that the behaviour of the smokeless powder has to be adapted to suit an arm, a cartridge, and a projectile originally designed for use with black powder, it will be understood that the devising of an explosive which shall be practically smokeless, sufficiently stable, and susceptible of perfectly safe use in the arm under all service conditions, easy of manufacture, and not too costly, is, after all, but a small part of the difficult problem of adapting a smokeless powder successfully to the new military rifle—a problem which, however, appears to be on the near approach to satisfactory solution.

The experience already acquired in guns ranging in calibre from 1·85 inches to 6 inches, with the smokeless powder devised for use in our service, has been very promising, and indicates that the difficulties attending its adaptation to guns designed for black powder are likely to prove considerably less than in the case of the small arm. But here, again, the circumstances that much smaller charges are required to furnish the same ballistics as the service black-powder charges, and that the comparatively gradual and sustained action of the new powder gives rise to lower pressures in the chamber of the gun, and higher pressures along the chase, demonstrate that the full utilization of the ballistic advantages, and the increase in the power of guns of a given calibre and weight with the new form of powder, are only attainable by some modifications in the designs of the guns—such as a reduction in size of the charge-chamber, and some additions to the strength, and perhaps, in some cases, of the length, of the chase.

When, however, the smokeless powder has been adapted with success in all respects to artillery, from small machine-guns to guns of comparatively heavy calibre, and when its ballistic advantages have been fully utilized in guns of suitable design, it will remain to be determined how far such a powder—undeniably of much more sensitive constitution than black powder, or any of its modifications—will withstand, unchanged and unharmed, the various vicissitudes of climate, and the service storage-conditions in ships and on land in all parts of the world—a condition essential to its adaptability to naval and military use, and especially to the service of our Empire; and whether sufficient confidence can be placed in its stability for long periods under these extremely varied conditions to warrant the necessary freedom from apprehension of possible danger, emanating from within the material itself, to allow of its being substituted for black powder wherever its use may present advantages.

Possible it might be, that the storage, with perfect safety, of such a powder in ships, forts, or magazines might demand the adoption of precautionary measures tending to place comparatively narrow limits upon the extent of its practicable service applications; even then, however, an imperative need for the introduction of special arrangements to secure safety and immunity from deterioration may be of small importance as

compared with the great advantages which the provision of a thoroughly efficient smokeless powder may secure to the possessor of it, especially in naval warfare.

That the opinions respecting the importance of such advantages are founded upon a sound basis, one can hardly doubt, after the views expressed by several of the highest military and naval authorities, although opinions as to their extent may differ very considerably even among such authorities.

The accounts furnished from time to time from official and private sources of the effects observed, at some considerable distance, by witnesses of practice with the smokeless powders successively adopted in France, have doubtless been regarded by military authorities as warranting the belief that the employment of such powders must effect a great revolution in the conduct of campaigns. Not only have the absence of smoke and flame been dwelt upon as important factors in such a revolution, but the recorders of the achievements of smokeless powder—whose descriptions have doubtless been to some extent influenced by the vivid pictures already presented to them of what they *should* anticipate—have even been led to make such explicit assertions as to the *noiselessness* of these powders, that high military authorities have actually been thereby misled to portray, by vivid word-painting, the contrast between the battles of the future and the past;—to imagine the terrific din caused by the discharge of several hundred field-guns and the roar of musketry in the great battles of the past, giving place to noise so slight that distant troops will no longer receive indications where their comrades are engaged, while sentries and advanced posts will no longer be able to warn the main body of the approach of an enemy by the discharge of their rifles, and that battles might possibly be raging within a few miles of columns on the march without the fact becoming at once apparent to them.

It is somewhat difficult to conceive that, in these comparatively enlightened days—an acquaintance with the first principles of physical science having for many years past constituted a preliminary condition of admission to the training establishments of the future warrior—the physical impossibility of such fairy tales as appear to be considered necessary in France for the delusion of the ordinary public, would not at once have been obvious. Yet, even in professional publications in Germany, where we are led to expect that the judgment of experts would be comparatively unlikely to be led astray through lack of scientific knowledge, we have, during the earlier part of last year, read, in articles upon the influence of smokeless powder upon the art of war (based evidently upon the reports received from France), such passages as these:—"The art of war gains in no way as far as simplicity is concerned; on the contrary, it appears to us that the absence of so important a mechanical means of help as *noise* and smoke were to the commander, requires increased skill and circumspection in addition to the qualities demanded by a general. . . ." "The course of a fight will certainly be mysterious, on account of the *relative stillness* with which it will be carried on."

In an amusing article, in imitation of the account of the Battle of Dorking, which appeared in the *Deutsche Heeres Zeitung* of April last, the consternation is described with which a battalion receives the information from a wounded fugitive from the outposts that the enemy's bullets have been playing havoc among them, without any visible or audible indications as to the quarter of attack. Later in the year, and especially since the manœuvres before the German and Austrian Emperors, when the employment of the new smokeless powder was the event of the day, the absurdity of the assertions as to the noiselessness of the new powders became a theme for strong observations in the German service papers; the assumed existence of a noiseless powder was ridiculed as a thing equally impossible with a recoil-less powder; the violence of the report, or explosion, produced upon the discharge of a firearm being in direct relation to the volume and tension of the gaseous matter projected into the surrounding air.

The circumstance that blank ammunition was alone used in the smokeless powder exhibition at the German manœuvres, may have served to lend some support to the assertions as to *comparatively* little noise made by the powder—the report of blank cartridges being slight, on account of the small and lightly confined charges used. It is said that the sound of practice with blank ammunition at the German manœuvres, was scarcely recognized at a distance of 100 metres. In a recently published pamphlet on the results of employment of the latest German smokeless powder in the manœuvres, it is stated, on the other hand, that the difference between the violence of the report of the new powder and of black powder is scarcely perceptible: that it is sharper and more ringing, but not of such long duration. This description accords exactly with our own experience of the reports produced by different varieties of smokeless powder, and of the lecturer's earlier experience with gun-cotton charges fired from rifles and field guns. The noise produced by the latter was decidedly more ringing and distressing to the ear in close proximity to the gun, but also of decidedly less volume than the report of a black-powder charge, when heard at a considerable distance from the gun.

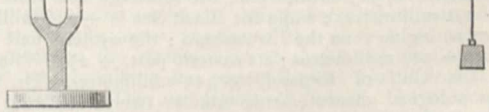
As regards smokelessness, the present German service powder is not actually smokeless, but produces a thin, almost transparent, bluish cloud, which is immediately dissipated. Independent rifle-firing was not rendered visible by the smoke produced at a distance of 300 metres, and at shorter ranges the smoke presented the appearance of a puff from a cigar. The most rapid salvo-firing during the operations near Spandau did not have the effect of obscuring those firing from distant observers.

That, in future warfare, if smokeless or nearly smokeless powders have maintained their position as safe and reliable propelling agents for small arms and field artillery, belligerents of both sides will be alike users of them, there can be no doubt. The consequent absence of the screening effect of smoke—which, on the one hand, removes an important protection and the means of making rapid advances or sudden changes of position in comparative safety, and, on the other hand, secures to both sides the power of ensuring to the fullest extent accuracy of shooting, and of making deadly attack by individual fire through the medium of cover, with comparative immunity from detection—can scarcely fail to change more or less radically many of the existing conditions under which engagements are fought.

As regards the naval service, it is especially and, at present at any rate, exclusively for the new machine and quick-firing guns that a smokeless powder is wanted; for such service the advantages which would be secured by the provision of a reliable powder of this kind can scarcely be over-estimated, and their realization within no distant period may, it is believed, be anticipated with confidence.

NOTE ON MR. MELDE'S VIBRATING STRINGS.

THE effect of Mr. Melde's pretty experiments with the vibrating stretched thread attached to one of the prongs of a tuning-fork is often spoiled to the spectators by the unfavourable plane of vibration assumed by the thread. A very simple device removes this inconvenience, and enables the operator to suit his own choice for the plane of vibration. The accompanying sketch sufficiently explains itself, and shows the arrangement for restricting the vibrations to the vertical plane.



Instead of attaching the end of the thread to the prong of the tuning-fork, it is tied to the middle of a short thread *d*A*e*, and the ends *d* and *e* of this are attached to the prong in a vertical line. It is clear that if the distance of A from the line *de* is an appreciable part of the quarter wave-length of the vibration, and AB is an integral multiple of the half wave-length, vibration is possible only in the vertical plane. For in the horizontal plane this rate of vibration is impossible, A being not a fixed point of the thread for vibration in this plane, and the length from the prong to the pulley being not an integral multiple of the half wave-length of vibration. And in any other plane the vibration, if possible, would be compounded of two, viz. of the vertical which is possible and of the horizontal which is impossible.

The most convenient form of fixture for the short thread *d*A*e*, is a light steel wire with an eye at each end, lashed to the prong

with two turns of fine thread. The plane of vibration can then be easily adjusted to suit the spectators by sluing the wire in its lashing.

Note.—The triangular thread *dAe* should be of the same quality as the vibrating length. If it is much heavier length for length the arms of the triangle may become half wave-lengths of the vibration for the tension employed, and then they lose their control over the plane of vibration.

The arrangement has its own worth, independently of the aid it lends to visible effect, as an illustration of the suppression of all half wave-lengths which are not true sub-multiples of the vibrating length of the cord. When the fork is moved from its position in the figure to bring up the line *de* to the position of A, the vertical vibrations are suppressed, and only the horizontal vibrations are possible. W. SIDGREAVES.

EIGHTH CONGRESS OF RUSSIAN NATURALISTS.

THE eighth Congress of Russian Naturalists and Physicians was opened on January 9 at St. Petersburg, and was a great success. It was attended by no fewer than 2000 members, half of whom came from the provinces, and at the three general public sittings (corresponding to the sittings of the British Association devoted to the delivery of the Presidential addresses), as well as the meetings of the Sections, the public were well represented. At the first general sitting, Prof. Mendeleeff delivered a most interesting address on the methods of natural science as applied to the study of prices. His parallels between the prices of goods and the specific weights and specific volumes of chemical bodies were very suggestive. The next address, by Prof. Sklifasovsky, was on the wants of Russian medical education. At the second general sitting, Prof. Stoletoff spoke of ether and electricity. Prof. Famintzyn's address on the psychical life of the simplest representatives of living beings, partly based upon his own recent researches into the intelligence of Infusoria, was full of facts as to the means used by various micro-organisms in attack and defence. Prof. Wagner dealt with the physiological and psychological views upon hypnotism, and Prof. Gustavson spoke of the micro-biological bases of agronomy.

The work of the Sections was very varied, and will be fully reported in the Diary of the Congress, the publication of which began during the sitting of the Congress, and will be continued till a full account has been produced.

The Sections of Geography and Anthropology, Hygiene, and partly of Agronomy, were most largely attended, and many interesting communications were made in them. At the combined sittings several important questions were raised as to the geography of Russia, its meteorology, and the bearings of a scientific study of climate and soil upon agriculture.

The following communications relative to geography and anthropology were especially worthy of note. Captain Makaroff reported the results of his careful measurements as to the differences of level of various seas of Europe. Taking the average level of the Atlantic Ocean opposite Lisbon for zero, he found that the level of the western parts of the Mediterranean is 434 millimetres below zero, its eastern part, − 507 millimetres; the Ægean Sea, − 563 millimetres; the Marmora Sea, from − 360 to − 291 millimetres; while the Black Sea is + 246 millimetres —that is, higher than the Lisbon zero; the western part of the Baltic, + 259 millimetres; its eastern part, + 254 millimetres; and the Gulf of Finland, + 415 millimetres. Dr. Blum's anthropological measurements amidst twelve different tribes of the Caucasus show that there are no pure races in Caucasia, all of them being mixtures between Semitic and Indo-European races. Like conclusions were arrived at by M. Kharuzin as regards the Bashkires, who proved to be a mixed race, presenting features both of the Mongolian and the Caucasian races.

Prof. Klossovsky's researches into the variations of level and temperature in the coast region of the Black Sea are most valuable, as they are based on accurate measurements made since 1879 at 16 different places. They fully disclose the importance of atmospheric pressure upon the level of the Black Sea, and it is worthy of note that the passage of a cyclone over Odessa resulted in a rise of the level of the sea by fully 5 feet over the average, followed by a sinking of the level by fully 7 feet, in accordance with the variations of atmospheric pressure.

Dr. Orzanski's extensive anthropological researches amidst the population of Russian prisons, and his numerous measurements, show no difference between the supposed "criminal's skull" and the average Russian skull. Numerous photographs were exhibited to illustrate this conclusion, so different from those arrived at by Dr. Lombroso.

Two new periodicals—one of them devoted to Russian natural science, and the other to meteorology—were founded while the Congress was at work. The meeting came to an end on January 20.

The Congress hoped to obtain from the Government permission to appoint a permanent Board, and thus to lay the foundation of a Russian Association for the Advancement of Science.

TECHNICAL EDUCATION IN ELEMENTARY SCHOOLS.

THE Committee of the National Association for the Promotion of Technical and Secondary Education have submitted to the Education Department the following suggestions for the modification of the Code as regards elementary technical education:—

A.—*Drawing.*

(1) Drawing to be introduced in infant schools, at least for boys.

(2) Drawing to be made compulsory in boys' schools.

(3) The Minute requiring cookery to be taught in girls' schools as a condition of receiving grant for drawing, to be repealed.

B.—*Object Lessons.*

(4) No school to be recognized as efficient which does not provide in the three lower standards a graduated scheme of object lessons in continuation of Kindergarten instruction in the infant school.

C.—*Science.*

(5) In order to encourage science as a class subject, the clause requiring English as one of the class subjects to be cancelled, and the teaching of science as a class subject to be further encouraged in the upper standards by an additional grant.

(6) Scholars of any public elementary school to be allowed to attend science classes held at any place approved by the inspector, and such attendance to count as school attendance.

(7) Examinations in science to be conducted orally, and not on paper, especially in the first five standards. If the inspection is satisfactory, an attendance grant of 4*s.* to be made for scientific specific subjects.

(8) Managers to be encouraged to submit alternative courses of instruction in specific subjects under Art. 16 (Code 1888). Such subjects to receive a grant on the same principle as the subjects enumerated in Art. 15.

[Art. 16. "Any other subject *other than those mentioned in Art.* 15, may, if sanctioned by the Department, be taken as a specific subject, provided that a graduated scheme of teaching it be submitted to and approved by the inspector."

But Art. 109 (*g*) which lays down the condition for grants, says, "The specific subjects which may be taken *are those enumerated in Art.* 15."]

(9) Grants to be made towards apparatus for science teaching and school museums.

D.—*Manual Instruction.*

(10) Manual instruction to be introduced in boys' schools, corresponding to needlework for girls.

(11) Instruction in the use of *simple tools* to be introduced in the higher standards as a specific subject, and grants to be paid thereon.

(12) Provision to be made for the introduction of *elementary modelling* in connection with the teaching of drawing, and a grant to be made in connection therewith.

(13) Instruction in *laundry work* to be encouraged in girls' schools, so far as practicable, as a part of domestic economy.

E.—*Evening Schools.*

(14) The clause providing that "No scholar may be presented for examination in the additional subjects alone" to be cancelled, to enable scholars to earn grants though not receiving instruction in the standard subjects.

(15) The number of "additional subjects" which may be taken to be increased from two to four.

F.—*Training Colleges.*

(16) Day Training Colleges and a third year of training to be recognized. The Universities and local University Colleges to be utilized for the training of teachers, where suitable arrangements can be made.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following appointments of Electors to Professorships have been made. Each Board consists of eight members, and it is provided by the Statutes that at least two members shall not be resident in the University or officially connected with it. In certain cases more than two such members have been voluntarily chosen by the Senate.

Arabic: Prof. Bensly; *Music:* Sir George Grove; *Chemistry:* Dr. E. Frankland, F.R.S.; *Plumian of Astronomy:* Mr. W. D. Niven; *Anatomy:* Dr. Huxley, F.R.S.; *Botany:* Prof. D. Oliver, F.R.S.; *Woodwardian of Geology:* Dr. A. Geikie, F.R.S.; *Jacksonian of Natural Philosophy:* Dr. Hugo Müller, F.R.S.; *Mineralogy:* Sir W. Warington Smyth, F.R.S.; *Political Economy:* Mr. R. H. Inglis Palgrave, F.R.S.; *Zoology and Comparative Anatomy:* Dr. Huxley, F.R.S.; *Sanskrit:* Prof. Aufrecht and Mr. R. A. Neil; *Cavendish of Physics:* Sir William Thomson, F.R.S.; *Mechanism:* Mr. W. Airy; *Downing of Law:* Mr. Justice Denman; *Downing of Medicine:* Dr. Richard Quain, F.R.S.; *Physiology:* Prof. Burdon Sanderson, F.R.S.; *Pathology:* Dr. J. F. Payne; *Surgery:* Sir James Paget, F.R.S; *Chinese:* Dr. Peile.

Prof. Robertson Smith being unable on account of the state of his health to lecture this term, Mr. A. A. Bevan, B.A., of Trinity College, has been appointed his deputy.

The Syndicate appointed to consider the probable expense of maintaining and working the great telescope offered to the University by Mr. Newall, report that a capital sum of £2225, and an annual expenditure of £400 will probably be required. They report further that the Sheepshanks Special Fund, founded in 1863 for the benefit of the observatory, will probably be able to furnish a capital sum of £1000, and an annual grant of £100, towards the expenses of the Newall telescope. The remainder, or £1225 at once, and £300 a year, will have to be provided from other sources; but whence is by no means apparent.

SCIENTIFIC SERIALS.

Revue d'Anthropologie, troisième série, tome iv., sixième fasc. (Paris, 1889).—Researches on the cephalic index of the Corsican population, by Dr. A. Fallot (of Marseilles). In an earlier number of this review, the author drew attention to the very appreciable alteration which the cephalic index had undergone in recent times among the inhabitants of Marseilles. Thus in one group of living subjects, born at the beginning of the century, he found that 21 per cent. exhibited an index of 84, while in another group, consisting of men of middle age, this number occurred only in the ratio of 7 per cent. This remarkable difference led the author to continue his determinations of the cephalic index among different communities. With this object in view, he last year visited Corsica, and in the present article we have the results of his craniometric determinations in this island, where from its peculiar geographical position and geognostic features, the inhabitants have preserved a permanence of type, and a homogeneity of ethnic characteristics, probably unequalled in any other European nation. Indeed so inconsiderable have been the changes effected in recent times in the Corsican population, that the observations made by Volney, in 1793, on the country and the people, apply almost equally well to their present condition. At the same time so little addition has been made since that period to our previously imperfect knowledge of Corsica, that Dr. Fallot's observations supply a valuable contribution to ethnological inquiry. All his determinations tend to demonstrate the great uniformity of cranial type and characters in the people. Thus while 54 per cent. of the population present a cephalic index varying from 75 to 78, not more than 13 per cent. gave an index above 80, while in only one out of 200 cases the index amounted to 86, and hence he assumes the mean index to be 76·5. He found that this uniformity was the greatest in the interior of the island, and more especially in the *département* of Corte; while at Bastia, in the extreme north, the cranial characteristics exhibited more variety, and afforded evidence of an admixture with foreign elements, a subbrachycephalic type supplanting the more general Corsican character of dolichocephalism. In the preponderance of this latter type Dr. Fallot thinks we have incontrovertible evidence against the opinion of Lauer, that the Corsicans are of Ligurian descent, and he believes that they may be more correctly characterized as an offshoot from the old Iberian races. The author gives numerous useful tables, and his brief summary of the history of the island is clear and instructive. From his observations on the geological conformation of the island we learn how numerous spurs, thrown off from the central high mountain range, have enclosed and isolated the several valleys, cutting off villages and settlements from their neighbours, and thus exerted so strong an influence upon the character and habits of the inhabitants, that the physical features of the island may be said to supply the key to its history. From the author's observations it may be assumed that in the mountain districts of the interior the genuine Corsican cranial type has been best preserved.—On infibulation, and other mutilations practised among the littoral tribes of the Red Sea, and the Gulf of Aden, by Dr. Jousseaume. The author describes at length the methods by which these processes are effected, and considers that whatever may have been their original motive they are in no way at present connected with religious observances, but are simply carried on from generation to generation as survivals of ancient barbarous customs.—On modern crania in Montpellier, by M. de Lapouge. In 1888 the author obtained 150 tolerably perfect skulls, which had been recovered from the soil of a cemetery at Montpellier used for interments from the seventeenth century until it was closed in 1830. An examination of the author's elaborate series of comparative craniometric measurements shows that the mean for the cephalic index of these skulls, viz. 78·3, is the lowest as yet observed in France, while their general cranial characters have less affinity with a French, than a North African type.—Prehistoric Scandinavia, by M. I. Undset. This is a sequel to a paper published in this review in 1887, the author now bringing his survey of the progress of northern palæontological science up to the present time.

THE *American Meteorological Journal* for December contains:—An article by W. M. Davis and C. E. Curry, on Ferrel's convectional theory of tornadoes; his theory, which is remarkably simple, is based on the occurrence of an ascensional movement in the tornado-whirl. The authors state that this fact seems too well established to admit of a doubt, although Faye and others in Europe, and Hazen in the United States, have questioned it. The paper contains graphical illustrations of the instability caused by convection.—Tornado chart of the State of Indiana, by Lieutenant J. P. Finley, compiled from statistics for seventy-one years ending 1888. The average yearly frequency is 4·5 storms. The month of greatest frequency is May.—Theory of storms, based on Redfield's laws, by H. Faye, continued from the November number, and dealing with the mechanics of whirls in flowing water, and with the upper currents of the atmosphere; the conclusion being that cyclones are whirls, originating in the upper regions of the air.—A continuation of the article on the meteorology at the Paris Exhibition, by A. L. Rotch, describing the meteorological instruments in the foreign sections.—The conclusion of Dr. F. Waldo's interesting discussion of wind velocities in the United States, with charts of "isanemonals" for January, July, and the year. The fact that the curves can be drawn with general symmetry shows that there is some uniformity in the exposure of the anemometers for *like* regions. The author points out that the effect of the Rocky Mountains seems to make itself felt on the winds to a distance of 200 or 300 miles to the eastward.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 19, 1889.—"Some Observations on the Amount of Luminous and Non-Luminous Radiation emitted by a Gas-Flame." By Sir John Conroy, Bart.

These experiments show—

(1) that 3 millimetres of glass and 10 centimetres of water transmit a small portion of the non-luminous radiation of an Argand gas-burner, but that, when the thickness of the water is increased to 15 centimetres, the transmitted radiation consists exclusively, or almost exclusively, of those kinds of radiation which affect the eye as light.

(2) That, with the form of apparatus employed (a thermopile and galvanometer), there is no measurable difference between the diathermancy of pure water and of a solution of alum.

(3) That the radiation from an Argand gas-burner consists of about 1·75 per cent. luminous and 98·25 per cent. non-luminous radiation.

January 30.—"On outlying Nerve-cells in the Mammalian Spinal Cord." By Ch. S. Sherrington, M.A., M.B., &c. Communicated by Prof. M. Foster, Sec. R.S.

Gaskell has shown that in the cord of the alligator scattered nerve-cells are to be seen at the periphery of the lateral column. Although nerve-cells appear to be absent from that position in the spinal cord of Mammalia as represented by the rabbit, cat, dog, calf, monkey, and man, yet there are in these animals isolated nerve-cells present in the white matter of the cord, not only in the deeper portions of the lateral column, but in the anterior and posterior columns as well.

In the anterior columns occasional nerve-cells, of the multipolar kind, lie among those fibre-bundles which pass between the deeper mesial border of the anterior horn and the anterior commissure at the base of the anterior fissure. They, in the instances observed, are smaller than the large cells characteristic of the anterior horn, and lie with two of the processes directed parallel with the horizontal transverse fibres among which they are placed.

In the lateral column, of the spinal cord of man and the other animals named above, it is common to find outlying members of the group of small cells of the lateral horn, Clarke's tractus intermedio-lateralis, situated in the white matter, distinctly beyond the limits of the grey. Some outlying cells here are placed at a great distance from the grey. They are generally placed upon, or at least in close connection with, the fine connective-tissue septa which pass across the white matter. It is probable that the cells are connected with the medullated nerve-fibres running along these septa.

In the part of the lateral column adjacent to the lateral reticular formation numerous nerve-cells are to be found among the interlacing bands of nerve-fibres. These are often fusiform, but in many cases multipolar; they are for the most part small, but occasional large individuals can be found; the latter would appear always to be multipolar. Where the lateral column comes into contact with the lateral limb of the substantia gelatinosa of the caput cornu posterioris ganglion-cells can frequently be seen in it. The larger axis of these cells is parallel to the outline of the caput cornu.

In the posterior columns outlying nerve-cells are also to be found, especially in the human cord. They are best seen in the upper lumbar and lower dorsal regions. They are large, measuring in some instances 70 μ across. In appearance they closely resemble the cells of Clarke's column. They are nearly always of broadly ovate shape. They appear always to lie on or in close relation to those horizontal bundles of nerve-fibres which curve in a ventro-lateral direction from the depth of the extero-posterior column into the grey matter in the neighbourhood of the posterior vesicular group. The longer axis of the cell is placed parallel to the nerve-fibres it lies upon or among. Where a process from the bipolar cell-body can be followed, it disappears in a direction which is that of the surrounding nerve-fibres.

With regard to the cells existing among fibres passing to the white commissure of the cord, it is legitimate to consider their presence as evidence in favour of the view that some of the cells of the median portion of the ventral grey horn are directly connected with medullated fibres passing to or from the opposite half of the cord by way of the anterior commissure.

The cells in the lateral column outside the lateral horn may be taken to point to the connection of the intermedio-lateral group of Clarke with the nerve-fibres which radiate in bundles from the grey matter of that region into the lateral column. Concerning some of the outlying cells in the more dorsal portion of the lateral column, the same inferences may be drawn; and some of them would seem to be connected with fibres of the posterior roots that curve round the lateral aspect of the caput cornu posterioris. Of the outlying cells in the posterior column, if they are outlying members of Clarke's group, the relations which they suggest for that group are—

i. That the group is connected *directly* with certain of the median fibres of the posterior spinal roots—namely, those which after an upward course in Burdach's column plunge into the grey matter of the base of the posterior horn.

ii. That some at least of the cells of that group are interpolated, more or less immediately, into the course of medullated nerve-fibres of large calibre.

The question naturally arises, May not these cells in the posterior column of the Mammalian cord represent the bipolar cells discovered by Freud, in the cord of *Petromyzon planeri*, to be in direct communication with fibres of the posterior roots? If so, may Clarke's column be considered a portion of the ganglion of the posterior spinal nerve-root which has been retained in the interior of the spinal cord in the thoracic and certain other regions?

Royal Meteorological Society, January 15.—Annual Meeting.—Dr. W. Marcet, F.R.S., President, in the chair.—The Council, in their Report, congratulated the Fellows on the generally prosperous state of the Society; the past year's work, though not in any respect exceptional, having been thoroughly successful. The total number of Fellows is 550, being an increase of 25 on the previous year; the finances are improving, and the library is overflowing.—Mr. Baldwin Latham was elected President for the ensuing year.—The retiring President, Dr. Marcet, then delivered an address on "Atmospheric Dust," which he divided into organic or combustible, and mineral or incombustible. The dust scattered everywhere in the atmosphere, and which is lighted up in a sunbeam, or a ray from an electric lamp, is of an organic nature. It is seen to consist of countless motes, rising, falling, or gyrating, although it is impossible to follow any of them with the eye for longer than the fraction of a second. It is difficult to say how much of the dust present in the air may become a source of disease, and how much is innocuous. Many of the motes belong to the class of micro-organisms which are frequently the means of spreading infectious diseases. Many trades, owing to their dusty nature, are very unhealthy. Dust, when mixed with air, is inflammable and liable to explode. After giving several instances of explosions due to fine dust in flour mills and coal mines, Dr. Marcet referred to inorganic or mineral dust, and gave an account of dust storms and dust pillars in India. He then proceeded to describe volcanic dust, which consists mainly of powdered vitrified substances, produced by the action of intense heat. The so-called ashes or scoriæ shot out in a volcanic eruption are mostly powdered pumice, but they also originate from stones and fragments of rocks, which striking against each other, are reduced into powder or dust. Volcanic dust has a whitish-gray colour, and is sometimes nearly quite white. Dr. Marcet concluded with an account of the great eruption of Krakatão in August 1883. The address was illustrated by a number of lantern slides.

EDINBURGH.

Royal Society, January 20.—Sir W. Thomson, President, in the chair.—Prof. Tait communicated an obituary notice of Dr. Andrew Graham, R.N., by Mr. John Romanes, W.S.—The President gave a paper on electrostatic stress. A complete dynamical illustration of electro-dynamic action may be had in an elastic solid, homogeneous in so far as rigidity is concerned, permeated with pores of unalterable size containing liquid. These pores may be in part in communication with each other, and in part closed by elastic partitions. These cases correspond to conductors and non-conductors respectively. Electrostatic stress depends on the curvature and extension of the partitions. The law of capacity in the model is identical with that in conductors.—Prof. C. Michie Smith described the great eruption at Bandaisan, Japan, photographs being shown.—Prof. Tait read a paper, by Prof. Heddle, on a curious set of fog-bows.—Dr. Berry Haycraft gave an account of some experiments which extend our knowledge of volitionary movement and explain the production of the muscle and heart sounds.

PARIS.

Academy of Sciences, February 3.—M. Hermite in the chair.—On the nuclei of the great Comet II. of 1882, by M. F. Tisserand. From the presence of five bright points disposed in a straight line, it is evident that the matter was not uniformly

distributed in the head of this comet. There exist several centres of condensation with apparent diameters of 1″ or 2″, their mutual distances changing from time to time, but their position remaining constant in the same straight line, which revolves progressively round the principal nucleus. These conditions are specially favourable for the development of secondary nuclei, which the author regards as so many minor comets submitted to the attraction of the sun alone, moving in very elongated elliptical orbits with a common perihelion and different long axes, disposed, however, according to the same straight line. Hence the comet contained within itself the germs of disrupture, its elements in this respect resembling those of the 1843 and 1880 comets.—On the roots of an algebraic equation, by Prof. A. Cayley. Resuming the theory of the roots of the equation $f(u) = 0$, instead of the surface $c - z = P^2 + Q^2$, the author now studies the surface $(c - z)^2 = P^2 + Q^2$, taking into consideration the positive values only of z that are not greater than c. He hopes to apply this theory to the case of a cubic equation, where the calculations, however, are much more difficult.—Determination of regulated harmonic surfaces, by M. L. Raffy. Very few surfaces are known whose linear element is reducible to the harmonic form (Liouville's form). To find others, the author employs two distinct processes. The first consists in taking the analytical form of the co-ordinates of the surface in function of two parameters, and determining the unknown functions, so that the linear element may be harmonic; the second, in seeking for harmonic surfaces amongst those which may be generated by taking their linear element alone.—Solar observations for the last six months of 1889, by M. Tacchini. Excluding the month of August, the observations here tabulated for the spots and faculæ show that the period of calm has continued to the end of the year, and the observations already made for January 1890 show that this period still continues. The same result is shown in the case of the protuberances, so that we appear to have entered the period of absolute minimum.—On the propagation of sound, by MM. Violle and Vautier. These experiments, made with a cylindical tube, lead to the inference that, whatever be the nature of the initial impulse, the sound-wave tends towards a simple, determined form, and this form once acquired, the various parts of the wave are propagated with a uniform velocity which must be regarded as the normal velocity of the sound. The velocity in the open air is greater than in a tube, where the influence of the walls causes a retardation in inverse ratio to the diameter, and exceeding 0·46 m. in a tube with diameter of 1 meter. The normal velocity of sound in a dry atmosphere at zero is 331·10 m., with probable error less than 0·10 m.—On the state of the magnetic field in conductors of three dimensions, by M. P. Joubin. The results of these researches, which agree with experience, show that the magnetic field produced by a current exists in the medium traversed by the electric flux as well as in the exterior medium.—On the mechanical actions of variable currents, by M. J. Borgman. In reproducing, with the limited resources of a laboratory, the interesting experiments exhibited by Prof. E. Thomson at last year's Exhibition, the author has obtained some fresh results, which are here described.—Results of the actinometric observations made at Kiev in 1888-89, by M. R. Savelief. These observations lead to the general conclusion that 63·5 per cent. of the annual solar heat reaching the earth is absorbed by the terrestrial atmosphere, only 36·5 arriving on the surface of the ground; in October the proportion is 41, in January and February 28 per cent. The maximum received on a fine day in the beginning of July is 610, and in December 87 calories on a given space.—On the compounds of the metals of the alkalies with ammonia, by M. Joannis. In continuation of his previous communication (*Comptes rendus*, cix. p. 900) the author describes some further experiments, which are totally at variance with the theory advanced by M. Bakhuis Roozeboom (*Comptes rendus*, cx. p. 134) to explain the phenomena already observed by M. Joannis.—On the combinations of ammonia and phosphuretted hydrogen with dichloride and dibromide of silicon, by M. Besson. With ammonia a solid, white, amorphous substance of the formula Si_2Br_4, $7NH_3$, is obtained, in all respects resembling the corresponding compound of the chloride. Phosphuretted hydrogen has no action on silicon dichloride at the ordinary temperature, but is absorbed at low temperatures. At − 60° C. the composition is approximately Si_2Cl_4, $2PH_3$.—On the part played by certain foreign substances in iron and steel, by M. F. Osmond. The author here gives results for boron, nickel, copper, silicium, arsenic, and tungsten, reserving for a future paper full treatment of the subject.—On lussatite, a new crystallized variety of silica, by M. Er. Mallard. To the substance here described as nearly pure silica, the author gives the name of lussatite, from the deposits of bitumen at Lussat, near Pont-du-Château, where its properties may best be studied.—On the oxides of manganese, by M. Alex. Gorgeu. In this paper, the author studies the psilomelanes and wads, reserving for a future note the manganites, properly so called: hausmannite, acerdese, and braunite.—Papers were read by M. Paul Marchal, on the structure of the excreting organ in the prawn; by M. P. A. Dangeard, on the junction of stem and root in the gymnosperms; by M. Stanislas Meunier, on a new method of artificially producing ferriferous platinum with magnetic poles; and by M. Alexis de Tillo, on the hypsometric chart of European Russia.—M. Gilbert was nominated Corresponding Member of the Section for Mechanics in place of the late M. Broch.

BERLIN.

Physiological Society, January 17.—Prof. du Bois-Reymond, President, in the chair.—Dr. Weyl gave an account of experiments which he had made in conjunction with Dr. Kitasato on the biology of anaërobic Bacteria. Koch had only imperfectly overcome the difficulty in the way of a pure culture of these Bacteria, viz. the exclusion of atmospheric oxygen, by covering the plates on which they were being grown with films of mica. Livonius was more successful by means of a deep layer of Agar-Agar, and by replacing the air by an atmosphere of hydrogen. The speaker had endeavoured to arrive at the same result by mixing the material on which the cultivation was carried on with some substance which has an affinity for oxygen, and obtained good results with dioxyphenols and aldehydes, but more particularly with formate of soda. The members of the first class of substances, of which a large number were tried, had for the most part to be abandoned, for they exerted a toxic action on the Bacteria when they were employed in quantities sufficient to insure the complete absorption of oxygen. Very fine pure cultures of the anaërobic Bacteria of "quarter-evil" (*Rauschbrand*), of tetanus, and of malignant œdema, were obtained on Agar-Agar by the use of eikonogen and of formate of soda, and were exhibited to the meeting. By means of these pure cultures it was possible to demonstrate that the anaërobic Bacteria exert a powerful reducing influence; this was shown on preparations in which the culture-material was deeply coloured with indigo-blue, the latter being then reduced by the organisms to indigo-white. These simple methods of cultivation facilitate greatly the further investigation of these Bacteria.—Prof. Liebreich spoke on the function of the bladder in fishes. During his investigations of the inert layer on the upper surface of fluids, he had allowed a float whose specific gravity was slightly less than that of the fluid to ascend through the fluid, and observed that it came to rest a short distance below the surface and remained there. During these experiments the slight changes of temperature which are unavoidable in large masses of fluid produced irregularities which led him to study the phenomena exhibited by a "Cartesian diver." These are not correctly described in either the older original works on the subject or in the more recent text-books of physics. The equilibrium of the diver is unstable for any given pressure exerted upon the elastic membrane which covers the upper end of the vessel in which he is contained. This the speaker proved, not only by developing the formulæ which hold good for a system composed partly of solids and partly of air when immersed in a liquid, but also by means of a series of striking experiments. When the attention is directed to the experiment, it may readily be noticed that it is impossible to keep the diver in a condition of rest at any given level by exerting a *uniform* pressure with the finger on the elastic membrane, but that in order to produce this result the pressure must be continuously varied. If the pressure is applied by a screw instead of the finger, the diver does not remain at rest. When the air is compressed until the specific gravity of the diver is slightly greater than that of the liquid, he sinks to the bottom and remains there, however great the air-pressure may be. If now he is drawn to the top of the liquid by means of a magnet attracting a small slip of iron attached to the diver, he similarly remains at rest at the surface. If, again, he is now drawn slightly down, he rises towards the surface again, when left to himself, until he reaches a level above which he no longer rises but now sinks to the bottom. This layer of fluid—such that when drawn above it he rises and when drawn down below it he sinks—may be called his "hydrosphere," or, in other words, it is a layer of liquid within the limits of which his specific gravity is unity. A fish possessed

of a swim-bladder is in exactly the same condition as the diver, for it also is in unstable equilibrium in the water. The fish can only remain at rest in the water by continually readjusting its "hydrosphere" by means of slight contractions of the bladder, and thus balancing itself in a position of rest. When the fish rises or sinks, or moves horizontally, the alterations of the swim-bladder and the changes in specific gravity which are the result of this, play an important part, inasmuch as they strike a continual balance between the forces tending to raise and depress the fish's body. The laws according to which the swim-bladder plays its part in a fish are in general the same as those which hold good for the Cartesian diver, and these laws are now considerably cleared up by the speaker's researches.

DIARY OF SOCIETIES.

LONDON.

THURSDAY, FEBRUARY 13.

ROYAL SOCIETY, at 4.30.—The Liquation of Gold and Platinum Alloys: E. Matthey.—On the Unit of Length of a Standard Scale by Sir George Shuckburgh: General Sir J. T. Walker, R.E., F.R.S.

MATHEMATICAL SOCIETY, at 8.—Concerning Semi-invariants: S. Roberts, F.R.S.—Ether-Squirts: Prof. K. Pearson.—On Class-Invariants: Prof. G. B. Mathews.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Theory of Armature Reaction in Dynamos and Motors: Jas. Swinburne.

ROYAL INSTITUTION, at 3.—The Three Stages of Shakspeare's Art: Rev. Canon Ainger.

FRIDAY, FEBRUARY 14.

ROYAL ASTRONOMICAL SOCIETY, at 3.—Anniversary Meeting.

AMATEUR SCIENTIFIC SOCIETY, at 7.30.—Annual General Meeting.—Election of Council, &c.—The Old Red Sandstone of North-East Scotland: J. W. Evans.

ROYAL INSTITUTION, at 9.—Problems in the Physics of an Electric Lamp; Prof. J. A. Fleming.

SATURDAY, FEBRUARY 15.

ROYAL INSTITUTION, at 3.—Electricity and Magnetism: Right Hon. Lord Rayleigh, F.R.S.

SUNDAY, FEBRUARY 16.

SUNDAY LECTURE SOCIETY, at 4.—Norway; its Scenery and its People (with Oxyhydrogen Lantern Illustrations): H. L. Brækstad.

MONDAY, FEBRUARY 17.

SOCIETY OF ARTS, at 8.—Stereotyping: Thomas Bolas.

ARISTOTELIAN SOCIETY, at 8.—The Distinction between Society and the State: J. S. Mann.

VICTORIA INSTITUTE, at 8.—Iceland (concluding paper): Rev. Dr. Walker.

TUESDAY, FEBRUARY 18.

SOCIETY OF ARTS, at 8.—Ocean Penny Postage and Cheap Telegraph Communication between England and all Parts of the Empire and America: J. Henniker Heaton, M.P.

ZOOLOGICAL SOCIETY, at 8.30.—First Report on Additions to the Lizard Collection in the British Museum (Natural History): G. A. Boulenger.—On a Guinea-fowl from Zambesi, allied to Numida cristata: P. L. Sclater, F.R.S.—Notes on the Genus Cyon: Dr. Mivart, F.R.S.

ROYAL STATISTICAL SOCIETY, at 7.45.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Shanghai Water-Works: J. W. Hart.—The Tytam Water-Works, Hong-Kong: Jas. Orange.—The Construction of the Yokohama Water-Works: J. H. T. Turner.

ROYAL INSTITUTION, at 3.—The Post-Darwinian Period: Prof. G. J. Romanes, F.R.S.

WEDNESDAY, FEBRUARY 19.

SOCIETY OF ARTS, at 8.—The Organization of Secondary and Technical Education in London: Prof. Silvanus P. Thompson.

ROYAL METEOROLOGICAL SOCIETY, at 7.—Observations on the Motion of Dust, as illustrative of the Circulation of the Atmosphere, and of the Development of certain Cloud Forms: Hon. Ralph Abercromby.—Cloud Nomenclature (illustrated by Lantern Slides): Captain D. Wilson-Barker.—An Optical Feature of the Lightning Flash (illustrated by Lantern Slides: Eric S. Bruce.

UNIVERSITY COLLEGE CHEMICAL AND PHYSICAL SOCIETY, at 5.—The Chemical History of a Crystalline Schist: E. Greenly.

THURSDAY, FEBRUARY 20.

ROYAL SOCIETY, at 4.30.

LINNEAN SOCIETY, at 8.—On the Fruit and Seed of Juglandia; on the Shape of the Oak-leaf; and on the Leaves of Viburnum; Sir John Lubbock, Bart., P.C., M.P., F.R.S.

CHEMICAL SOCIETY, at 8.—The Behaviour of the most Stable Oxides at High Temperatures: G. H. Bailey and W. B. Hopkins.—The Influence of Different Oxides on the Decomposition of Potassium Chlorate: G. J. Fowler and J. Grant.

ZOOLOGICAL SOCIETY, at 4.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

ROYAL INSTITUTION, at 3.—The Three Stages of Shakspeare's Art: Rev. Canon Ainger.

FRIDAY, FEBRUARY 21.

GEOLOGICAL SOCIETY, at 3.—Annual General Meeting.

PHYSICAL SOCIETY, at 5.—On a Carbon Deposit in a Blake Telephone Transmitter: F. B. Hawes.—The Geometrical Construction of Direct Reading Scales for Reflecting Instruments: A. P. Trotter.—A Parallel Motion Suitable for Recording-Instruments: A. P. Trotter.—On Bertrand's Refractometer: Prof. S. P. Thompson.

INSTITUTION OF CIVIL ENGINEERS, at 7.30.—Some Types of American Locomotives, and their Construction: C. N. Goodall.

ROYAL INSTITUTION, at 9.—Magnetic Phenomena: Shelford Bidwell, F.R.S.

SATURDAY, FEBRUARY 22.

ROYAL BOTANIC SOCIETY, at 3.45.

ROYAL INSTITUTION, at 3.—Electricity and Magnetism: Right Hon. Lord Rayleigh, F.R.S.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

A Dictionary of Applied Chemistry, vol. 1: Prof. T. E. Thorpe (Longmans).—Prodromus Faunæ Mediterraneæ, vol. 2, Part 1: J. V. Carus (Stuttgart, E. Koch).—Reports from the Laboratory of the Royal College of Physicians, Edinburgh, vol. 2 (Pentland).—Catalogue of the Fossil Reptilia and Amphibia in the British Museum (Natural History), Part 3: R. Lydekker (London).—Elements of Logic: E. E. C. Jones (Edinburgh, Clark).—A Catalogue of British Fossil Vertebrata: A. S. Woodward and C. D. Sherborn (Dulau).—The Elements of Astronomy: Prof. C. A. Young (Arnold).—American Spiders and their Spinning Work, vol. 1: Dr. H. C. McCook (Author, Philadelphia).—The Flowering Plant: J. R. A. Davis (Griffin).—The *Electrician* Electrical Trades' Directory and Handbook for 1890 (*Electrician* Office).—The Photographers' Diary and Desk Book, 1890 (*Camera* Office).—Untersuchungen über die Bewegungsverhältnisse in dem Dreifachen Sternsysteme Scorpii: B. Schorr (München, Straub).—A Modern University: Hy. Dyer (Perth, Cowan).—On a University Faculty of Engineering: Hy. Dyer (Glasgow, Munro).—Types of Metamorphosis in the Development of the Crustacea: I. C. Thompson (Liverpool).—Magnetism and Earth Structure: Dr. E. Naumann (Trübner).—Journal of the Chemical Society, February (Gurney and Jackson).—Brain, No. 48 (Macmillan).—Journal of the Institute of Actuaries, January (Layton).—Monograph of the British Cicadæ, Part 1: G. B. Buckton (Macmillan).—Quarterly Journal of the Geological Society, No. 181 (Longmans).—Bulletin of the U.S. Geological Survey, No. 54 (Washington).

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