THURSDAY, FEBRUARY 15, 1900.

ORIENTAL HISTORY FROM B.C. 850 TO B.C. 330.

The Passing of the Empires. By G. Maspero. English Edition. Pp. xiv + 814. (Society for the Promotion of Christian Knowledge, 1900.)

THE appearance of the third and concluding volume of the English translation of M. Maspero's "Histoire ancienne des Peuples de l'Orient" will be welcomed by many, for this section of the work deals with a period which is full of interest for every student of the records of the past. In the centuries which passed between the rise of the Assyrian kingdom under Assurnasirpal and the advent of Alexander the Great, vast empires sprang into being and decayed, mighty dynasties in Babylonia, Assyria, Elam, Persia, Syria, Palestine, and Egypt rose and fell, and the balance of power among the nations of Western Europe and North-East Africa changed so frequently, and in changing produced such unexpected results, that the history of that period in the world's life is as remarkable as that of any which has come down to us. Moreover, the mass of material which is now available for constructing a connected account of the last great Semitic Empires which developed and flourished before the birth of Christ is very large, and we are enabled, by means of the documents now before us, not only to read the narratives of the events which occurred in that comparatively remote period, but also to understand many of the motives which prompted the policy of some of the greatest Oriental despots to whom Providence deputed the sway of empire. Indeed, more is known of the military prowess of the kings of Western Asia than of their civilisation; but we must hope that masses of tablets inscribed in cuneiform still lie buried beneath the mounds in Mesopotamia, and that when the excavations, which will certainly be conducted in future years, have been successfully concluded, and the newly-discovered texts have been fully investigated, we may learn fuller details of the daily life and interests of the peoples whose victories in war, though only made known to us twenty-five centuries after they were won, fascinate us by their glory, and indicate by their frequency the vigour of the power which could strike so quickly and so hard.

M. Maspero divides the volume of his work now before us into seven chapters, each of which is tolerably complete in itself. The first deals with the rise of the great Assyrian Empire of Assurnasirpal, and the struggle for the possession of Northern Syria and Palestine between that king and the warlike, powerful tribes of people whose ancestors had, centuries before, withstood the might of Rameses the Great of Egypt. Assurnasirpal and his son, Shalmaneser II., once more made the Assyrian power predominant in Syria, and they gained possession of the lands over which their ancestor, Tiglath-Pileser I., about B.C. 1100, had hunted the lion of the desert and jungle, but not without a series of fierce fights. The second chapter discusses the development of the Assyrian rule under Tiglath-Pileser III., about B.C. 740, and describes the downfall of Babylon and the collapse of the Jewish power, which had been long foreseen by thoughtful Jewish politicians. By the end of the eighth century B.C., the whole of Western Asia was in the hands of the "great king, the King of Assyria.' To many the third chapter will appear the most interesting in the book; for it treats of the rise of Nineveh, and of the subjugation of Palestine by Sennacherib, and of the siege and fall of Jerusalem. The foolish idea of obtaining support from the kings of Egypt led Hezekiah and his governors of cities hopelessly astray, and this fact M. Maspero has well brought out. Had Hezekiah seen as clearly as the shrewd Isaiah, he could never have failed to discover that sooner or later his "buffer" kingdom must be crushed between those of his great neighbours Assyria and Egypt. When once Sennacherib had shown that it was possible to overrun Syria and Palestine, and to march on to the frontiers of Egypt, his successors, Esarhaddon and Assurbanipal, were not slow to follow in his footsteps. In the fourth chapter the deeds of the last two kings are described at length; and by means of their annals we can watch their victorious progress until we find Assurbanipal actually appointing Assyrians to be governors of some of the greatest cities in the delta of Egypt! But two hundred and fifty years of conquest had enriched Assyria, and made it greater than the greatest of its ancient kings had ever succeeded in making it; and under the vigorous rule of Assurbanipal, Nineveh became the centre of all the known arts and sciences, of literature, and of luxury and wealth. The warlike tribes on the eastern and southern frontiers of Assyria watched with eagle eyes the gradual relaxation of the hold which the last of its kings kept upon his tributary peoples, and they silently made ready to claim their independence when the opportunity for doing so should arrive. They had not long to wait, for before the close of the seventh century before Christ we find that the eastern portion of the Assyrian Empire had been seized by the Medes, and that Babylon and all the rich land about it had become the possession of Nebuchadnezzar II., whose character has suffered so much at the hands of the writer or editor of the Book of Daniel. Under the hand of this last-named king the Jews lost their kingdoms in Palestine, and the glory of Israel was transferred to Babylon, where it introduced a new element into the cosmopolitan population of Babylon. But Nebuchadnezzar's empire was doomed not to last, and in the reign of Nabonidus, who seems to have been interested in the archæology of his country, if we may judge by his annals, it fell into the hands of Cyrus, who captured Babylon about B.C. 538. Under the rule of the Persian or Achæmenian kings the Babylonians and Assyrians enjoyed great freedom, and the liberal-minded Cyrus gave the Jews the opportunity to rebuild their temple at Jerusalem. At the beginning of the fourth century we find the Persian rule becoming as lax as was that of the Assyrians in the days of Nabopolassar, the father of Nebuchadnezzar, and all the nations that were nominally subject to it anxiously looked for the appearance of a king who would protect their fast vanishing interests and lead them in successful battle. About the same time the power of Egypt was crumbling away, and towards the period of the birth of Alexander the Great her once mighty empire was presided over by a king who, if we may believe tradition, spent more time in studying magic than in ruling his kingdom. It is quite clear, when we look at the history of the period, that the kingdoms of the Medes, Persians, Babylonians, Assyrians, and Egyptians had become effete, and that the time for the coming of the Macedonian hero had arrived. As soon as Alexander began to attack them they fell before him like corn before the sickle, and the Oriental nations, exhausted by centuries of luxury, formed a comparatively easy prey for the warlike Greeks.

Such, in brief outline, is a sketch of the contents of M. Maspero's interesting volume. In the limits of a short notice it is impossible to discuss details, much less differences of opinion, and now the work is done it is easy to see where improvements could have been made. In matters relating to Egyptology, M. Maspero's opinion is generally sound; but it goes without saying that when he finds it necessary to refer to cuneiform literature, he is obliged to do so at second hand. There is no discredit attaching to him for this necessity when discussing native records of Babylonia, Assyria, and Persia; only the reader of the work before us must remember that M. Maspero merely repeats what experts in cuneiform have written in their books. The references are full and are honestly given; and if the reader seeks further information, it is only necessary for him to consult the authorities whose names are given in the notes, when he will be in a position to judge for himself. Whether it was wise for M. Maspero to attempt to cover such a vast field of study—a work which to do successfully involves a good knowledge of several difficult Oriental languages—is a matter which we do not care to decide; but there is no doubt that he has written an interesting book, and one which will give the reader a good general view of a most eventful period in the history of the world.

AMERICAN ICHTHYOLOGY.

The Fishes of North and Middle America: a Descriptive Catalogue of the Species of Fish-like Vertebrates found in the Waters of North America, North of the Isthmus of Panama. By David Starr Jordan and Barton Warren Evermann. Part I. Pp. lx+1240 (1896). Part II. Pp. xxx+1241–2184 (1898). Part III. Pp. xxiv+2185–3136 (1898). (Washington: U.S. National Museum.)

THIS work forms No. 47 of the *Bulletin* of the United States National Museum; the third volume reached this country last year; and a fourth, which will contain a complete table of contents of the whole work, addenda, and a representative selection of illustrations, is still to come.

The present work is, in some measure, a revision of the "Synopsis of the Fishes of North America," which the senior author published in conjunction with Dr. Gilbert in the year 1882 as No. 16 of the *Bulletin* mentioned, and which, up to the present time, has been of such great service to the student of North American fishes. In this "Synopsis," however, all fishes were excluded from south of the boundary between the United States and Mexico, and no distinct attempt was made to draw a line between the marine fishes of the Southern States and those of the West Indies. The present work has a much wider scope: the marine fauna is extended southwards to the equator, and that of the freshwater to the Isthmus of Panama; the whole of the West Indies, the Caribbean Sea, the waters of the Gulf Stream, and the Galapagos Archipelago are included. Towards the north, the fishes not only of the Alaska Sea, but also those which are known from Kamtchatka and the Kurile Islands, form part of the work. Thus, the number of species that had been described in the "Synopsis" is nearly doubled, and amounts to 3127 in the present catalogue, besides about a hundred which are added in a supplement at the end of the third volume. The pagination runs continuously throughout the three volumes, a plan the advantage of which is doubtful, as, in referring to a species, it will not enable us to dispense with noting the volume in addition to the page. Some 260 pages of the last volume are taken up by an artificial key to the families of "true fishes," a glossary of terms, and a general alphabetical index; the latter seems to have been prepared with great care, and has never failed us on the occasions we had to refer to the work.

The mode of treatment of the subject is uniform throughout the work. A diagnosis is given of each of the genera and higher divisions, and followed by a key to their constituent parts. The species are concisely, sometimes more fully, described, either from actual specimens or from previously published accounts, with a few notes on their geographical range or their economic importance. We shall subsequently refer to the synonymy.

It will be apparent from these notes that the work initiated by Dr. Jordan was a serious and very laborious undertaking. It could be successfully carried through only by men who through long and patient inquiry and study had acquired an intimate acquaintance with both the fishes and the literature of their country, who had at their disposal the large accumulations of specimens in the museums of the United States, and who at the same time possess in a rare degree the gifts of methodical work and energetic application. These conditions were amply fulfilled in Dr. Jordan and his coadjutor. Dr. Jordan seems to have commenced his ichthyological studies as far back as 1875, and we see from a list dated 1890 that in the intervening fifteen years he published more than two hundred papers on North American Ichthyology, many of them of considerable extent. Of his pupils and colleagues he imbued some with his own love of ichthyology, and when we consider that his duties as President of the Indiana, and later of the Stamford University, and as Commissioner of the Fur Seal Fisheries, must have taxed his time to the utmost, we cannot be surprised that he found it beneficial for the progress of the work under review, to join forces with Dr. Evermann, himself an author of many original papers on American fishes.

Two features of the work characteristic of American Ichthyology, to which the European student, at any rate, the writer of this notice, will be scarcely reconciled, obtrude themselves too forcibly to be passed over in silence. One is the excessive subdivision into families and genera: the 3127 species are relegated to no less than 223 families and 1077 genera, leaving out of consideration the subgenera which are not numbered, and which we are afraid to count. Then, the authors have adopted a set of rules which, when applied to ichthyology, make the greatest possible disturbance in previously accepted nomenclature. So-called rules of priority are made retrospective, uniformly and pedantically: reasons which induced elder authors to select certain names for their genera are set aside, and not even Linnæus himself is allowed to change his own names; no regard is to be paid to the character and spirit of a work in which the names take their origin; a name by a Rafinesque or Swainson deserves as much consideration as one given by Cuvier or Rüppell. Both these methods result in a nomenclature which is more or less difficult to grasp by a European systematist.

Finally, we have to refer to the manner in which the authors have dealt with "synonymy." This seems to us too scanty to satisfy the wants of the student either of systematic ichthology or of the American fauna. The authors announce as the principle by which they have been guided, to give "enough synonymy to connect this work with other descriptive works, and no more"; and of such works they mention the first descriptions that have been given of supposed new species or genera, the "British Museum Catalogue of Fishes," Jordan and Gilbert's "Synopsis," and "other works in which special information is given." No objection could be taken to the adoption of this principle, but we fail to see that the authors have strictly adhered to it. What we expect in a work specially devoted to a fauna, is full reference to every paper in which our knowledge of the species of that fauna has been advanced in some respect. Considering the vast amount of ichthyological literature scattered through the American periodicals, a more perfect collection and arrangement of references would have been of great benefit to the student, though, we admit, a work of considerable labour.

We will mention only one case to show that the scantiness in their references may even cause inconvenience to the student. The ichthyological parts of the Reports of the United States Survey Expeditions were prepared by Charles Girard, and published about the middle of the present century; they form a considerable portion of those quarto volumes, and were very liberally illustrated. A great number of forms were described in them, and we learned from them at any rate that a large contribution to our knowledge of the American fauna had been made in the collections of those expeditions. Unfortunately, the treatment of the subject by the naturalist mentioned was not satisfactory, and it seemed most desirable that the typical specimens should be re-examined and the descriptions revised. What position, now, do these reports take in the "Fishes of North and Middle America"? Indeed, the names of the Girardian species appear therein without exception, many as synonymous with other species, a part as valid species, but reference to an examination of the several types is made only in some of the cases. Thus, of eighteen species described by Girard as *Alburnops* and *Moniana*, reference to a type is made only in eight. Further, the authors refer only to preliminary descriptions in the *Proceedings* of the Philadelphia Academy, rarely to the enlarged edition in the "Reports," and almost every mention of the numerous illustrations prepared and published at the expense of the United States Government is omitted. Probably, a great number of those types, which were deposited in the Museum of the Smithsonian Institution, are lost by this time, thus depriving the identifications made by Drs. Jordan and Evermann of much of their authoritative value or finality. Possibly, the authors consider those reports, or at least the illustrations, not reliable enough to be safely quoted: an opinion expressed by the writer of this notice some thirty years ago; but it would have been well if the authors had given some explanation of the matter in their preface or introductory note.

A work like the one under review, composed at it is of an immense amount of technical details, which only too frequently have to be gathered from imperfect or even misleading sources, cannot fail to lay itself open to criticism on points of minor importance. But it would be most unjust to the authors to allow such real or supposed imperfections to detract from the high merits of their work. It was one of the greatest desiderata in Ichthyology. It is a faithful representation of our present knowledge of American fishes, and will form the basis for all researches in that field for some time to come. For how many years? Those are, in our experience, the most useful systematic works which most stimulate the activity of new workers, and, as a natural consequence, soonest yield their position to the progress of discovery and the accumulation of new facts. We anticipate that the "Fishes of North and Middle America" will prove to be one of those works, and hope that, when once a new edition will be required, the strength and knowledge of the authors will still be available for this task. Next to the authors, science is greatly indebted to the Secretary of the Smithsonian Institution for having undertaken the publication of such an extensive work, following so soon the appearance of "Oceanic Ichthyology." The publication of these two monumental works in Ichthology stand now to the credit of the Smithsonian Institution. A. G.

ASTRONOMICAL PHOTOGRAPHY.

Die Photographie der Gestirne. Von Dr. J. Scheiner, a.o. Professor der Astrophysik an der Universität Berlin, und Astronom am Königl. Astrophysikalischen Observatorium zu Potsdam. Pp. iv + 382; 1 plate and 52 figures, with an atlas of 11 plates. (Leipzig: Engelmann, 1897.)

DR. SCHEINER'S book has been before the public for some time, and it is to be regretted that we have not had an earlier opportunity of calling attention to its contents and expressing an opinion on its merits. For a book of this character cannot but grow out of date as processes become obsolete, and as improved methods are adapted. Astronomical photography is essentially a progressive science, and when Prof. Scheiner compiled this book, many of the methods employed were admittedly tentative and not accepted beyond dispute. The direction of the further development of photographic practice was not decided, and even the instrumental equipment best adapted to its ends was, and still is, not settled with certainty. This is no proof that such a book was not needed, nor does it imply that Prof. Scheiner's attempt was hasty and ill-advised; but it does affect the point of view from which the book is to be regarded at the present day. A second edition is needed to bring the matter up to date in all particulars, and this will no doubt be forthcoming; but in any case the book will stand as a valuable record, supplied by an expert, of the methods in which the problem of photographic production and measurement was applied before familiarity and experience had shaped the most suitable method of treatment. The author is already favourably known as a writer of high-class text-books dealing with practical work in the observatory, and we can have no hesitation in saying that this book will add to his reputation and that of the Potsdam Observatory, whose staff have from time to time issued a welcome series of manuals.

Dr. Scheiner treats his subject under three divisions. First, the production and utilisation of photographs; secondly, photographic photometry and the nature of the photographic image; and thirdly, the history of astronomical photography and its results. This arrangement seems satisfactory, and permits the author to group his facts clearly about the main points at issue, but we doubt whether in the future so much importance will be attached to photometrical measurement, as the prominence here given to that subject seems to intimate. There are not wanting signs that we shall be content to guess the magnitude of a star from its appearance on the film, just as we judge of its brilliancy in the telescope, though there will always remain specialists who will be content to gather their facts much more slowly, and possibly with greater accuracy, by rigorous measurement of the disc.

In the first part we have some valuable remarks on photographic technique, in which the author's practical knowledge is shown to great advantage. Of the different methods of development to produce definite results, probably we know as much as we ever shall, but it is not easy to convey the necessary information by precept. No student would, however, content himself with mere book knowledge, but would have recourse to actual manipulation in the laboratory, and the value of this preliminary chapter would be forced upon his attention. The second chapter contains a discussion of the ordinary forms of object glasses and mirrors suitable to photographic work, and attention is called to the errors that arise, whether from the construction of the optical parts, or from the manner in which the image is received on the sensitised film. The remarks are clear and pertinent; but if the chapter were to be written anew, it would probably be felt desirable to dwell more on the photographic doublet, and to contrast the amount of its distortion with that of the ordinary object glass. The peculiarities and advantages arising under certain circumstances from greater variation in the focal length to the aperture might have to be considered, and the peculiar forms of cœlostat now in use would demand more attention.

In the next and most important chapter, on the methods of measurement and reduction, the author has adhered perhaps rather too strictly to the historical than to the practical side of the question. It would have been, we submit, of greater service to the astronomical student to have possessed in the fullest detail that method which experience has shown to be of the greatest utility, illustrated by a numerical example, than the reproduction of a variety of processes which have not met with general approval. And since Dr. Scheiner has already published no insignificant portion of the catalogue of that part of the sky allotted to him by the International Committee, his experience would have enabled him to speak with authority on this vexed question of reduction. Or, disliking this method of selection, he might have worked out an example by the different methods, and thus furnished us with the means of exercising our judgment on this important question. The historical student may hereafter be very grateful to him for collecting the methods, which were suggested in the early days, before the photographs existed in any considerable numbers and ingenuity could run riot, untrammelled with the weight of the heavy numerical calculations that must come after. He may choose to weigh and contrast the methods of Bakhuyzen and Jacobi for rectangular, with that of Gill, arranged for polar, co-ordinates. He may linger over the ingenious device of M. Lœwy, or take refuge in the more practical method due to Prof. Turner; but in any case he would have been more grateful to the author if he had introduced a uniform notation, and so made the different methods more easily comparable. By simply reproducing the methods as they are given in the original memoirs, Dr. Scheiner has missed an excellent opportunity for rendering an essential service to the cause of clearness and order. This section is apparently complete up to the time of compilation, but various improvements have been suggested since, which could not possibly find a place here. We are probably far from hearing the last word on this subject of reduction, and possibly still further from the adoption of any method that will commend itself to all the participants in the international scheme, and ensure, or at least attempt, a uniform standard of accuracy. In the last chapter of the first section the author deals with the automatic registration of star transits and of latitude determinations by means of photography. These attempts are admittedly in an experimental stage, and some of the instruments by which it is proposed to compass the desired end still exist only on paper. The Observatory of Georgetown appears to be leading the way, but we have no figures by which we can judge of the measure of success that has attended the application. Prof. Turner's proposed form of photographic transit is apparently of too recent a date to obtain a critical notice; the same remark applies to Sir R. Ball's telescope at Cambridge.

On the subject of photographic photometry, which forms the second section of the book, the author is quite on his own ground, and, writing with authority, he gives us the most complete exposition of the methods which has yet appeared. It is a subject which early attracted attention, when photography first attacked the question of astronomy of position, since many of the decisions of the International Committee were founded upon more or less imperfect knowledge of the growth of the image, and the relations between the time of exposure and the magnitude of a star photographed in a given time. Much information, not all of which was consistent, was rapidly accumulated, and the author deals with this mass of material very satisfactorily. Some of the formulæ which have been suggested, and which are here quoted, for determining the radius of the star image, or deriving the photographic magnitude, were admittedly only convenient methods of interpolation, and any attempt to show that such formulæ possess a physical basis is of doubtful policy, and will hardly be everywhere accepted; but the practical value of the chapter is high, and gains immensely from the fact that the author incorporates much of the results of his own original investigations.

In the history of photography we come naturally upon more popular ground. We have an instructive, and on the whole complete, picture of the achievements of photography applied to the heavens. The section treats each object, such as the moon, the sun, &c., separately, the history of each being treated independently of the others. The later results obtained from recent eclipse expeditions are of course wanting, and possibly a little too much space is given to the Transit of Venus. The photographic reproductions that illustrate this section are excellent, and make a handsome addition to a very valuable treatise. A bibliography accompanies the work, which already needs extension, so frequent are the contributions to this attractive development of astronomy.

OUR BOOK SHELF.

Euclid's Elements of Geometry. By Charles Smith and Sophie Bryant. Pp. vi+127. (London: Macmillan and Co., Ltd., 1899.)

THIS book deals only with Euclid's Books III. and IV. Although the original order of the propositions has been maintained, there are many divergences as regards the treatment of his methods. In the modern teaching of Euclid's propositions the student is not so restricted as to particular methods of solution as long as the method he employs is accurate. The learning of propositions by heart is, we hope, a relic of the past, and the compilers of this work encourage the ingenuity of the student. In Book III. the method of superposition is used with advantage. In addition to numerous exercises, the appendix contains many interesting and important theorems and problems. As a school course this edition should be found useful.

A First Book in Statics and Dynamics. By Rev. J. R. Robinson. Pp. viii+98. (Longmans, Green and Co., 1899.)

THIS book is intended only for beginners, and specially for those who are preparing for the matriculation in the University of London and for the elementary stage of South Kensington examination. For this reason only a limited knowledge of Euclid, algebra and trigonometry is assumed in the treatment of the subject, and the text is accompanied by numerous representative examples. The author's large experience in teaching the subject has enabled him to place clearly before his readers portions which are usually stumbling-blocks for the beginner, and the numerous clearly-printed diagrams add greatly to the explanations in the text.

Life and Happiness. By Auguste Marrot. Pp. 90. (London: Kegan Paul, Trench, Trübner and Co., Ltd. Paris: Libraire Fischbacher.)

HAPPINESS is too much a matter of temperament for the perusal of these chatty little essays on the laws of health, the development of the mind, and similar subjects, to very much affect the reader's share of this desirable possession. But there can be very little doubt that the observance of some of the rules for the preservation of health here laid down will do a great deal in removing definite causes of physical discomfort—and in this way unhappiness may, at least, be diminished.

LETTERS TO THE EDITOR.

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

On the Carriers in the Kathode Rays.

IN a former communication to these columns of NATURE (January 19, 1899), I showed that an upper limit for the density of the matter composing the kathode rays can be deduced from the fact that a shaft of rays emitted from a plane kathode retains its cylindrical form. The result arrived at was that the density must be small compared with 10^{-15} grams per cubic centimetre. In a subsequent note (February 16), I called attention to some results of E. Riecke, which seemed to indicate a value as low as 10^{-20} grams per cubic centimetre.

The researches of Prof. J. J. Thomson have now put us in possession of information as to the mass of the individual carriers. Using the value which he has given (*Phil. Mag.* December 1899) for the mass of a "corpuscle" in connection with the above estimate of the density of the stream, we can obtain a limiting value for the number of corpuscles per cubic centimetre. I find that this leads to a number very much smaller than that indicated by the kinetic theory for the average number of molecules per cubic centimetre in the vacuum tube.

We have, in round numbers, 2×10^{-20} for the charge on a corpuscle in electromagnetic units, and 6×10^{6} for the ratio of charge to mass, giving $\frac{1}{3} \times 10^{-26}$ grams for the mass. If then, the density is small compared with 10^{-15} grams per cubic centimetre, the number per cubic centimetre must be small compared with 3×10^{11}. In Meyer's "Kinetic Theory of Gases" (English translation, p. 333) the number of molecules present in a cubic centimetre of gas at atmospheric pressure is given as 60×10^{18}, so that in the vacuum tube the number would be of the order of 10^{16}. Thus the carriers in the kathode stream are very sparsely scattered as compared with this average.

Another point which may be worth mentioning arises in connection with Prof. Thomson's suggestion, that the mass of the corpuscle may be of electrical origin. He shows (*loc. cit.*, p. 563) that, in order to account for the effective mass in this way, the radius of the corpuscle, supposed spherical, would require to be of order 10^{-13} centimetre. The various lines of argument employed to arrive at an estimate of the size of a *molecule*, or of the "molecular sphere," agree in making its dimensions comparable with 10^{-7} centimetre. In order that a molecule of this size should be built up of, say, two atoms, each consisting of a complex of even a thousand corpuscles of radius 10^{-13} centimetre, these ultimate elements of a molecular structure would require to be very widely spaced in proportion to their dimensions.

W. B. MORTON.

Queen's College, Belfast, February 6.

Drunkenness and the Weather.

NATURE, in its issue for November 16 (1899), did me the honour of devoting considerable space to a modest publication of mine, "Conduct and the Weather," a fact to which I feel free to allude, since the reviewer found so little to praise. One remark of his, however, was suggestive to one "bound hand and foot by the demon of statistics." In commenting upon the indicated excesses of arrests for assault and battery during the hot summer months he says, "In our own ignorance we were rather tempted to attribute these lapses of good conduct to too free indulgence in alcoholic beverages in the hot weather." Here was a cue worth following out. The data were available, why not use them?

The plan followed was the same that found so little merit in the eyes of the jocular reviewer, but even at the risk of tempting him to again couch his lance, I shall outline it somewhat in detail. The general plan is that of comparing the normal daily prevalence of any abnormality of conduct with its prevalence under definite weather conditions. It necessitates a daily record of the crime to be studied, and some daily record of the weather conditions.

In the study of drunkenness, the data were taken from the records of the New York City Police Force. From them were copied the exact number of arrests for that crime for each one of the 1095 days of the three years 1893-94-95; 44,495 in all (males). The necessary meteorological data were obtained at the New York City Station of the United States Weather Bureau. There were copied the mean temperature, barometer and humidity, the total movement of the wind, the character of the day and the precipitation for each of the days of those same three years. Then, by a somewhat laborious process of tabulation, excesses or deficiencies in the occurrence of arrest for drunkenness were determined. In the accompanying diagrams these are shown for the different months of the year, and for definite conditions of temperature. In each, the heavy horizontal line represents the normal occurrence, distances along the abscissa line the months of the year and definite temperature groups, while ordinate distances show excesses or deficiencies in percentages of the expectancy. The extremes of the temperature curve are omitted where the probable error equalled or exceeded the discrepancy in occurrence.

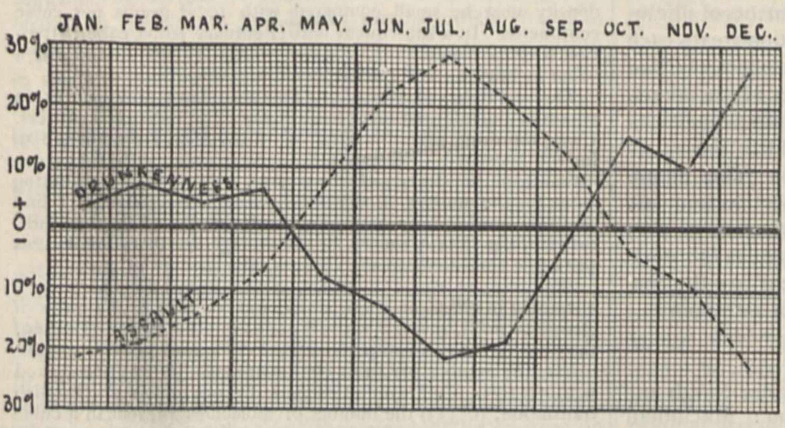


FIG .

As may be seen from both of the diagrams, the surmise of the reviewer with respect to the use of intoxicants is erroneous. In fact, their showing is somewhat surprising. As shown by Fig. 1, the prevalence of intoxication during the cold months is much in excess of that for the warm ones, December giving the police-court 47 per cent. more business from its use than did July. The physiological problem which this fact might suggest, as to the effect of equal quantities of alcohol taken under different conditions of temperature, I do not here attempt. If there is not a marked difference in this respect, our figures would indicate that much more liquor was drunk in the City of New York during the colder months of the years studied than during those of the other extreme of temperature. We claim no broader bearing for the problem; but even this is interesting.

The difference might be due either to social or meteorological influences. Under the first we may consider the effect which certain holidays might have upon the prevalence of drunkenness. Undoubtedly some days of the year are made the occasion of a drunken debauch by persons so inclined, and Christmas is one of them. But the 4th of July is perhaps just as much of a favourite for such diversion to us in America, a fact which would swell the numbers for that month. This, however, fails to show any such effect. In fact, a careful inspection of the record, although showing a slight increase of drunkenness for the festivals mentioned, proves it to be too small to account for the monthly showing. The excesses for the cold months are due to a large daily occurrence, and the deficiencies for the cold ones to the reverse conditions.

Another social condition which might effect the results is the exit from the city for the summer of some who are brought with some regularity before the bar of the police-court during the rest of the year. My study of assault and battery would, however, lead me to believe that the influence of this exodus is not great. It would be reasonable to infer that arrests for these crimes and for drunkenness would, for the most part, be made from the same social stratum, and that social conditions which would influence the prevalence of one would have the same effect upon the other. That is, if public drunkards were gone in any numbers from the city, public brawlers would be also. Yet this is precisely the reverse of what our study of assault has shown. Upon Fig. 1 I have shown, by means of a dotted curve, the arrests for this crime for the same years. It shows as marked excesses for the warm months as we have deficiencies for drunkenness for that season, a fact which would lessen the validity, if not entirely negative the weight of any migration theory which might be brought to bear upon the problem.

The third hypothesis is that of the direct effect of the peculiar meteorological conditions, and it seems to be the most plausible. Of these, temperature is the only one which we shall here consider. As shown by Fig. 2, the relation between expectancy and occurrence was worked out for each of the temperature groups indicated at the top, and represented by the curve. Low temperatures made business for the police judge, and high ones lessened his labours. Of course, if our conclusions in the preceding paragraph on occurrence were erroneous, those from this figure would be also. In that case, deficiencies for high temperatures shown here would be but concomitant variations.

The summer is hot. If there be but few arrests for drunkenness during the summer, there can be but few during high temperatures. On the other hand, if high temperatures so affect the individual that less stimulant is demanded than during those which are lower, we have here the cause of the peculiarities shown in Fig. 1. There are many reasons for believing that this is the case. In the first place, there is every reason to believe that the vitality of the body is lower in cold weather than during that which is moderately warm. This in itself would influence the demand for stimulant. A "wee drappie" is taken when *needed*, and for many this means a drunk. No doubt many of the *habitués* of the police-court as prisoners struggle against their tendencies to drink, knowing the consequences. When vitality is great, they do so with success. For days, and perhaps weeks, they are winners, but the time comes when the fight is too severe, and they succumb. That was on the day when vitality was at its lowest ebb, and the cold contributed to that condition. The poor fellow was cold; he was weak. The stimulant would give him immediate though temporary relief. He took it, and our figure shows the result.

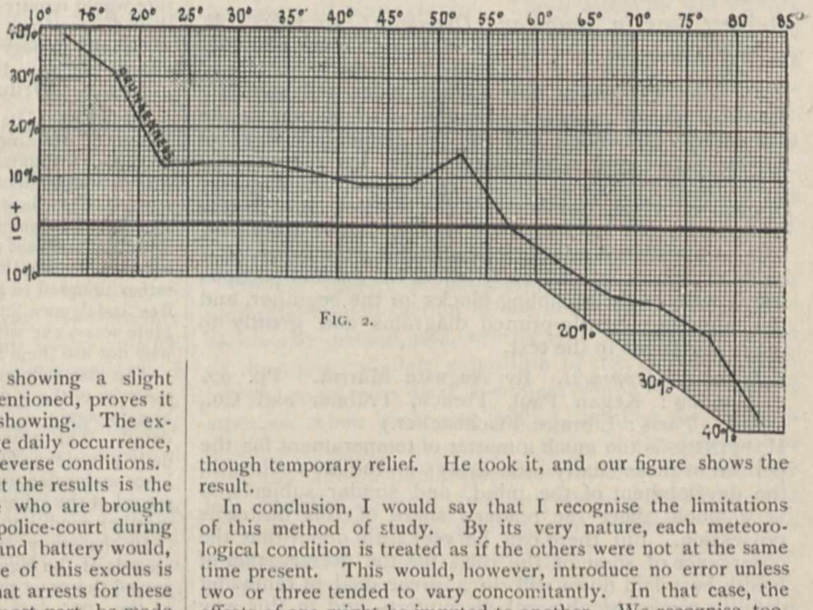


FIG. 2.

In conclusion, I would say that I recognise the limitations of this method of study. By its very nature, each meteorological condition is treated as if the others were not at the same time present. This would, however, introduce no error unless two or three tended to vary concomitantly. In that case, the effects of one might be imputed to another. We recognise, too, that a study of drunkenness does not have quite the bearing upon the drink problem that one based upon the consumption of liquor would have, but perhaps is not entirely without value. It certainly is not if it tends in the slightest way to throw the temperance problem into the hands of social reformers. Better heated tenements, warmer overcoats, and more nourishing food may have more to do with it than we think.

EDWIN G. DEXTER.

IF the writer of the notice, by any remarks of his, has given annoyance to Prof. Dexter, whose industry and careful compilation of facts have never been called into question, he would greatly regret it. But in so far as that notice has been the means of procuring from the author a most interesting letter, he can only congratulate himself.

One might call attention to many significant conclusions that could be drawn from Prof. Dexter's curves; but perhaps the most prominent is that, apparently, the greatest number of assaults are committed when the populace is the most sober. This is an entirely unexpected conclusion. In this country, we have been repeatedly told that drunkenness is the main cause of crime, especially of crimes directed against the person; and yet a careful elaboration of statistics, compiled by an eminent authority, completely demonstrates the fallacy of such an argument when applied to the City of New York.

THE WRITER OF THE NOTICE.

Deceptive Bibliographic Indications.

AUTHORS' reprints of scientific papers are indeed a boon to the worker in science, especially to him who is distant from a large library. But their usefulness to the recipient who is himself a writer of works, and not a reader only, depends to a large extent on whether the reprints are or are not provided with correct and complete bibliographical indications of their origin. Occasionally one gets a reprint without date, with no reference to the original volume, page, and plate numbers, and even it may be without the name of the periodical from which it is an extract. But in the majority of reprints distributed nowadays, an attempt has been made to give the requisite information. Success is not often attained, it is true; still one is grateful for the good intention.

The imperfections hitherto mentioned are only too easily observed, and the task of making them good, though wearisome, is not impossible if one lives long enough. But among the reprints sent to me during the last two months are numerous instances of an error more difficult to detect, and more annoying in its results. To all appearance the reprints in question give the requisite bibliographic indications, their paging seems to be that of the original, and the type shows no signs of having been disturbed. But in each case one or more of these appearances is a specious falsehood. Here are some of the misstatements observed. A reprint paged 141–147 originally appeared on pp. 142–148. A paper that occurs on pp. 170–175 of the publishing society's *Bulletin* has had the type spaced out so that the pagination of the reprint is 170–176. A reprint has the original pagination carefully given in [ ] on each page, and runs from 367 to 370; the original pages were 367–371, and half of every page has been shifted to the preceding. Sometimes the wrapper of the reprint gives one set of numbers, while the pages themselves bear another set, each purporting to be the original.

The last case is not so objectionable, since it is clear there is a mistake somewhere. But in the other cases it is only by chance that one detects the error. Each seems trivial in itself, and a single instance hailing from some petty local club would be passed over with a laugh and a grumble. But examples have come to me alone, during a few weeks, from the publications of the German Geological Society, the Zoological Society of France, the Natural History Museum of Paris, the International "Congress of Zoology," the Geological Survey of Canada, and the *Geological Magazine*.

This contempt for veracity is chargeable to the printer, not the authors; and the remedy lies in the hands of the editor. If the editors of our scientific publications would but realise the perpetual inconvenience that is caused by a little want of thought, and would but give clear and definite instructions to their printers to place the required bibliographic indications at the head of each reprint, to retain original pagination, and never to shift the type without duly stating the fact—then the amount of time saved by the numerous workers who have to rely upon authors' copies would be far greater than most people have any idea of.

F. A. BATHER.

January 31.

Specific Heat of Marble.

IN 1898 we published, in the *Proceedings* of the American Academy of Arts and Sciences, a paper containing a discussion of certain mathematical problems arising in the study of the flow of heat in prisms, together with an account of an investigation of the conductivities of a number of specimens of glass and of marble.

In this paper we called attention to two groups of fine-grained marbles, which have conductivities (nearly independent of the temperature within wide limits) of 0·0068 and 0·0076 respectively, while Carrara Statuary marble and many of the British marbles—as Messrs. Herschel, Lebour and Dunn have shown—have conductivities of only 0·0051.

Within a few weeks we have found time to determine the specific heats of all our marble blocks, and have obtained the results given in the table which follows.

These specimens, each of which is described in our former paper, had been lying untouched in the warmed laboratory for about ten months, and were, therefore, neither abnormally moist nor abnormally dry.

Variety of Marble.	Sp. Gr.	Conductivity.	Average sp. ht. between 25° C. and 100° C.	Sp. ht. per unit volume.
"Carrara Statuary"	2·72	0·00501	0·213	0·579
" "		0·00509		
"Mexican Onyx"	2·71	0·00556	0·211	0·572
"Vermont Statuary"	2·71	0·00578	0·210	0·569
"American White"	2·72	0·00596	0·214	0·582
"Egyptian"	2·74	0·00623	0·212	0·581
"Sienna"	2·68	0·00676	0·215	0·576
"Bardiglio"	2·69	0·00680	0·218	0·586
"Vermont Cloudy White"	2·75	0·00681	0·210	0·578
"Vermont Dove Coloured"	2·74	0·00684	0·208	0·570
"Lisbon"	2·75	0·00685	0·211	0·580
"American Black"	2·68	0·00685	0·214	0·574
"Belgian"	2·75	0·00755	0·206	0·567
"African Rose Ivory"	2·75	0·00756	0·212	0·583
"Tennessee Fossiliferous"	2·71	0·00756	0·214	0·580
"Knoxville Pink"	2·73	0·00757	0·212	0·579
"St. Baume"	2·70	0·00761	0·210	0·567

The results of twenty-two determinations made between different temperature limits with a number of pieces of Carrara Statuary marble artificially dried at a temperature a little above 100° C. are well represented by the following formula

$$Q = 0{\cdot}1848(t-25) + 0{\cdot}00019(t-25)^2,$$

in which Q represents the amount of heat in calories required to raise one gramme of this *dry* marble from 25° C. to the temperature t.

Jefferson Physical Laboratory, Harvard University, U.S.A.

B. O. PEIRCE.
ROBERT W. WILLSON.

The Coccidæ of New Zealand.

MR. H. FARQUHAR, in your issue of January 11, p. 247, has some interesting remarks on the Coccidæ of New Zealand, which, however, need to be slightly modified in the light of recent researches. The genera of Coccidæ peculiar to New Zealand are as follows:—

(1) *Phenacoleachia*, Ckll. (type *Leachia zealandica*, Maskell). One species. This is an extremely distinct genus, and may be regarded as the type of a distinct subfamily (Phenacoleachiinæ), differing from the Coccinæ by the compound eyes of the male, wherein it is allied to the Ortheziinæ.

(2) *Coelostomidia*, new name (*Coelostoma*, Maskell, not of Brullé, 1835, nor *Coelostomus*, McLeay, 1825). Five species. All the supposed species of *Coelostomidia* found in Australia belong to *Callipappus*.

(3) *Lecanochiton*, Maskell. Two species. A very distinct genus.

The two following genera were thought peculiar to New Zealand, but are now known from elsewhere:—

(1) *Eriochiton*, Maskell. The only species referred to this genus from elsewhere than New Zealand is *E. cajani*, Maskell, which is in reality a *Ceroplastodes;* but Mr. E. E. Green (in litt.) tells me that he has just received a genuine *Eriochiton* from Australia.

(2) *Solenophora*, Maskell. This is now known from North America and Ceylon.

I have no doubt at all that *all* of the truly native *species* of New Zealand Coccidæ are strictly endemic. The only apparent exception is that of *Eriococcus multispinus*, Maskell, which is said to occur in Australia on *Acacia;* but the Australian form was separated by Maskell as a distinct variety (var. *laevigatus*), and is doubtless a valid species. T. D. A. COCKERELL.

Mesilla Park, New Mexico, U.S.A., January 26.

The Fitting of the Cycle to its Rider.

THERE is much interesting theory in your paper on the bicycle fitted to the rider in crank and gear, by Mr. Crompton (p. 87). But what is the practice? I agree with Mr. Crompton's theories, if a slight modification be made. I think that the crank-length should be proportional not only to a man's thigh-length, but to the weight of a man's leg. The loss of power in a bicycle, as soon as it travels fast, arises from the loss of momentum at each up and down stroke of the leg according to the well-known equation:—

$$M = m.v.$$

Where M = momentum.
m = mass.
v = velocity.

A slender-built man with a light, thin (even although long) leg, can afford a higher value for v because his constant for m is low.

Not so the strongly-built man with a high constant for m. He must keep his velocity down, or M rises in value and there is a loss of power at each stroke when travelling fast.

Let me give an illustration. A few days ago I was riding an 8″ crank and 84 gear machine rather fast on a down grade. I travelled swiftly but easily. In front of me was a low-geared cyclist, his feet flying round at a high speed, the bicycle frame quivering with the velocity of his strokes, the cyclist breathing hard with his exertions. As I overhauled him I heard a pedestrian remark against his scorching. Certainly he was scorching in the sense of strongly exerting himself, but his exertions were mainly expended in the lost momentum of each stroke. The only remedy for this is a high gear.

Admitting the advantage of a high gear, the necessity for long cranks follows, otherwise the cyclist has not the power to face hills, winds, or bad roads. Two inches increased crank-length gives an enormously increased power of propulsion. I find that with 8″ cranks and 84 gear I can climb hills easier than with an ordinary roadster, say with 6½″ cranks and 64 gear.

The increased comfort and safety on a bicycle fitted as Mr. Crompton recommends are very remarkable and pleasing. The ampler free motion does away with most leg-weariness and saddle-soreness. The long, powerful cranks give one a command over the bicycle that is equally satisfactory up-hill or down-hill. One gets over the ground with a long, easy swing. Compared with the ordinary bicycle, it is like the outside edge and the inside edge in skating; or like rowing with sliding or fixed seats.

For track riding it seems possible that short cranks and high gears may give the best return for the muscular power exertion expended, since v is kept down by the high gear, and m probably represents the limb of an active young athlete weighing perhaps 10 stone. And, since there is little resistance to be overcome, the long crank may represent an unnecessary high lift of the leg.

Conversely, the greatest advantage is to be derived from long cranks and high gears in a hilly and difficult country, or where the winds are strong, as here at the Cape, and when the rider has a heavy, powerful leg.

Long cranks and high gears necessitate an alteration to the frame of the bicycle that is troublesome to makers. And hence, I suppose, the curious tabooing of the subject in the too-often interested bicycle literature of the day. D. E. HUTCHINS.

Kolàra, Kenilworth, nr. Cape Town, January 7.

Telephones and Lightning Discharges.

IN NATURE of February 8, Sir G. G. Stokes suggests an arrangement for hearing a lightning flash in a telephone. To hear the corresponding earth current, it is only necessary to put a telephone in connection with the gas and water pipes of a house. These pipes seem to suffice to entrap the corresponding earth currents, which practically enable the listener to hear the lightning. Flashes invisible in the daylight are quite noisy in the telephone. A. R. HUNT.

Southwood, Torquay.

THE GEOGRAPHY OF EUROPE.[1]

EUROPE is undoubtedly the most refractory of the great divisions of the earth to get within the limits of a geographical treatise. The mass and variety of data of high scientific accuracy are so overwhelming that it is impossible for any one man to make himself acquainted with even a small fraction of the whole, and the compilation of a book on Europe, even on the generous scale which two volumes permits, cannot in the nature of the case be much more than a compilation of earlier compilations. In unskilled hands it could not fail to become a heterogeneous collection of facts; but Mr. Chisholm has brought to bear experience and expert knowledge in the choice and co-ordination of his material, and the result is a credit to British geography. It shows a great amount of reading amongst original, and sometimes not very accessible, works in many languages, which few compilers would have considered it necessary to undertake in preparing a volume in a popular series. Numerous references are given throughout to the sources of information, and we hope that the second volume will be furnished with a bibliography of the best works dealing with Europe as a whole, and with its larger regions.

The plan of the "Compendium" has always been to take the country rather than the continent as the unit, and by doing so its scientific character has suffered, because the only possible element of unification has been ignored. Mr. Chisholm has endeavoured, with considerable success, to improve the plan of his volume by an excellent introductory chapter dealing with Europe in general, although this, to our mind, is too short; while the individual countries appear to be described in disproportionate detail. In a series obviously intended to convey information rather than to inculcate geographical principles this disproportion is, however, inevitable, and it is doubtless recognised more fully by the author than by the critic.

The guiding principle which has been kept in view throughout all the descriptions of countries is that the character of a country at the present time is due to the influence of the physical structure of the land upon the historical development of the nation. Hence a good many geological and historical facts are mentioned; but they are mentioned, not as facts for their own sakes, but as working causes accounting for the present adjustment of peoples to lands. The application of this principle has led Mr. Chisholm to commence his detailed description with Italy, which he treats with great fulness on account of its historical importance. He gives to the central Mediterranean peninsula nearly twice as much space as to Russia or France, and a third more than to the German empire. Interesting as Italy is, and vast as was its influence on all Europe, we confess that we should

[1] Stanford's "Compendium of Geography and Travel (New Issue), Europe. Vol. I. The Countries of the Mainland (excluding the North-west)." By Geo. G. Chisholm, M.A., B.Sc. Maps and Illustrations. Pp. xx + 736. (London: Edward Stanford, 1899.)

hesitate to give it so marked a pre-eminence from the geographical point of view.

Considerable stress is laid upon the importance of town-sites and the growth of towns. This is as it should be; and we would gladly have seen the peculiarities of every important town-site made clearer by means of small plans, such as are employed in Reclus' great work, and in a few modern atlases. There are excellent general and local maps, in some cases specially prepared, in others adapted from old maps, and in these instances bristling with unnecessary and sometimes mis-spelt place-names, and over one hundred pictorial illustrations, most of which are well chosen. The photograph we reproduce shows the site of Amalfi, concerning which Mr. Chisholm says, in explaining its commercial supremacy over Naples in the Middle Ages: "one may conjecture that in those troubled times merchants felt more secure on a site so well defended by nature on the side of the land as Amalfi." The disastrous landslip which occurred since the book was published gives a hint of the price exacted by nature from the posterity of the merchants who acquired this defended position.

FIG. 1.—Amalfi.

Not the least interesting part of the book is furnished by the footnotes and parentheses, which abound in curious or illustrative statements in the tersest form. These are often explanations of the forms of place-names, or the pronunciation of the more uncouth Slavonic consonants, or the briefest comparative statistics. Mr. Chisholm has studied the question of geographical orthography, and introduces some forms of Russian transliteration not usually employed, such as the terminal letter *ñ*. The difficult matter of the rendering of the Russian *e* is not yet fully grappled with, its phonetic value *ve* is not, for instance, given in the case of Ekaterinburg, nor in Kiev. The spelling *Kossack* is surely wrong; if the usual form *Cossack* (which occurs in one place) is departed from, the only reasonable forms to adopt would appear to be *Kossak* or *Kosak*. These, however, are matters which do not affect the quality or the value of the book.

Amongst the larger maps it is interesting to notice one of the geology of Europe, in which the colour-scheme of the International Geological Map is employed. It has a striking and interesting appearance; but its legibility would be improved by the adoption of reference initials, to enable similar colours to be distinguished. The Permian and Devonian, in particular, are very much alike in small patches. HUGH ROBERT MILL.

THE UNIVERSITY OF LONDON ELECTION.

THE University of London has preserved its dignity by returning Sir Michael Foster as its Parliamentary representative. From the commencement of the contest he led the way, and when the poll was declared on Monday the numbers were: Sir Michael Foster, 1271; Dr. Collins, 863; and Mr. Busk, 586.

That such a large majority should have been obtained, in spite of the fact that Sir Michael Foster entered the field nearly a fortnight after his opponents, is a result which was scarcely anticipated by the most sanguine of his supporters, and is therefore all the more satisfactory. It shows that the majority of the electors are capable of taking a broad view of their responsibilities, and that a University constituency is not influenced by the political practices found successful elsewhere. The graduates may rest assured that Sir Michael Foster will guard their privileges, and promote the progress of Science and Learning in the House of Commons. The following remarks, made by the new member for the University after the declaration of the poll on Monday, as reported in the *Times*, will convince the whole body of graduates that a representative in every respect worthy of the electorate has been sent to Parliament.

Sir Michael Foster said that the graduates had for the first time in the history of the University returned to Parliament one of themselves. He wished to be allowed to state how deeply he felt the honourable and proud position in which they had placed him. He took it that in the main they sent him to Parliament, not that he should add one more unit to this party or to that, but that he should place at the disposal of the House the somewhat special experience which he had gained in science and learning. But the Government of this country was by party, and there were only two sides to the House, on one of which he must sit. Even if he were the superior person he had been called by some newspapers, he could not expect to sit in an isolated chair, and he must respond to the lash of the Whips of one side or the other. He had carefully considered on which side of the House he should sit, and he had come to the conclusion that it was only consistent with the opinions which he had expressed concerning the present war, and with the feelings which he had as to the supreme importance of strengthening the bonds of our great colonies with this little island, that he should first of all, at all events, take his seat among the supporters of the present Government. But he took it that he might so order his ways that he did not sacrifice to party demands, or jeopardise by party action, the opportunities that he might have of forwarding in the House all interests of science, learning and education. He was subject to tradition. As one who was born in the same town as Oliver Cromwell, who was married from the house in which he dwelt, as one whose forefathers—obeying what they thought their consciences — sheltered their friend John Bunyan when he preached outlaw sermons in the woods of Hertfordshire, he felt that tradition wrapped him so about that the war cry of civil and religious liberty always made him prick his ears. Without saying what exact meaning in the new order which had given place to the old might be attached to those words, it at least meant this to him —that the affairs of the nation should not be conducted either to the detriment or to the advantage of any particular set of religious opinions. He believed that that was not his tradition only, but the tradition of that University. The University began as University College, and that college was founded, not simply for local reasons, but to afford the highest academical training to those to whom access was more or less denied to the older Universities. And he had a tradition in the University itself. To the University in its old form he owed all that he had. It had made him what he was. Did they think it was likely, therefore, that he should take any steps which he believed would tend to deny to others the good which he himself had received? He confessed that he did not wholly understand the cry which had been raised of the external student—the cry which had been used, and, if he might say so, skilfully used, to clog the voting in his favour. When he listened to some expressions it seemed to him that the cry meant "We are in possession, and we are unwilling that others should share it with us." But he could not believe that to be meant, because it was a spirit which was wholly repugnant to the spirit of the University. And in any case he himself, looking all round, could not think otherwise than that the great future which he believed lay before the University in its new form would bring good to all alike who took part in it. At all events, he should hold it to be his duty to labour in the House, not for the interests of any particular class of the University, be they doctors or lawyers, men of letters, men of science, or men of business, internal or external students, teachers or taught, men or women, but he should strive to do his best for the common good of all.

NOTES.

THE sum of 3000*l*., previously allotted for the purchase of plant for the detachment of the Electrical Engineers Volunteer Corps going to the front, is to be increased to 5000*l*.

THE death is announced of M. Emile Blanchard, member of the Paris Academy of Sciences, in the section of anatomy and zoology.

THE introduction of the metric system of weights and measures in Russia seems to be not far off. A scheme to that effect, prepared by the Ministry of Finances, has already received the approval of the Council of State, on the condition that it should be supplemented by a scheme for organising the aid, which different scientific societies and the universities are ready to render, in the verification of the new weights and measures for commerce. This latter scheme is nearly ready, and will shortly be brought before the Council of State. In the military pharmacopœia, published in 1896, all measures are already given in the metric system, which has thus been rendered obligatory for the medical staff of the army.

WE learn that traffic has just been opened on the Trans-Baikalian section, 700 miles long, of the Siberian railway, as far as Sryétensk. This little town, situated on the Shilka, is in the summer the head of a regular steam-navigation along the Amur, and, with the interruption offered by Lake Baikal, which has still to be crossed on a steamer, Sryétensk can now be reached by rail from Moscow, a distance of about 5000 miles.

AT the last meeting of the French Astronomical Society, Baron La Baume Pluvinel gave an account of the results of his inquiry into the conditions for observing the forthcoming total solar eclipse in Spain. He said that the railway service is bad; trains are very slow, and only leave Madrid once a day. The chief party of the Society will make their observations from Alicante, which is situated at the base of a high cliff, crowned by the strong Fort St. Barbara, and on one side sinks sheer down to the sea. A friend of the Society has placed a steamer at the disposal of the observers, free of charge. In addition to this steamer moored off the coast of Spain, another, with a party of astronomers on board, will go to Algiers. Mr. Percival Lowell and Prof. D. P. Todd have already left the United States to proceed to some suitable station in North Africa, from which to observe the eclipse. Mr. A. E. Douglass will make simultaneous observations under Mr. Lowell's auspices in Georgia. Messrs. Cook and Son have arranged a conducted tour to Talavera, where the total phase will be visible. The party will leave London on May 21, and will visit Paris, Bordeaux, Biarritz, and Madrid on the way.

WE learn from *Science* that the American Academy of Arts and Sciences has granted from the income of the Rumford fund 500 dollars to Prof. E. C. Pickering, for the purpose of carrying out an investigation on the brightness of faint stars, by co-operation with certain observatories possessing large telescopes, and 100 dollars to Prof. T. W. Richards, in aid of a research on the transition points of crystallised salts.

MENTION has already been made of many of the congresses to be held in connection with the forthcoming International Exposition at Paris. The following list, prepared by the committee of the Paris International Assembly, the secretaries of which are Prof. Patrick Geddes and Mr. T. R. Marr, shows the dates of some of the more important congresses announced in science and education:—Pure Science: Ornithology, June 26-30; meteorology, July 23-28; physics, August 6-11; mathematics, August 6-11; geology, August 16-28; electricity, August 18-25; anthropology and archæology, August 20-25; psychology, August 22-25; ethnography, August 26-September 1; chemistry, September 20-29; botany, October 1-6. Applied Science and Associated Industry: Horticulture, May 25-27; forestry, June 4-7; mines and metallurgy, June 18-23; vine cultivation, June 20-23; insurance, June 25-30; actuaries, June 25-30; agriculture, July 1-7; testing of materials, July 9-16; steam engines and machinery, July 16-18; applied mechanics, July 19-25; architecture and naval construction, July 19-21; photography, July 23-28; applied chemistry, July 23-31; navigation, July 30-August 4; pharmacy, August 8; economic and commercial geography, August 23-31; tramways, September 10-12; fruit culture, September 13-14; railroads, September 20-29. Medicine and Hygiene: Homœopathy, July 18-21; professional medicine, July 23-28; medicine, August 2-9; dermatology, August 2-9; dentistry, August 8-14; hygiene, August 10-17; hypnotism, August 12-15. Education: Modern language teaching, July 24-29; higher education, July 30-August 3; teaching of social science, July 30-August 5; primary education, August 2-5; secondary education, August 2-5; technical, industrial education, August 6-11; educational press, August 9-11; bibliography, August 16-18; teaching of drawing, August 29-September 1; popular education, September 10-13; agricultural instruction, September 14-16.

THE death is announced of Prof. Thomas Egleston, Professor of mineralogy and metallurgy in the school of mines of Columbia University, at the age of sixty-seven years.

Science announces that Prof. Reginald A. Fessenden, of the electrical engineering department of the Western University of Pennsylvania, has resigned his chair to accept a position in the Signal Department of the United States Weather Bureau, at Washington.

THE Simplon tunnel is now progressing at the rate of sixteen feet per day. It was begun fourteen months ago, and must be finished in five years and a half from its commencement.

THE proposal of the Council of the Royal Astronomical Society, that the meetings should in future be held at five o'clock, was rejected by the annual meeting on Friday last, and the ordinary meetings will therefore continue to be held at eight o'clock. Taylor's Calendar of the meetings of the scientific bodies of London shows that the number of societies which commence their meetings about eight o'clock is more than twice as great as the number of those which meet at four or five o'clock.

WE learn from the *Scientific American* that a special commission has been appointed to report on the ruins of the cliffdwellers in the vicinity of Mancos and Cortes, Colorado, and also near Aztec, Mexico, with the idea of reserving the lands as a national park. This action has been taken as a result of an agitation in Colorado for the protection of these ruins against vandalist relic hunters. Some of the best preserved ruins have been ruthlessly entered by curio hunters, who have broken through walls and roofs and carried away the relics. It would be a wise policy for the U.S. Government to have these ruins guarded, so that they can be investigated by experts. Fortunately, some of the best of them have not been tampered with as yet.

A NOTE upon recent improvements in the production of electrolytic copper appears in *Engineering*, and the following particulars have been obtained from it. It is a comparatively simple matter to get a good deposit of copper electrolytically, provided always that a sufficiently low current density is used. This, of course, involves a very large and expensive plant if any reasonable output of the metal is desired. With greater current densities difficulties make their appearance, and the deposit, in place of being smooth and homogeneous, becomes granular and lacks cohesion. By certain devices of one nature or another, the troubles referred to above have been largely overcome. The effect of these is shown by the fact that 10 years ago an electrolytic bath for the deposition of copper commonly contained 75 to 100 times as much metal in solution as was deposited in 24 hours. Nowadays these figures have been reduced to one-fifth of the values stated. As a consequence, the proportion of the metal obtained in the wet way has been enormously increased, the world's production being now estimated at 500 tons of electrolytic copper per diem. One of the earlier plans of increasing the output was that introduced by Elmore, in which an agate burnisher was caused to continuously pass over the surface on which the deposit was being made. The resultant metal proved to be of extraordinary strength. In a more recent development, a sheepskin impregnated with animal fat is used as a burnisher. Quite recently Mr. Sherard Cowper-Coles has hit upon another plan, in which the copper is deposited on a vertical mandril, which is caused to rotate at a very rapid rate. The centrifugal force developed and the wash of the electrolyte over the rotatory surface keeps the latter clean and free from gas, and as a consequence a smooth and dense deposit has been obtained with current densities approaching 200 ampères per square foot. An account of the process, together with details of the mechanism used, will be found in a paper recently read by Mr. Cowper-Coles before the Institution of Electrical Engineers.

THE Deutscher Mathematiker Vereinigung, which holds its meetings concurrently with the Naturforscherversammlung, has published the report of its meeting at Munich last year. The meeting was attended by about eighty members, and twenty-two papers were read, including a discussion on the decimalisation of angles and of time. Upon the proposal of Prof. Boltzmann, a committee was appointed to consider the terminology of mathematical physics. The next meeting will be held at Aachen, in September 1900.

OF the six first numerals in the Etruscan language, viz. *maχ*, *θu*, *zal*, *huθ*, *ci*, *s'a*, it has been remarked by Prof. Thomsen, in a communication to the Danish Academy, that we do not know their precise order. M. E. Elia Lattes, writing in the *Rendiconti del R. Istituto Lombardo*, discusses the value of the numeral *θu*, and the examination of old inscriptions in which this word and its derivatives occur would appear in conformity with the view previously expressed that *θu* stood for "two."

IN the *Transactions* of the Institution of Engineers and Shipbuilders in Scotland, xliii. (2), (3), Mr. W. J. Luke discusses the means adapted for moderating the rolling of ships, and in particular Froude's experiments. The principal point brought out by the paper, and the discussion on it, is the efficacy of bilge keels in extinguishing rolling motion, a result no doubt largely due to the discontinuous motion of the water past the sharp edges of the keels in each swing of the ship.

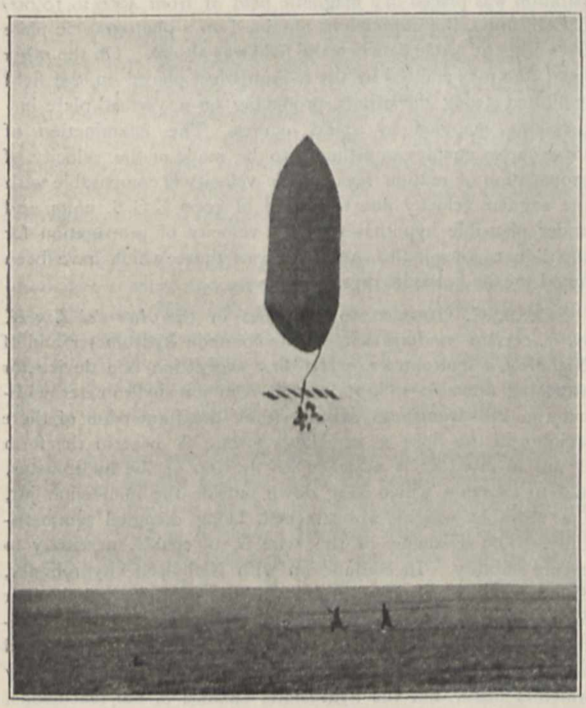
THE *Rendiconto* of the Naples Academy, v. 8-12, contains the abstract of a paper by Prof. E. Ascione, on the properties of conicoids with elliptic points, viz. the ellipsoid, hyperboloid of two sheets, and elliptic paraboloid deduced from projections made by taking an umbilicus as the vertex of conical projection, and a plane parallel to the tangent plane at the umbilicus as the plane of projection. The projections of the focal conics are evidently circles, and the author finds that the projections of the lines of curvature are obtainable by a simple geometrical construction. The method, which includes stereographic projection of a sphere as a particular case, would appear likely to lead to a number of not difficult problems in analytical solid geometry.

THE properties of certain radio-active bodies form the subject of a short note by M. Henri Becquerel (*Comptes rendus*, cxxix. 26, 1899). The nitrate of polonium, of which samples were provided by M. and Mme. Curie, was found to be nearly as active as radium, both in its power of rendering air a conductor, and in its action on a photographic plate; but the radiation from this compound did not experience any modifications in a magnetic field, such as occurred with radium. When the polonium preparation was placed in a magnetic field of from 4000 to 10,000 C.G.S. units, the impressions obtained on a photographic plate were just the same as when the field was absent. On the other hand, the rays emitted by the radium when placed in the field exhibited strong deviations, producing on a vertical plate impressions bounded by spiral curves. The examination of these curves enables an estimate to be made of the velocity of propagation of radium rays. This velocity is comparable with the angular velocity due to a field of 4000 C.G.S. units, and under plausible hypotheses give a velocity of propagation for the radium rays of the same order as those which have been found for the kathodic rays.

SIGNOR G. GUGLIELMO describes in the *Atti dei Lincei*, ix. 1, certain modifications of the common hydrometer and of Nicholson's hydrometer. His first suggestion is a device for attaching movable weights to the common hydrometer without the inconveniences arising from the immersion of these weights in the fluid as in Sikes's form. A wire in the form of an inverted U is attached to the top of the hydrometer, and to its ends, which hang down outside the immersion jar, the movable weights are attached, being disposed symmetrically. The U-shape of the wire is, of course, necessary to ensure stability. In conjunction with Nicholson's hydrometer, Signor Guglielmo recommends the use of a graduated pillar for reading off small differences of density to avoid the difficulties involved in immersing the instrument exactly to a fixed mark. Finally, a "hydrostatic balance" is described, by which is meant, not the hydrostatic balance of our text-books, but a hydrometer adapted for weighing purposes, as a substitute for the common beam balance.

THE Weather Bureau of Washington has just issued a preliminary report (Weather Bulletin, No. 208) on the kite observations of 1898, by H. C. Frankenfield, containing an interesting discussion of the vertical gradients of temperature, humidity and wind-direction at a number of stations in the United States. The report deals with probably the largest amount of free air meteorological observations taken in the same space of time, and is a valuable contribution to the general knowledge of the physics of the lower levels of the atmosphere. The mean rate of diminution of temperature with increase of height, as determined from 1217 ascents to 1000 feet or more, was 5°·0 for each 1000 feet. The largest gradient, 7°·4 per 1000 feet, was found up to 1000 feet, after which there was a steady decrease up to 5000 feet, the rate becoming less as the altitude increased. The gradient up to 5000 feet was 3°·8 per 1000 feet; above this altitude there appears to be a tendency to a slow rise. The relative humidity at and above the surface of the earth differed but little, except at 7000 feet, where the surface humidity was 11 per cent. less than that above. The mean result obtained from all the observations showed 60 per cent. at the surface and 58 per cent. above, a difference only of 2 per cent. The work contains an important introductory paper, by Prof. C. F. Marvin, on the construction and operation of the kite meteorograph.

DR. K. DANILEWSKY has sent to the *Scientific American* some interesting photographs and particulars of the latest improvements he has made in his balloon-flying machine. The experiments were conducted under the auspices of the Russian Government in order to give the inventor an opportunity of demonstrating the practicability of this dirigible air-ship, and its feasibility for use in the Signal Service Corps of the Russian Army. The balloon is shown descending in the accompanying picture. It is filled with pure hydrogen, and its comparatively small size makes it easy to manage, three or four men being sufficient to start it, and half an hour long enough to fill it with



The Danilewsky Dirigible Balloon.

gas. The balloon possesses sufficient force of ascension, or levity, to neutralise the weight of the man and tackle suspended from it. The work done by the aëronaut may thus be entirely devoted to propelling and steering the balloon, apparently by means of wing-systems, which are not described in the *Scientific American*, but may be seen in the illustration. At one of the trials of this flying-balloon, Dr. Danilewsky ascended from a certain place, disappeared from view and remained out of sight for two hours, and then returned close to the shed from which the balloon started. The experiments have induced a number of Russian experts to state that in their opinion Dr. Danilewsky has presented a practical solution of the problem of aërial navigation.

THE Botanical Garden at Buitenzorg, Java, has followed the example of that at Kew, and those of some of our Colonies, in bringing out a *Bulletin* in addition to the well-known *Annales*. The issue of the *Bulletin* of the Boissier Herbarium at Geneva has been discontinued, and its place will be taken by *Mémoires de l'Herbier Boissier*, to be published at irregular intervals.

WE have received the first number (January 1900) of the *Journal of the New York Botanic Garden*, edited by the Director of the Laboratories, Prof. T. D. Macdougal. It commences with an account, accompanied by an illustration, of the Museum Building, which claims to be "the largest, most elegant, most satisfactorily illuminated, and for its purposes the best adapted, of any similar edifice in the world." A description is given of the structure of the building, of its lecture-theatre, museums, library, and laboratories. The General Museum is designed to exhibit types of all the families and tribes of plants, from the slime-moulds or Myxomycetes to the Compositæ; and an interesting feature of the collection is that fossil plants are shown along with the living ones to which they are most nearly related. Then follow short papers on comparative forestry; on etiolated plants as food; on mycorhizas of orchids, in which it is stated that the roots and underground organs of every one of more than seven hundred species examined were found to be infested by symbiotic fungi; and on colours.

WE have received the fifth number of another new Argentine scientific journal, *Comunicaciones del Museo Nacional di Buenos Aires*. To this part Señor Ameghino contributes an illustrated account of a small skull from the Paranà deposits described last year under the name of *Arrhinolemur*, and now regarded as indicating a new order of mammals allied to the Lemurs. This skull, which is remarkably short and broad, presents the unique feature of having the nasals soldered together and placed in a cleft between the maxillæ and the premaxillæ in such a manner that, according to its describer, there is no nasal aperture! Another peculiarity is the presence of a preorbital vacuity in the cranium, and of an unossificed space on each side of the dentary portion of the lower jaw; in both of which respects it resembles the skulls of certain reptiles and birds. If rightly described, and really mammalian, the specimen is of surpassing interest, and demands the best attention of systematists. In another article in the same journal, Señor Mercerat contributes his quota to the already teeming literature on the "last of the ground-sloths" (*Neomylodon* or *Glossotherium*), in the course of which he severely criticises the determinations made by his countrymen of some of the associated remains of other animals.

THE Report for 1899 on the Lancashire Sea-fisheries Laboratory at University College, Liverpool, and the Sea-fish Hatchery at Piel, drawn up by Prof. Herdman, contains a very important account of the common cockle by Mr. J. Johnstone, who treats his subject both from the zoological and the economical point of view. The anatomy of this mollusc is very fully described, with some excellent figures; but the chief general interest centres on the economical aspect. Cockles form the food of several kinds of valuable fishes, more especially the plaice and the dab, while vast numbers are said to be consumed by the larger sea-birds. And we have a remarkable instance of how protection afforded to one group of animals reacts on another, in the statement that the recent decrease in some of the Lancashire cockle-beds is directly attributable to the increase in sea-gulls due to the operation of the Sea-Birds Preservation Act. The enormous commercial value of the Lancashire cockle-fishery will probably come as a revelation to the majority of our readers. It is stated that 2*s.* per cwt. is a low estimate of the value of the molluscs to the fishermen, since a certain quantity are hawked in the district; but, supposing the greater amount to be sent to market by rail, about 6*s.* per cwt. will represent fairly the price paid by the consumer. In the year May 1899, the total weight of cockles taken in Lancashire was 6685 tons, of which the money value at 2*l.* per ton is 13,370*l.*, and at 6*l.* per ton 40,110*l.*

MR. H. F. WITHERBY has sent us an interesting little *brochure*, entitled "Two Months on the Guadalquiver," being a reprint of articles contributed to *Knowledge*. The author made his trip for the purpose of studying the abundant bird-life of the valley. Some of his most interesting experiences were those connected with the Great Bustard. These noble birds were observed among long grass and corn; and from his observations Mr. Witherby was led to conclude that the only season when they could be coursed by dogs would be the period of the moulting of the old quills and the sprouting of the new, since at other times Bustards take at once to their wings and fly strongly.

MR. J. J. SEDERHOLM, director of the Geological Survey of Finland, has been engaged for several years in the exploration of the Archæan rocks of his mother-country. His exhaustive work on this subject, "Ueber eine archäische Sediment-Formation in Süd-westlichen Finland," accompanied by an excellent geological "Uebersichtskarte" of Finland (1 : 2,500,000), another of the Tammerfors region on a larger scale, and numerous engravings, was published, in German, in the *Bulletin* of the Finnish Geological Survey, No. 6, in February last. Mr. Sederholm, using a quotation from Prof. Lapworth's introduction to his memoir, places himself explicitly under the banner of English actualism, and he endeavours to show that the presumption of the followers of Lyell and Darwin in favour of the existence of an immense thickness of pre-Cambrian sediments is fully verified by a detailed study of the pre-Cambrian rocks in Northern Europe. He describes in great detail a typical area of Archæan crystalline schists, which are so slightly metamorphic that their original clastic character can almost everywhere be detected, as also their gradual change into gneiss-like rocks, mainly through the intervention of granite veins. Shortly describing next the Archæan sediments of Eastern Finland, and referring to the former observations of Archæan clastic and effusive-eruptive rocks by Swedish geologists and by himself, the author concludes that his ideas can be generalised so as to hold good for the whole of the pre-Cambrian region of Northern Europe, and thus have a bearing upon the solution of the Archæan problem altogether.

MESSRS. H. SOTHERAN AND CO. have just issued a catalogue of superior second-hand books in natural history which they are offering for sale.

THE current number of the *Geological Magazine* contains a notice of the life and work of the Rev. Osmond Fisher, the well-known author of the "Physics of the Earth's Crust." The memoir, which is illustrated by a copy of a recent photograph, forms one of the series of "Eminent Living Geologists."

THE "Anales de la Oficina Meteorologica Argentina" (Tomo xii.), edited by Mr. G. G. Davis, contains a discussion of the meteorological observations made at Asuncion, the capital of Paraguay, and Rosario, in Santa Fé. The volume is the second part of a work on the climate of these places.

A SECOND edition of Prof. E. Mach's "Principien der Wärmelehre" has just been published by J. A. Barth, of Leipzig. The original work was reviewed in NATURE in April 1896 (vol. 55, p. 529), and few alterations other than necessary corrections have been made. The full page portraits of physicists are better than they were in the first edition.

THE first part of "The Birds of Eastern North America," dealing with water birds, by Mr. C. B. Cory, was noticed in our issue of February 1 (p. 323). The second part, in which the land birds of the same region are described, has since been received, and is similar in character to the previous volume, and of equal importance.

WITH regard to a remark made in the notice of Kölliker's "Gewebelehre," Bd. iii. 1 Hälfte, in NATURE of February 1, as to the absence of an index, we have been informed by the publishers that their intention is to provide an index on the completion of the whole work, which they anticipate will be in about a year from the present time. It may, however, be pointed out that as each part is practically a monograph upon its special department of histology, and as eleven years has elapsed since the appearance of the first part, the absence of an index to each part is a practical inconvenience which it would have been worth a little extra cost to remedy.

THE latest number of the *Bulletin* of the Liverpool Museums, edited by Dr. H. O. Forbes, is a most creditable publication, profusely illustrated and full of scientific contributions of prime importance. Dr. Forbes is sole or joint author of three articles of the four which make up the *Bulletin*. He describes in detail a collection of stone implements in the Mayer Museum, made by Mr. H. W. Seton-Karr, in mines of the ancient Egyptians discovered on the plateaux of the Nile Valley. Numerous excellent illustrations of the implements and the workings where they were discovered, by Mr. Seton-Karr, accompany the article. As further evidence of the noteworthy character of the *Bulletin*, we may remark that there are described in it fourteen new species of birds, one new genus and six new species of reptiles, eight new species of molluscs, one new genus and thirty-three new species of insects, and eleven new species of arthropoda, many of them representing the results of the expedition to Sokotra, organised conjointly by the British Museum and the Liverpool Museum. A special volume on the expedition will shortly be issued, and, judging from the present preliminary contribution, it will be a very valuable addition to science.

THE true molecular weight of sulphur in the gaseous states has been made the subject of numerous researches. In the current number of the *Berichte*, O. Bleier and L. Kohn give an account of their work on the density of sulphur vapour at very low pressures. They hoped to be able to make determinations at such a low pressure that there would be no dissociation, but even for a pressure of 2·1 mm. of mercury the found molecular weight was 251 instead of 256, corresponding to S_8. The results obtained, plotted in the form of a curve, were quite sufficient, however, to show that the true molecular formula of gaseous sulphur, undissociated, is S_8, a value, it is interesting to note, which is in agreement with the conclusions previously arrived at by the application of the freezing-point and boiling-point methods to sulphur solutions.

RECENT discoveries in the space isomerism of nitrogen compounds have led to attempts to resolve into active constituents compounds containing asymmetric sulphur atoms. Two papers bearing on this subject have recently been read before the Chemical Society, by S. Smiles, and W. J. Pope and S. J. Peachey, respectively. In both cases methyl-ethyl-thetine was the starting-point, Smiles attempting, unsuccessfully, to prepare a strychnine or cinchonine salt of the thetine hydrobromide, or a malate of the base. Pope and Peachey succeeded in preparing two salts of the thetine with active acids (dextrocamphorsulphonic and dextro-α-bromocamphorsulphonic acids), but found that no resolution of the asymmetric thetine into optically active components occurs. Hence they draw the conclusion that if sulphur really exists as a quadrivalent element in these salts, the four atoms directly and independently attached to the sulphur lie in the same plane as the latter.

THE additions to the Zoological Society's Gardens during the past week include an Entellus Monkey (*Semnopithecus entellus*) from India, presented by Mrs. E. J. Gaudie; a Red Deer (*Cervus elaphus*, ♂) from Scotland, presented by the Right Hon. the Marquis of Breadalbane, K.G., P.C.; a Spanish Blue Magpie (*Cyanopolius cooki*) from Spain, presented by Mr. L. Ingram Baker; an Alligator Terrapin (*Chelydra serpentina*), a Floridan Terrapin (*Chrysemys concinna*), a Salt-water Terrapin (*Malacoclemmys terrapin*), a Sculptured Terrapin (*Clemmys insculpta*), four American Box Tortoises (*Cistudo carolina*), a Prickly Trionyx (*Trionyx spinifer*), two Reeves's Terrapins (*Damonia reevesi*), a Blue Lizard (*Gerrhonotus coeruleus*), a Three-striped Boa (*Lichanura trivirgata*), two Striped Snakes (*Tropidonotus sirtalis*), a Seven-banded Snake (*Tropidonotus septemvittatus*), four Corn Snakes (*Coluber guttatus*), a Chicken Snake (*Coluber obsoletus*), an American Black Snake (*Zamenis constrictor*), two King Snakes (*Coronella getula*), nine Changeable Tree-Frogs (*Hyla versicolor*) from North America, a Common Boa (*Boa constrictor*), an Annulated Terrapin (*Nicoria annulata*) from South America, eight Adorned Terrapins (*Chrysemys ornata*) from Central America, a Wrinkled Terrapin (*Chrysemys scripta rugosa*) from the West Indies, two Grooved Tortoises (*Testudo calcarata*) from South Africa, a Starred Tortoise (*Testudo elegans*) from India, deposited; two Tcheli Monkeys (*Macacus tcheliensis*, ♂ ♀) from Northern China, presented by Dr. S. W. Bushell; a Vulpine Phalanger (*Trichosaurus vulpecula*) from Australia, presented by Miss Freda Gilder; three Dial Birds (*Copsychus saularis*) from India, purchased.

OUR ASTRONOMICAL COLUMN.

DEFINITIVE ORBIT OF COMET 1897 III.—Herr E. Wessell, of the Helsingfors Observatory, has reduced 168 observations of Perrine's Comet, 1897 III, made at various observatories, and gives the resulting definitive elements of the orbit in the *Astronomische Nachrichten*, Bd. 151, No. 3614, as follow:—

Definitive Elements of Comet Perrine (1897 III.).

T = 1897 Dec. 8·679793 Berlin Mean Time.

$$\left.\begin{aligned} \omega &= 65^\circ\ 53'\ 57''\cdot6 \\ \Omega &= 32\ \ 3\ \ 8\cdot7 \\ i &= 69\ 35\ 58\cdot2 \end{aligned}\right\}\ 1897\cdot0.$$

$$\log q = 0\cdot132477$$

NEW VARIABLE STAR IN DRACO.—Dr. T. D. Anderson, of Edinburgh, has communicated to the *Astronomische Nachrichten*, No. 3618, his recent discovery of the variability of a star having the following position:—

$$\left.\begin{aligned} &\text{R.A.}\ \ 17\text{h.}\ 55\cdot6\text{m.} \\ &\text{Decl.}\ +54^\circ\ 51' \end{aligned}\right\}1855.$$

The variation in magnitude is from 9·4 to 10·4. Neither the variable nor the four stars used for comparison are mentioned in the *Bonn Durchmusterung*.

TIME USED IN EPHEMERIDES.—With the current number of the *Observatory* is issued a slip stating that the variable star ephemerides, published in the *Annual Companion*, are given in Greenwich civil time, and not in astronomical time, as heretofore. The day is divided into 24 hours, and begins at midnight. This change was rendered necessary by reason of its having been adopted by M. Loewy in the *Annuaire du Bureau des Longitudes*, from which the data for the variable star ephemerides are obtained. It is thought that this change is responsible for the recent misleading reports as to the adoption by the principal observatories of the civil time reckoning.

LEONID METEORS.—Signor E. Fergola contributes to the *Rendiconto* of the Naples Academy a note on observations of the Leonid shower, made at the Observatory at Capodimonte. The numbers of meteors observed on November 14, 15, 16 and 17 were 15, 30, 32 and 11, and the radiant point, as determined by conjoint observations of Signori Alberti, Tedeschi and Nobili, was in R.A. 10h. 8m., and declination 23°4s.

THE FUNCTIONS OF THE ENGINEER.[1]

THE success of the modern engineer is due to the fact that he has buried in the depths of oblivion the much-vaunted empirical rule of thumb, and that he has elevated to the heights of science the observations of exact practice and the exercise of pure reason. The principle of doubt, which is the root of all scientific inquiry, forces him to consider every phase of weakness in the materials that he employs in his structures, to examine every possible cause of error in his designs, to anticipate every source of failure in his work. The principle of faith, which is the outcome of the growth of his experience, must be continually illuminated by the light of progress, and controlled by the patient development and consideration of the too-long-hidden laws of nature. The engineer must maintain his acquaintance with ever-growing science so as to be able to fulfil promptly and accurately his duty, which is the application of the great principle of energy and the utilisation of the marvellous properties of matter to the wants, comfort and happiness of man.

In considering the functions of the engineer we have to consider his *practice* and his *making*.

His practice—what has he got to do? The practice of engineering can be divided into three branches: Civil, Military and Naval.

The term civil was originally introduced to distinguish the practical man of peace from the practical man of war. Engineering applied to our wants and comforts is a very different thing to that applied to the destruction of our foes or to protect ourselves from their wish to destroy us. War is waged both on land and sea, and as the conditions involved in attack and defence in modern times have become so totally different in these two cases, the term military has been gradually confined to the operations of our army on land, while the term naval is applicable to the warlike operations of our fleets. England owes her present position as the centre of a great empire to her naval supremacy, and she has acquired this supremacy as much by the inventive, constructive and maintaining powers of her working engineers as by the mighty deeds of her fearless fighting sailors.

Civil engineering aids us not only to build that haven of rest and comfort that we call home, but to surround it with the elements of health—pure air, pure water, pure food, pure light. If we congregate together in towns or scatter ourselves in country districts it supplies us with all possible means of transport by road, river and rail, and of means of intercommunication by post, telegraph and telephone. These means of annihilating time and space are not only inter-urban in our own country but international in our continents, and in a wider sense imperial, cosmical and universal, over the whole earth. The world is knit in one connected whole by wire. We know to-day from that triumph of art, science and culture—the intelligent and free British daily public Press—the history of nearly all that took place yesterday over the whole globe.

The engineer fears not the infinitely great, for the stars in their courses aid him to survey the land and to cross the deep with safety. He spurns not the infinitely little, for the molecules in their mutual actions and reactions supply him with those metals and those elements of purity and strength which give him the means to resist the forces of nature so as to span the broad channel, laugh at the foaming river, build the palace of glass at Sydenham, cover acres of ground so as to display this year in Paris the goods, manufactures, and works of art, industry and utility of the whole world.

[1] An address by Sir William Henry Preece, K.C.B., F.R.S., delivered before the Glasgow Association of Civil Engineers on February 8.

The engineer utilises matter wherever it can be found; he delves into the crust of the earth for ores and minerals which give him wealth, currency, protection and strength; he dives into the sea to survey the bottom as a bed for his cables, and to see that he has secured proper foundations for his moles, piers and breakwaters; he explores the surface of the earth for articles of necessity, of use and of luxury. He irrigates the land, to prepare it for the growth of pure and wholesome food, for the supply of cheering and sustaining drinks, for the maintenance of the stores on the shelves of the doctor, and for those articles of pure clothing that add so much to the comfort, cleanliness and health of man. He utilises for his purpose the great principle in the construction of roads, bridges, aqueducts, canals, river navigation and docks, for internal intercourse and exchange, and in the construction of ports, harbours, moles, breakwaters and lighthouses, and in the art of navigation by artificial power for the purposes of commerce, and in the construction and adaptation of machinery, and in the drainage of cities and towns."

It is difficult to classify the sections of engineers into any logical order; but I have attempted in the following table to arrange methodically the various branches upon the same principle as we draw up a genealogical tree, for every branch emanates by direct descent from the one root, engineering, which is applied science.

ENGINEERING.

- CIVIL.
- MILITARY.
- NAVAL.

NAVAL:

- Artillery. Gun Mountings. Explosives.
- Ship-building.
- Marine Engineering.
- Hydrography.
- Application of Steam Hydraulics and Electricity to the auxiliary machinery of Ships.
- Torpedoes. Submarine Mining.

MILITARY:

- Fortification.
- Artillery and Explosives.
- Surveying and Reconnaissance.
- Submarine Mining.
- Signalling and Telegraphy.
- Barracks Construction.
- Traction. Road / Railway } making.
- Search-lights.
- Ballooning.

CIVIL:

Domestic.	*Municipal.*	*Inter-Urban.*	*National.*	*International.*	*Cosmical (or Universal).*
Bells and Signals.	Electrical Energy.	Bicycles.	Breakwaters.	Connection of National Surveys.	Astronomical Mensuration.
Buildings (Architecture.)	Gas.	Canals.	Ceramics.	Lighthouses.	Geodesy.
Drainage.	Housing the Working Classes.	Motors.	Chemical Industries.	Posts (Letter Carriage).	Hydrography.
Lifts.	Hydraulic Power.	Railways.	Coinage.	Steam Navigation.	Manufactures.
Lighting.	Hygiene.	River Navigation.	Construction of Machinery and Engines.	Submarine Telegraphy.	
Ventilation.	Markets.	Roads.	Docks.		
Warming.	Overcrowding.	Telegraphs.	Harbours.		
Water-supply.	Parks and Recreation Grounds.	Telephones.	Irrigation and Agriculture.		
	Public Buildings.	Surveying.	Lighthouses.		
	Public Lighting.		Management of Estates.		
	Refuse-destruction.		Manufacturing Processes.		
	Sewage and Drainage.		Metallurgy.		
	Slaughter-houses.		Mining and Quarrying.		
	Smoke-prevention.		Refrigeration.		
	Streets.		Signal Stations.		
	Tramways.		Trigonometrical Survey.		

of energy, so as to transform it at his will into its various forms of heat, light, electricity, sound, chemism and material motion. By these agencies he transforms crude matter into its various elements, compounds and states, so as to secure permanence, strength and value.

Life is not free from his grasp. He has developed the Empire of Bacteria, and has encouraged the minute microbe in countless armies—to liquefy and purify our sewage, and to become the scavenger of our homes and our cities. He has by defensive measures freed the soil and the river from those ruthless bacterial enemies who invade our frames and bring disease and death in their train.

Engineering is divided into various sections, many of them having their own institutions and their own publications.

The definition of a civil engineer, as given in the charter of the institution, is very comprehensive. This institution is "a society for the general advancement of mechanical science, and more particularly for promoting the acquisition of that species of knowledge which constitutes the profession of a civil engineer, being the art of directing the great sources of power in nature for the use and convenience of man, as the means of production and of traffic in states both for external and internal trade, as applied

The growth of invention in early ages was very slow. Man sheltered himself in caves. How long did it take him to devise a tent, or a hut, or a house? How long to protect himself with clothing? How long to construct weapons of offence and defence, not only to protect himself from wild beasts and from his neighbours, but to secure for himself food and raiment? The first protection from weather was probably the skins of the animals he hunted, killed and ate, and the first art acquired—the making of leather. How long did it take him to obtain a knowledge of the use of fire, and of the means of producing it artificially, so as to cook his food and to bake the plastic clay into pots and pans for drinking and eating purposes?

We have no record of these early stages of the evolution of the human being. The first known picture depicts him as a hunter. Ages elapsed before the conception of a record "engraved upon the rock forever" seems to have occurred to him, and though stone, papyrus, clay, skin and wax gave him material upon which he could record in elementary pictures his victories, his virtues, and his commands, many centuries passed before the greatest invention the world has ever acquired—the alphabet—occurred to some smart Phœnician, probably in the land of Egypt, where picture-writing, hieroglyphy, had reached its acme. It has taken 3000 years to mature this invention. The alphabet we use to-day is a direct descendant of that first Phœnician attempt to indicate the elementary sounds of speech by letters. But what a change has occurred since the next great invention in this direction—printing! The brain is now excited by the publication of every new fact extracted from Nature's storehouse. Inventions spring up like mushrooms. They are published by the Press to the whole world at once. Innumerable minds of all nations are thus set to work to utilise, develop and improve them. Advance is rapid, and progress proceeds at a compound interest rate. I said it took 3000 years to mature the alphabet. It has taken 450 years to perfect printing, but sixty years in our days have matured telegraphy and photography, and only sixty months have been sufficient to apply Röntgen rays to assist the physician to apply his gentle art to restore to health the maimed and wounded. Such is the advantage of publicity!

Why such marvellous constructive skill and scientific progress should have been developed on the banks of the Euphrates and the Nile on the old, and in Mexico and Peru on the new continent, so early in the history of the world, is a mystery of the development of the mind that remains to be satisfactorily explained as much as the persistent conservatism of the negro and the gipsy of the present day. The wicker hut depicted on Egyptian bas reliefs 3000 years ago is the same dwelling-place of the same race in the present day!

The luxurious, roomy, and well-warmed southern villa of their Roman conquerors failed to commend itself permanently to the mind of the unrefined ancient Briton. Nevertheless, the Roman taught us the arch, showed us how to build a bridge, and left us his straight and admirable road. The words arch, pont and street remain in our languages historical memorials of those early colonists.

The rapid progress of modern engineering is phenomenal. Practice grows by leaps and bounds. Take any form of energy and examine its utilisation in any field of industry. Take only one instance of the application of electricity. See how it comes to the aid of the sailor! It controls the rudder, it ventilates the interior and the living space of the ship, it forces the draught and assists the raising of steam, it revolves the turrets, it trains and controls the guns, it handles the ammunition, it purifies the drinking water, it lights up the ship internally, it enables the captain to sweep the horizon with the brilliant rays of the search-light, and to communicate with his tender, or with his commanding officer across space independent of weather, night, season, fog or rain. It would lengthen this address too much to illustrate this point further. Light, sound, heat, chemism and mechanics have been equally active in the service of man, and have helped to specialise in many directions the functions of the engineer.

The Making of the Engineer.—It is idle to ignore the fact that the modern engineer is the outcome of high-class and long-sustained education, either imparted or self-acquired. Education means generally the training of the intellectual, moral and physical faculties of youth, but the education of the engineer never ceases as long as he remains in active practice. I am still in school, and rarely fail to acquire some new fact each day of my life. The first foundation is clearly a broad, solid, general education, not specialised in any way until the pupil has reached the stage when he can work and think for himself. But from the very earliest years—in fact, from infancy—I advocate the cultivation of the powers of observation, a systematic training of the memory, and an encouragement of the exercise of thought. This is, in reality, the scientific method. Many people advocate the early teaching of science, but I do not. I advocate the collection and naming of plants, the love of animals and knowledge of their habits, the observation and explanation of the daily occurrences in the house, the air and the ground. The fire, a candle, the teapot, cooking, blacking boots, the dewdrop, clouds, rain, wind and storm, the ebb and flow of the tide, the performances of tops and bicycles, familiarly explained, excite a love of nature and of science, and train the mind to observe, to think and to remember. Cramming the young mind with ill-digested text-book science, illustrated by experiments that generally fail, excites ridicule—the common accompaniment of ignorance.

The engineer must be a scientific man. Science deals with the facts of nature, their laws and their theory. The engineer applies this knowledge to the uses of mankind. His practice means the correct design and due execution of works. The present President of the British Association, in his inaugural address delivered at Dover, drew no distinction between natural knowledge (science) and applied science (engineering). His illustrations to glorify the former were drawn from the triumphs of the latter. Sciences are *experimental*, such as chemistry, mechanics and physics, and *observational*, such as botany, zoology geology, geography, astronomy, biology, &c. They are very numerous, and, as engineering is only another term for applied science, it is clear that an engineer would waste his time in acquiring abstruse sciences that would be of no subsequent use to him He must confine himself to those branches of science which will be of service to him in his future career, so as to enable him to apply them to living, industry and commerce. *Mathematics*, the shorthand of thought and the purest form of logic, *experiment*, the handmaid of observation, *measurement*, the instigator of accuracy and precision, and *reasoning*, the organ of common sense, are the tools that shape his store of knowledge which memory brings to his help when he has to practise what he has learnt. The boy who has passed well through the ordinary curriculum of school, and proceeds thence into a university, from which he emerges as a young man not only well imbued with the refining influences of literature and art, but with a well-earned degree of science, is fully prepared to commence his engineering training, and to enter the workshop or the drawing-office, where alone he can acquire that combination of knowledge and skill, and that training of the brain and the hand for mutual aid which is called technical education.

The Institution of Civil Engineers will now admit into their body only those who can produce the certificate of such an educational career as I have indicated above, or who can pass an examination which will give evidence of his possessing similar qualifications. A scientific man can become an engineer only when he has become an expert through practice and experience.

It is not a question between science and practice; it is a question between science and rule of thumb. Practice is always there, but rule of thumb means rule of error, until by repeated failures rule of thumb becomes rule of right, which means the victory of organised common sense. Organised common sense is a very good term for science. Scientific men talk nonsense when they observe differences between science and practice, and so-called practical men act foolishly when they ignore science, and assert that an ounce of practice is worth a ton of theory. Practice based on true science means immediate success and economy; practice based on rule of thumb means error, delay and excess of estimates. The engineer cannot neglect the laws of nature, any more than the scientific man can ignore the success of practice. The science of the Chair has, however, often been obsolete or behind the day. The professor is not sufficiently in touch with the industrial and economical interests of the country. It happens that in my own special branch of the profession practice has always been in advance of theory. The progress of telegraphy and telephony owes nothing to the abstract scientific man. The fundamental principles and natural facts that underlie the practice of electrical engineering are the teachings of actual experience, and not the results of laboratory research or professorial teaching. The science is, however, now established, and those who are academic students have the advantage of acquiring a knowledge of facts and principles in the class-room before they commence their practical career. Their path is thus much cleared and their progress expedited. They start well equipped mentally to grasp and comprehend the art of their profession.

Smeaton, Watt, Telford, Stephenson, Fairbairn, Whitworth, and all our early engineers had to acquire their own natural knowledge by their own individual investigations. They had to seek out and determine first principles for themselves. All that is now changed. The science of to-day is the science of the Victorian era. The engineer is not now required to research as much as his predecessors. There are now physical laboratories where it can be done for him, but this must not tempt him to lessen his enthusiasm in verifying the facts of nature by experiment. Doubt must always be transformed to faith.

The civil engineer of eminence has not only to know thoroughly the science, but to conduct the practical operations of his profession. The lives of human beings are entrusted to his designs. People have faith in the safety of his ships, long tunnels, bridges and railway trains. He is called upon to advise on policy, to deal with commercial management, to act as arbitrator or judge in many important intricate judicial cases, and to appear in courts of law and committee rooms of Parliament as an expert witness. The mental qualities of the engineer must, therefore, be of the very highest order. His scientific training and his world-wide practice have broadened his views and enlarged his mind. Above all, his character must be above all reproach. The honour of the engineer is the honour of his profession. The Lord Chief Justice's Bill was welcomed by every member of the Institution of Civil Engineers. The evil it is desired to suppress is very great and very wide, but it is not the characteristic of the engineer.

Let me, in conclusion, impress on you the antiquity and the universality of the functions of the engineer. Tubal-Cain was an instructor of every artificer in brass and iron, and this before the flood. The very earliest remains of Egyptian, Babylonian and Assyrian temples and monuments indicate a wonderful knowledge of the strength of materials. The Cloaca Maxima of the early Latin King Tarquinius Priscus exists still, though built 2,600 years ago. In the track of war and diplomacy, in the earliest days of history, went trade and commerce. The general became the engineer. Western Asia was covered with roads, not only to facilitate the transport of troops and chariots, but to assist the merchant in the distribution of his wares. Intercourse of all kinds has always been the outcome of civilisation. The balance of power falls to the strong. In days of old it was to the strong physically. In modern days it is more to the strong mentally and financially. The greatest political gift that mind can give to man, the greatest security for peace and comfort, is the ability to wield the great powers of nature so as to destroy human life with the greatest rapidity and at the greatest distance. An overpowering fleet and an efficient army are our insurance for security at home. There is not a habitable spot on the face of the earth that does not bear traces of the presence of the engineer. He is the great civiliser. He not only immediately follows, but he sometimes even precedes the military conqueror. He distributes peace and good-will without the accompaniments of fire, blood and famine. Mr. Cecil Rhodes is opening up Africa with the "wonder-working wire." Khartoum has been brought within seventy hours of Cairo by train, and ere long, when peace is restored in that self-disturbed country, South Africa, Cairo and Cape Town will be in direct and immediate communication by telegraph, and eventually by rail.

The engineer is not only a benefactor to his race, but he is a necessity of the age.

WIRELESS TELEGRAPHY.[1]

WHEN Ampère threw out the suggestion that the theory of a universal ether, possessed of merely mechanical properties, might supply the means for explaining electrical facts, which view was upheld by Joseph Henry and Faraday, the veil of mystery which had enveloped electricity began to lift. When Maxwell published, in 1864, his splendid dynamical theory of the electro-magnetic field, and worked out mathematically the theory of ether waves, and Hertz had proved experimentally the correctness of Maxwell's hypothesis, we obtained, if I may use the words of Prof. Fleming, "the greatest insight into the hidden mechanisms of nature which has yet been made by the intellect of man."

A century of progress such as this has made wireless telegraphy possible. Its basic principles are established in the very nature of electricity itself. Its evolution has placed another great force of nature at our disposal.

We cannot pay too high a tribute to the genius of Heinrich Hertz, who worked patiently and persistently in a new field of experimental physics, and made what has been called the greatest discovery in electrical science in the latter half of the nineteenth century. He not only brought about a great triumph in the field of theoretical physics, but, by proving Maxwell's mathematical hypothesis, he accomplished a great triumph in the progress of our knowledge of physical agents and physical laws.

I cannot forbear saying one word as to the eminent electrician who was placed in his last home as recently as Saturday last, for it is manifest that several years ago Prof. Hughes was on the verge of a great discovery, and, if he had persevered in his experiments, it seems probable that his name would have been closely connected with wireless telegraphy as it is with so many branches of electrical work in which he gained so much renown and such great distinction.

[1] Abridged from a discourse delivered at the Royal Institution, on February 2, by Mr. G. Marconi.

The experimental proof by Hertz thirteen years ago, of the identity of light and electricity, and the knowledge of how to produce, and how to detect these ether waves, the existence of which had been so far unknown, made possible true wireless telegraphy. I think I may be justified in saying that for several years the full importance of the discovery of Hertz was realised but by very few, and for this reason the early development of its practical application was slow.

The practical application of wireless telegraphy at the *present* time is many times as great as the predictions of five years ago led us to expect in so short a time. The development of the art during the past three or four years, and its present state of progress, may perhaps justify the interest which is now taken in the subject. Yet only a beginning has been made, and the possibilities of the future can as yet be only incompletely appreciated. All of you know that the idea of communicating intelligence without visible means of connection is almost as old as mankind. Wireless telegraphy by means of Hertzian waves is, however, very young. I hope that if I pass over the story of the growth of this new art, as I have watched it, or do not attempt to prove questions of priority, no one will take it for granted that nothing is to be said on these subjects, or that all that *has* been said is entirely correct.

The time allowed for this discourse is too short to permit me to recount all the steps that have led up to the practical applications of to-day. I believe it will probably interest you more to hear of the problems which have lately been solved, and the very interesting developments which have taken place during the last few months.

I find that a great element of the success of wireless telegraphy is dependent upon the use of a coherer such as I have adopted. It has been my experience, and that of other workers, that a coherer as previously constructed—that is, a tube several inches long partially filled with filings enclosed by corks—was far too untrustworthy to fulfil its purpose. I found, however, that if specially prepared filings were confined in a very small gap (about 1 mm.) between flat plugs of silver, the coherer, if properly constructed, became absolutely trustworthy. In its normal condition the resistance of a good coherer is infinite, but when influenced by electric waves the coherer instantly becomes a conductor, its resistance falling to 100 or 500 ohms. This conductivity is maintained until the tube is shaken or tapped.

I noticed that by employing similar vertical and insulated rods at both stations it was impossible to detect the effects of electric waves of high frequency, and in that way convey the intelligible alphabetical signals, over distances far greater than had been believed to be possible a few years ago.

I had formerly ascertained (see paper read before the Institution of Electrical Engineers by G. Marconi, March 1899) that the distance over which it is possible to signal with a given amount of energy varies approximately with the square of the height of the vertical wire, and with the square root of the capacity of a plate, drum, or other form of capacity area which may be placed at the top of the wires.

The law governing the relation of height and distance has already been proved correct up to a distance of 85 miles. Many months ago it was found possible to communicate from the North Haven, Poole, to Alum Bay, Isle of Wight, with a height of 75 feet, the distance being 18 miles. Later on two installations with vertical wires of double that length, *i.e.* 150 feet, were erected at a distance of 85 miles apart, and signals were easily obtained between them. According to a rigorous application of the law, 72 miles ought to have been obtained instead of 85; but, as I have previously stated, the law has been proved only to be approximately correct, the tendency being always on what I might call the right side; thus we obtain a greater distance than the application of the law would lead us to believe. There is a remarkable circumstance to be noted in the case of the 85 miles signalling. At the Alum Bay station the mast is on the cliff, and there is no curvature of the earth intervening between the two stations; that is to say, a straight line between the base of the Haven and Alum Bay stations would clear the surface of the sea. But in the case of the 85 miles the two stations were located on the sea-level, and between them exists a hill of water, owing to the earth's curvature, amounting to over 1000 feet. If these waves travelled only in straight lines, or the effect was noticeable only across open space, in a direct line, the signals would not have been received, except with a vertical wire 1000 feet high at both stations.

While carrying out some experiments nearly three years ago at Salisbury, Captain Kennedy, R.E., and I tried numerous forms of induction coils wound in the ordinary way, that is, with a great number of turns of wire on the secondary circuit, with the object of increasing, if possible, the distance or range of transmission, but in every case we observed a very marked decrease in the distance obtainable with the given amount of energy and height. Similar results were obtained some months later, I am informed, in experiments carried out by the General Post Office Engineers at Dover.

In all our above-mentioned experiments the coils used were those in which the primary consisted of a smaller or larger number of turns of comparative thick wire, and the secondary of several layers of thinner wire. I believe I am right in saying that hundreds of these coils were tried, the result always being that by their employment the possible distance of signalling was considerably diminished instead of being increased. We eventually found an entirely new form of induction coil that would work satisfactorily, and that began to increase the distance of signalling.

The results given by some of the new form of induction coils have been remarkable. During the naval manœuvres I had an opportunity of testing how much they increased the range of signalling with a given amount of energy and height. When working between the cruisers *Juno* and *Europa*, I ascertained that when the induction coil was omitted from the receiver, the limit distance obtainable was seven miles, but with an improved form of induction coil included, a distance of over sixty miles could be obtained with certainty. This demonstrated that the coils I used at that time increased the possible distance nearly tenfold. I have now adopted these induction coils, or transformers, at all our permanent stations.

A number of experiments have been carried out to test how far the Wehnelt brake was applicable in substitution for the ordinary make and break of the induction coil at the transmitting station, but although some excellent results have been obtained over a distance of forty miles of land, the amount of current used, and the liability of the brake getting fatigued or out of order, have been obstacles which have so far prevented its general adoption.

As is probably known to most of you, the system has been in practical daily operation between the East Goodwin Lightship and the South Foreland Lighthouse since December 24, 1898, and I have good reason for believing that the officials of Trinity House are convinced of its great utility in connection with lightships and lighthouses. It may be interesting to you to know that, as specially arranged by the authorities of Trinity House, although we maintain a skilled assistant on the lightship, he is not allowed to work the telegraph. The work is invariably done by one of the seamen on the lightship, many of whom have been instructed in the use of the instrument by one of my assistants. On five occasions assistance has been called for by the men on board the ship, and help obtained in time to avoid loss of life and property. Of these five calls for assistance, three were for vessels run ashore on the sands near the lightship, one because the lightship herself had been run into by a steamer, and one to call a boat to take off a member of the crew who was seriously ill.

In the case of a French steamer which went ashore off the Goodwins, we have evidence, given in the Admiralty Court, that, by means of one short wireless message, property to the amount of 52,588*l.* was saved; and of this amount, I am glad to say, the owners and crews of the lifeboats and tugs received 3000*l.* This one saving alone is probably sufficient in amount to equip all the lightships round England with wireless telegraph apparatus more than ten times over. The system has also been in constant use for the official communication between the Trinity House and the ship, and is also used daily by the men for private communication with their families, &c.

It is difficult to believe that any person who knows that wireless telegraphy has been in use between this lightship and the South Foreland day and night, in storm and sunshine, in fog and in gales of wind, without breaking down on any single occasion, can believe, or be justified in saying, that wireless telegraphy is untrustworthy or uncertain in operation. The lightship installation is, be it remembered, in a small damp ship, and under conditions which try the system to the utmost. I hope that before long the necessary funds will be at the disposal of the Trinity House authorities, in order that communication may be established between other lightships and lighthouses and the shore, by which millions of pounds' worth of property and thousands of lives may be saved.

At the end of March 1899, by arrangement with the French Government, communication was established between the South Foreland Lighthouse and Wimereux, near Boulogne, over a distance of thirty miles, and various interesting tests were made between these stations and French warships. The maximum distance obtained at that time, with a height of about one hundred feet on the ships, was forty-two miles. The commission of French naval and military officers who were appointed to supervise these experiments, and report to their Government, were in almost daily attendance on the one coast or the other for several weeks. They became intensely interested in the operations, and I have good reasons to know made satisfactory reports to their Government. I cannot allow this opportunity to pass without bearing willing testimony to the courtesy and attention which characterised all the dealings of these French gentlemen with myself and staff.

The most interesting and complete tests of the system at sea were, however, made during the British naval manœuvres. Three ships of the "B" fleet were fitted up, the flagship *Alexandra*, and the cruisers *Juno* and *Europa*. I do not consider myself quite at liberty to describe all the various tests to which the system was put, but I believe that never before were Hertzian waves given a more difficult or responsible task. During these manœuvres I had the pleasure of being on board the *Juno*, my friend, Captain Jackson, R.N., who had done some very good work on the subject of wireless telegraphy before I had the pleasure of meeting him, being in command. With the *Juno* there was usually a small squadron of cruisers, and all orders and communications were transmitted to the *Juno* from the flagship, the *Juno* repeating them to the ships around her. This enabled evolutions to be carried out even when the flagship was out of sight. This would have been impossible by means of flags or semaphores. The wireless installations on these battleships were kept going night and day, most important manœuvres being carried out and valuable information telegraphed to the Admiral when necessary.

The greatest distance at which service messages were sent was 60 nautical miles, between the *Europa* and the *Juno*, and 45 miles, between the *Juno* and the *Alexandra*. This was not the maximum distance actually obtained, but the distance at which, under all circumstances and conditions, the system could be relied upon for certain and regular transmission of service messages. During tests messages were obtained at no less than 74 nautical miles (85 land miles).

As to the opinion which naval experts have arrived at concerning this new method of communication, I need only refer to the letters published by naval officers and experts in the columns of the *Times* during and after the period of the autumn manœuvres, and to the fact that the Admiralty are taking steps to introduce the system into general use in the navy.

As you will probably remember, victory was gained by the "B" fleet, and perhaps I may venture to suggest that the facility which Admiral Sir Compton Domville had of using the wireless telegraph in all weathers, both by day and night, contributed to the success of his operations.

Commander Statham, R.N., has published a very concise description of the results obtained in the *Army and Navy*, illustrated, and I think it will be interesting if I read a short extract from the admirable description he has published.

"When the reserve fleet first assembled at Tor Bay, the *Juno* was sent out day by day to communicate at various distances with the flagship, and the range was speedily increased to over 30 miles, ultimately reaching something like 50 miles. At Milford Haven the *Europa* was fitted out, the first step being the securing to the main topmast head of a hastily prepared spar carrying a small gaff or sprit, to which was attached a wire, which was brought down to the starboard side of the quarter-deck through an insulator and into a roomy deck house on the lower after-bridge which contained the various instruments.

When hostilities commenced the *Europa* was the leading ship of a squadron of seven cruisers despatched to look for the convoy at the rendezvous. The *Juno* was detached to act as a link when necessary and to scout for the enemy, and the flagship of course remained with the slower battle squadron. The *Europa* was in direct communication with the flagship long after leaving Milford Haven, the gap between reaching to 30 or

40 miles before she lost touch while steaming ahead at a fast speed. (This difference between the ranges of communication on these ships was owing to the *Juno* having a higher mast than the *Alexandra*).

"Reaching the convoy at four o'clock one afternoon, and leaving it and the several cruisers in charge of the senior captain, the *Europa* hastened back towards another rendezvous, where the Admiral had intended remaining until he should hear whether the enemy had found and captured the convoy; but scarcely had she got well ahead of the slow ships when the *Juno* called her up and announced the Admiral coming to meet the convoy. The *Juno* was at this time fully 60 miles distant from the *Europa*.

"Now imagine," says Commander Statham, "a chain of vessels 60 miles apart. Only five would be necessary to communicate some vital piece of intelligence a distance of 300 miles, receive in return their instructions, and act immediately all in the course of half an hour or less. This is possible already. Doubtless a vast deal more will be done in a year or two or less, and meanwhile the authorities should be making all necessary arrangements for the universal application of wireless telegraphy in the navy."

The most important results, from a technical point of view, obtained during the manœuvres were the proof of the great increase of distance obtainable by employing the transformer in the receiver, as already explained, and also that the curvature of the earth which intervened, however great the distance attained, was apparently no obstacle to the transmission. The maximum height of the top of the wire attached to the instruments above the water did not on any occasion exceed 170 feet, but it would have been geometrically necessary to have had masts 700 feet high on each ship in order that a straight line between their tops should clear the curved surface of the sea when the ships were 60 nautical miles apart. This shows that the Hertzian waves had either to go over or round the dome of water 530 feet higher than the tops of the masts or to pass through it, which latter course I believe would be impossible.

Some time after the naval manœuvres, with a view to showing the feasibility of communicating over considerable distances on land, it was decided to erect two stations, one at Chelmsford and another at Harwich, the distance between them being 40 miles. These installations have been working regularly since last September, and my experiments and improvements are continually being carried out at Chelmsford, Harwich, Alum Bay, and North Haven, Poole.

In the month of September last, during the meetings of the British Association in Dover and of the Association Française pour l'avancement de Science in Boulogne, a temporary installation was fixed in the Dover Town Hall, in order that members present should see the practical working of the system between England and France. Messages were exchanged with ease between Wimereux, near Boulogne, and Dover Town Hall. In this way it was possible for the members of the two associations to converse across the Channel, over a distance of 30 miles.

During Prof. Fleming's lecture on the "Centenary of the Electric Current," messages were transmitted direct to and received from France, and *viâ* the South Foreland Lighthouse to the East Goodwin Lightship. An interesting point was that it was demonstrated that the great masses of the Castle Rock and South Foreland cliffs lying between the Town Hall, Dover, and the lighthouse did not in the least degree interfere with the transmission of signals. This result was, however, by no means new. It only confirmed the results of many previous experiments, all of them showing that rock masses of very considerable size intervening between two stations do not in the least affect the freedom of communication by ether wave telegraphy. (See *Journal* of the Institution of Electrical Engineers, April 1899, p. 280.)

It was during these tests that it was found possible to communicate direct from Wimereux to Harwich or Chelmsford, the intervening distance being 85 miles. This result was published in a letter from Prof. Fleming addressed to the *Electrician* on September 29. The distance from Wimereux to Harwich is approximately 85 miles, and from Wimereux to Chelmsford also 85 miles, of which 30 miles are over sea and 55 over land. The height of the poles at these stations was 150 feet, but if it had been necessary for a line drawn between the tops of the masts to clear the curvature of the earth they would have had to have been over 1000 feet high. I give these results to show what satisfactory progress is being made with this system.

In America wireless telegraphy was used to report from the high seas the progress of the yachts in the International Yacht Race, and I think that occasion holds the record for work done in a given time, over four thousand words being transmitted in the space of less than five hours on several different days.

Some tests were carried out for the United States Navy; but, owing to insufficient apparatus, and to the fact that all the latest improvements had not been protected in the United States at that time, it was impossible to give the authorities there such a complete demonstration as was given to the British authorities during the naval manœuvres. Messages were transmitted between the battleship *Massachusetts* and the cruiser *New York* up to a distance of 36 miles.

A few days previous to my departure from America the war in South Africa broke out. Some of the officials of the American line suggested that, as a permanent installation existed at the Needles, Isle of Wight, it would be a great thing, if possible, to obtain the latest war news before our arrival on the *St. Paul* at Southampton. I readily consented to fit up my instruments on the *St. Paul*, and succeeded in calling up the Needles station at a distance of 66 nautical miles. By means of wireless telegraphy, all the important news was transmitted to the *St. Paul* while she was under way, steaming twenty knots, and messages were despatched to several places by passengers on board. News was collected and printed in a small paper called the *Transatlantic Times* several hours before our arrival at Southampton.

This was, I believe, the first instance of the passengers of a steamer receiving news while several miles from land, and seems to point to a not far distant prospect of passengers maintaining direct and regular communication with the land they are leaving and with the land they are approaching, by means of wireless telegraphy.

At the tardy request of the War Office, we sent out Mr. Bullocke and five of our assistants to South Africa. It was the intention of the War Office that the wireless telegraph should only be used at the base and on the railways, but the officers on the spot realised that it could only be of any practical use at the front. They therefore asked Mr. Bullocke whether he was willing to go to the front. As the whole of the assistants volunteered to go anywhere with Mr. Bullocke, their services were accepted, and on December 11 they moved up to the camp at De Aar. But when they arrived at De Aar, they found that no arrangements had been made to supply poles, kites, or balloons, which, as you all know, are an essential part of the apparatus, and none could be obtained on the spot. To get over the difficulty, they manufactured some kites, and in this they had the hearty assistance of two officers, viz. Major Baden-Powell and Captain Kennedy, R.E., who have often helped me in my experiments in England. (Major Baden-Powell, it will be remembered, is a brother of the gallant defender of Mafeking.)

The results which they obtained were not at first altogether satisfactory, but this is accounted for by the fact that the working was attempted without poles or proper kites, and afterwards with poles of insufficient height, while the use of the kites was very difficult, the kites being manufactured on the spot with very deficient material. The wind being so variable, it often happened that when a kite was flying at one station there was not enough wind to fly a kite at the other station with which they were attempting to communicate. It is therefore manifest that their partial failure was due to the lack of proper preparation on the part of the local military authorities, and has no bearing on the practicability and utility of the system when carried out under normal conditions.

It was reported that the difficulty of getting through from one station to another was due to the iron in the hills. If this had not been cabled from South Africa, it would hardly be credible that any one should have committed himself to such a very unscientific opinion. As a matter of fact, iron would have no greater destructive effect on these Hertzian waves than any other metal, the rays apparently getting very easily round or over such obstacles. A fleet of thirty ironclads did not affect the rays during the naval manœuvres, and during the yacht race I was able to transmit my messages with absolute success across the very high buildings of New York, the upper storeys of which are iron.

However, on getting the kites up, they easily communicated from De Aar to Orange River, over a distance of some seventy miles. I am glad to say that, from later information received, they have been able to obtain poles, which although not quite high enough for long distances are sufficiently useful. We have also sent a number of Major Baden-Powell's kites, which are the only ones I have found to be of real service.

Stations have been established at Modder River, Enslin, Belmont, Orange River, and De Aar, which work well and will be invaluable in case the field telegraph line connecting these positions should be cut by the enemy.

It is also satisfactory to note that the military authorities have lately arranged to supply small balloons to my assistants for portable installations on service waggons.

While I admire the determination of Mr. Bullocke and our assistants in their endeavour to do the very best they could with most imperfect local means, I think it only right to say that if I had been on the spot myself I should have refused to open any station until the officers had provided the means for elevating the wire, which, as you know, is essential to success.

Mr. Bullocke and another of our assistants in South Africa has been transferred with some of the apparatus to Natal to join General Buller's forces, and it is likely that before the campaign is ended wireless telegraphy will have proved its utility in actual warfare. Two of our assistants bravely volunteered to take an installation through the Boer lines into Kimberley; but the military authorities did not think fit to grant them permission, as it probably involved too great a risk.

What the bearing on the campaign would have been if working installations had been established in Ladysmith, Kimberley and Mafeking, before they were besieged, I leave military strategists to state. I am sure you will agree with me that it is much to be regretted that the system could not be got into these towns prior to the commencement of hostilities.

I find it hard to believe that the Boers possess any workable instruments. Some instruments intended for them were seized by the authorities at Cape Town. These instruments turned out to have been manufactured in Germany. Our assistants, however, found that these instruments were not workable. I need hardly add that as no apparatus has been supplied by us to any one, the Boers cannot possibly have obtained any of our instruments.

I have spoken at great length about the things which have been accomplished. I do not like to dwell upon what may, or will, be done in the immediate or more distant future, but there is one thing of which I am confident—viz. that the progress made this year will greatly surpass what has been accomplished during the last twelve months; and speaking what I believe to be sober sense, I say, that by means of the wireless telegraph, telegrams will be as common, and as much in daily use, on the sea as at present on land.

THE AIR MOVEMENT AT SIMLA AND IN THE WESTERN HIMALAYAS.[1]

IT will generally be admitted that the Meteorological Reports that are issued from time to time by the Indian authorities possess two very valuable features. The work is thorough in its execution, and the result derived is interesting. The present discussion of the air movement at Simla and in the Western Himalayas does not, in either novelty or importance, fall behind the other memoirs which have preceded it, although it presents only a portion of the full investigation, which, when complete, will embrace a similar discussion of the observations made at Darjeeling, a station as characteristic of the Eastern Himalayas, as Simla is of the Western. Two circumstances contribute to the interest attaching to this special inquiry. One is, that our knowledge of the behaviour of the winds in mountain areas is somewhat limited, both on the practical and theoretical side: consequently, a thorough study is particularly welcome. The other is the suitableness of the situation for such an inquiry, since the phenomena can exhibit themselves here on a large scale, and the influence of minor interfering effects be much eliminated. In Indian meteorology we have to deal with large masses of air, subject to periodic laws and partaking of the general movement of the air at the earth's surface. In this particular instance, we have the Indo-Gangetic plain stretching from the North Punjab to East Bengal, some 1350 miles long, and 200 miles in average breadth. The whole of this area is below 1000 feet in elevation, and probably averages barely 400 feet above the sea. From this plain the outer ranges of the Himalayas rise with remarkable abruptness over nearly the whole length. On the northern side, by way of contrast, we have the elevated tableland of Thibet, of which a considerable portion exceeds 14,000 feet in elevation, constituting the great protuberance above the general level of the earth's surface, of which the Himalaya and Karakoram mountains are nothing but the northern and southern borders. In this noble theatre and laboratory, the movements of the air peculiar to mountain areas can be studied with effect, and yet, by some strange perversity, the subject has been neglected. The knowledge which we have gained, and which is repeated in text-books, has unfortunately been derived from wind registers which were either not continuous in their action, or from which partial extracts have been made. The records selected for discussion were made at 8 and 10 a.m. and 4 p.m., consequently, the effect of the night winds, accompanying a fall of temperature, did not come within the scope of investigation. Moreover, the stations chosen for the anemometric instruments represented the characteristics of the air movement across the lower mountain ranges and not the local up and down movements in the deep valleys which lie between these ranges. It is therefore not surprising that the results derived from so partial a source need corrections, or that the accounts given by travellers through these districts, limited as they necessarily are to certain seasons of the year, do not adequately represent the whole of the observed phenomena.

In the opening pages Mr. Eliot briefly reviews the state of our knowledge, and sketches the work of his predecessors in office. The conclusions derived from this haphazard and intermittent kind of observation were to the effect that southerly winds prevail throughout the whole year at the Himalayan hill stations, indicating that in the south-west monsoon the lower air current extends to these elevations; whereas, in the cold weather, the air current giving these winds is the upper movement complementary to the north-westerly winds at the level of the plains. Moreover, the records indicated that the air movement is strongest in the Western Himalayas from January to April, and is feeblest during the monsoon period from June to September. To these statements, which have been frequently quoted, Sir Richard Strachey added, from his own experience and observation, that the most important feature of the air movement in the Western Himalayas was the up and down valley winds, blowing up the valleys during the day from 9 a.m. to 9 p.m. and down them during the corresponding hours of the night.

Mr. Eliot deals with these statements in the first series of tables founded on the records of a large Beckley anemometer, not particularly described. He gives the number of winds recorded under each of eight points of the compass for portions of the years 1893–1896, and derives the constants of the well-known Besselian formula representing the diurnal variation of the winds. The result is to show that the mean monthly air movement is in January and February approximately S.E., and for the remainder of the year is N. 46° E. as opposed to S. 61° W. from the partial records already referred to. Other deductions which come out of this preliminary inquiry show that the air movement is least during the rainy season of July and August, greatest from January to May, and that, since the mean movement is almost as great in January and February as in the hot weather months, it is not a function of the temperature. Mr. Eliot sums up the general conclusions in the following terms:—"The air moment at Simla varies slightly in strength throughout the year, but has two well-marked maxima and minima, in no way related directly to the seasons or to the air movement over the plains in Northern India. These facts alone constitute a strong proof of the inference that the air movement over the Himalayan area is a unique system, independent of the general air movement over the plains in Northern India, and dependent on local conditions and features."

Neither does the *diurnal* variation of the wind, whether in velocity or rotation, partake of that simple character which has been ascribed to it, but within a limited space it is not easy to summarise the results of the analysis applied. For Mr. Eliot

[1] "Indian Meteorological Memoirs; being occasional discussions and compilations of meteorological data relating to India and the neighbouring countries." Vol. vi., Part 5. (Published by order of H.E. the Viceroy and Governor-General of India in Council, under the direction of John Eliot, M.A., F.R.S., C.I.E., Calcutta, 1899.)

not only discusses the broad effects of great seasonal changes, but considers the minuter variations noticeable month by month. Still unsatisfied and fearing that some effects are masked by the fallacious system of averages, into which occasional and irregular disturbances can enter with perplexing and even misleading effect, he finally studies the air movement during normal days in each of the characteristic weather periods that mark the climate of India. In this way, and in this way only, does it seem possible to assign a correct physical interpretation to the various types of air movements that are shown to exist. It is impossible to read this section without acknowledging the presence of a master hand, in the closeness of the reasoning, in the clear marshalling of facts, and in the accuracy of the deductions.

The broad result is to show that there is an upward movement during the day hours from about 8 a.m. to 5 p.m., giving southerly winds with more or less westing, and having their maximum intensity at 2 p.m., and a downward movement during the remaining hours, giving northerly winds with more or less easting. A comparison of the barometric readings, at the hill and plain stations respectively, shows that this observed transfer of air (from hills to plains by night, and plains to hills by day) is accompanied by a similar transfer in the opposite directions in the upper strata of the atmosphere. In other words, there is a complete air circulation between the hills and plains of the Western Himalayas.

From the arrangement of his facts Mr. Eliot passes to a theoretical discussion based on the diurnal variation of the vertical pressure anomalies and of the temperature conditions prevailing in the hills and plains, establishing the existence of horizontal pressure gradients from the plains to the hills in the day hours, and from the hills to the plains in the night time, giving rise to alternating movements, roughly proportional to the diurnal range of temperature in the Punjab plains. The hours at which the gradients disappear are worked out with care, and demonstrate the existence of a see-saw motion. Such alternating movements cannot be without their effect on the temperature and humidity of the air at Simla. In fact, the maximum day temperature over the East Punjab plains mainly determines the maximum day temperature at Simla, while the height of the snow line on the Himalaya range will affect the minimum readings. Into the cloud observations and the humidity conditions we have not space to enter. We can only say that the author leaves untouched no clue that can throw light upon this important feature of day and night alternating currents. The observations at his command do not extend over a very long period, in which it might be expected that disturbances would counteract and destroy each other; but by the careful sifting of the evidence the author has been able to deduce many points of interest, and has left a model which may serve for any future discussion of local air movements.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—An additional year has been granted, in addition to the usual University period of residence, which qualifies for examination in any honour school, to those members of the University who shall have been absent on military service in connection with the war in South Africa.

In a congregation held on February 6, the preamble of the statute instituting the degrees of Doctor of Letters and Doctor of Science was approved, without opposition. By this action the University undertakes to institute these degrees; the exact provisions of the scheme will, of course, be arranged later, but it has been proposed that a candidate for the degree shall submit *published* papers or books containing an original contribution to the advancement of learning or science. (*See* NATURE, vol. lxi. p. 164).

The curators of the University chest are authorised to expend such sums as may be necessary in maintaining the rooms assigned to the new department of geography. A considerable number of students have availed themselves of the opportunities afforded by this new department.

CAMBRIDGE.—The decision of the Senate on the question of remodelling the Mathematical Tripos, is to be taken to-day (February 15). The discussion by means of fly-sheets indicates that the opposition will be strong; but the arguments adduced against the present proposals of the Mathematical Board, point rather to regression towards the old undivided and unlimited examination than to the maintenance of the existing Tripos, with which few persons are perfectly satisfied.

The following have been appointed Electors to the several scientific chairs:—Chemistry, Prof. Dewar; Plumian of Astronomy, Lord Rayleigh; Anatomy, Dr. D. MacAlister; Botany, Zoology, and Agriculture, Sir M. Foster; Geology, Mr. W. H. Hudleston; Jacksonian of Natural Philosophy, Prof. Liveing; Downing of Medicine, Sir T. Lauder Brunton; Mineralogy, Sir G. G. Stokes; Experimental Physics, Prof. Darwin; Engineering, Prof. A. B. W. Kennedy; Physiology, Dr. Gaskell; Surgery, Mr. T. Holmes; Pathology, Dr. L. Humphry; Mental Philosophy, Prof. Sidgwick.

Profs. Liveing, Marshall Ward, Hughes, and Somerville, and Messrs. Warburton, Widdicombe, Adie, and McCracken, have been appointed examiners for the Diploma in Agricultural Science.

BY the will of the late Mr. W. Hiddingh, who died on December 10, 1899, the University of the Cape of Good Hope is bequeathed the sum of 5000*l*. for the foundation of a scholarship to enable young persons to pursue and complete a course of professional study, the scholarship to be tenable for four years. The University is also bequeathed the sum of 25,000*l*. for the purpose of building a university hall and suitable university offices, and a large piece of ground for the site of the building. The South African College will receive the sum of 10,000*l*. for the erection of a students' building.

IT appears from a return just published that the amount expended on technical education, exclusive of the sums allocated to intermediate and technical education under the Welsh Intermediate Education Act, was in 1897–98 860,104*l*., and the estimated total expenditure during the year 1898–99 was 874,611*l*. The amounts raised by loan on the security of the local rate under the Technical Instruction Acts were—in 1897–98 69,333*l*., and in 1898–99 133,583*l*. The total amount of the residue received under the Local Taxation (Customs and Excise) Act by the councils of counties and county boroughs in England, excepting Monmouth, in respect of the financial year 1897–98 was 834,826*l*., of which 759,400 was appropriated to educational purposes, and 75,426*l*. to the relief of rates, the latter sum including 42,108*l*. devoted by the London County Council, to relief of the rates. Of the forty-nine counties forty are applying the whole of the residue, and nine a part of it, to technical education. The total of the residue paid to the thirteen county councils and the councils of three county boroughs in Wales and Monmouth was 40,061*l*., and these local authorities are devoting the whole of it to intermediate and technical education under the Welsh Intermediate Act, 1889. In the case of Ireland the residue is not applicable to technical education. Twelve local authorities expended on technical education during the year 1897–98 5649*l*., and the estimated total expenditure by them during 1898–99 was 4523*l*.

THE Massachusetts Institute of Technology is well known to be among the foremost educational institutions in the United States. The "Annual Catalogue," for 1899–1900, which has just been received, is an instructive volume for any one interested in the methods of technical education followed in America. The equipment of this Institute accords with the view that the foundation of all sound technological education requires, not only thorough theoretical training, but also prolonged, well-directed laboratory drill which shall first give the student the power of close and accurate observation, and then bring him into direct contact with the material problems of his future profession. The laboratories of the Institute are numerous and extensive, the Kidder laboratories of chemistry affording accommodation for more than six hundred students; their equipment is correspondingly ample, and is kept well up to the rapid advances in technical practice. Provision is made for exact general training in the problems of physics and chemistry, for highly specialised work in these and other sciences, and for engineering tests and processes on a practical scale. Great importance is attached to the study of mathematics, both as a means of mental discipline, and as affording a necessary basis for further instruction in the engineering and other courses. The instruction in applied chemistry includes the use of text- and reference-books in both

French and German. Many other instances might be given of the thorough character of the work being done, but those cited will serve to show that the alumni of the Institute receive an education which is of service in assisting the development of American industries.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, February 9.—Annual General Meeting.—Prof. Lodge, F.R.S., President, in the chair.—The following officers were elected to form the Council:—President, Prof. Lodge; Vice-Presidents (who have filled the office of President), Dr. Gladstone, Prof. Carey Foster, Prof. Adams, Lord Kelvin, Prof. Clifton, Prof. Reinold, Prof. Ayrton, Prof. Fitzgerald, Prof. Rucker, Sir W. Abney, Mr. Shelford Bidwell; Vice-Presidents, Mr. Blakesley, Mr. Boys, Prof. Everett, Mr. Griffith; Secretaries, Messrs. H. M. Elder and W. Watson; Foreign Secretary, Prof. S. P. Thompson; Librarian, Mr. W. Watson; Treasurer, Prof. Callendar; other members of Council, Prof. Armstrong, Dr. Atkinson, Mr. W. Baily, Prof. Glazebrook, Mr. E. H. Griffiths, Mr. S. Lupton, Prof. Perry, Mr. Swinburne, Prof. Threlfall and Mr. J. Walker.—Prof. Lodge delivered his Presidential address, on the controversy concerning Volta's contact force. Those who take a metallic view of the Volta contact force are accustomed to deny that the Peltier evolution of heat measures the local E.M.F. existing at a junction; they assert that it measures the rate at which that same E.M.F. varies with temperature. In the thermodynamic equation connecting the Peltier effect with the variation of E with temperature, the E which varies is not necessarily that at the junction considered, but is the total E.M.F. of the circuit. The reversible heat at a specified junction is a measure of the metallic E.M.F. located there. Those who say it is a temperature variation of the E.M.F. beg the question by locating the whole E.M.F. of the circuit at the particular junction they are considering, usually an interface of zinc and copper. At a chemical junction the E.M F. is not purely thermal, and hence is not measured by the Peltier effect; it is chiefly of chemical origin, and is calculable from the energy of combination of the materials on either side of the boundary. At a metallic junction there is no such chemical potentiality. A strong current may be passed across a zinc-copper junction for years and no brass is formed. It is, therefore, improbable that the chemical affinity of zinc for copper is the propelling influence which causes the E.M.F. located at such a junction. In showing the Volta effect experimentally, a trace of liquid can act detrimentally by forming a conducting bridge between the plates, across which the bulk of the electricity passes as the metals are being separated. The safest and clearest mode of expressing the Volta effect is that it consists in an opposite charge acquired by dry zinc and copper while in metallic contact, a charge which results from an E.M.F. of fixed value, and is controlled solely by this E.M.F. and electrostatic capacity. It is undeniable that the order of the Volta force can be calculated from the differential heats of combination of the metals for oxygen, although it is doubtful whether it can be calculated from the heat of formation of brass. The opposing sides of the old controversy used to be called contact theorists and chemical theorists. Now the opposite sides are involved both in contact and in chemical views. It is a question of which of several contacts is the effective one, and what kind of chemical action or affinity is the active cause. Is it the contact and chemical affinity across the metal-metal junctions, or across the metal-air junctions? The opposite sides are thus metallic and dielectric. The metal-air force is of the order volts; the metal-metal force is of the order milli-volts. When a piece of zinc is put in contact with a piece of copper, the oxygen atoms which surround these bodies move slightly away from the copper and approach slightly nearer to the zinc. These slight motions produce the whole Volta effect. All that is necessary for the Volta effect is the inherent film on the surface. All the rest of the gas is mere dielectric, and might be substituted by a vacuum. It was proposed by Prof. Perry and seconded by Prof. Armstrong that a meeting should be held to discuss the address. The meeting was adjourned until February 23.

Mineralogical Society, January 23.—Prof. A. H. Church, F.R.S., President, in the chair.—Mr. E. G. J. Hartley, in continuation of his investigations on the constitution of the natural arsenates and phosphates, gave the results of analyses of beudantite, which lead to the new formula:

$$3PbSO_4.2Fe(P, As)O_4.6Fe(OH)_3.$$

Prof. H. A. Miers found by optical examination that the mineral was probably not uniaxial, but pseudorhombohedral.—Mr. G. T. Prior described rock-specimens from the Little Island of Trinidad, S. Atlantic, which were collected by the Ross Antarctic Expedition. They consisted mainly of phonolites, with nephelenite and limburgite.—Mr. W. Barlow contributed a paper on a new method of deriving the thirty-two classes of crystal symmetry, which, it is stated, is more rigorous and at the same time simpler and more concise than the solutions hitherto given.—Mr. R H. Solly exhibited crystals of dolomite from the Binnenthal, in which the tetartohedral character was well displayed.—Mr. A. L. Hall described new forms on crystals of copper-pyrites from Cornwall.

Geological Society, January 24.—W. Whitaker, F.R.S., President, in the chair.—Fossils in the University Museum, Oxford: II.—On two new genera and species of Crinoidea, by Prof. W. J. Sollas, F.R.S. The first genus and species are founded on two calyces in the University Collection and three in the British Museum; all the specimens come from the Carboniferous Limestone. The arms and stem are at present unknown. The genus in general character and structure recalls *Platycrinus*, but the incorporation of the costal and distichal plates in the calyx affords a very obvious distinction. The analysis of the calyx, however, suggests the Melocrinidæ, from the members of which it is chiefly distinguished by the comparatively small size of the costal and distichal plates. The new genus is a truly annectant form uniting the Melocrinidæ and the Platycrinidæ, and may be indifferently associated with either. The second genus and species are founded on a specimen in the Grindrod Collection, obtained probably from the Silurian rocks, but from a locality not known, possibly Dudley. In general appearance it resembles an elongated form of *Pisocrinus*, particularly in its calyx, but the arms are those of a Heterocrinid. This conjunction of characters, though rendering necessary a revision of the definition of the Pisocrinidæ, cannot be regarded as bringing this family appreciably nearer to the Heterocrinidæ, which are fistulate, while the Pisocrinidæ, so far as known, are not.—Fossils in the University Museum, Oxford: III.—A new worm-track from the slates of Bray Head, Ireland, with observations on the genus *Oldhamia*, by Prof. W. J. Sollas, F.R.S. The curious marking known as *Oldhamia* have not been hitherto recorded from other than the Lower Palæozoic rocks, although they have a wide distribution in space, being found in Ireland, in the Ardennes, in Brabant, in America, and possibly in Norway. While the organic nature of *Oldhamia* was scarcely a matter of doubt in the minds of the earlier writers, there existed a great diversity of opinion as to its place in the organic world, and it was placed by different observers among polyzoa, hydrozoa, and plants, respectively. The microscopical observations made by the author prove that *Oldhamia* is not the remains of an organism, but merely a marking in the rock, though one which might be, nevertheless, of organic origin.—Contributions to the Geology of British East Africa: Part II.—The geology of Mount Kenya, by Dr. J. W. Gregory. The three main zones of Kenya are characterised by different geological features. The long slope of the forest-belt consists in the main of volcanic ash, though the remains of secondary parasitic craters occur in it. The Alpine zone consists of coarser ash, agglomerates, and tuffs, interbedded with lava-flows and traversed by numerous dykes, with the remains of some secondary centres of eruption. The third zone, or central peak, consists of the plug which choked the central vent, of beds of agglomerate, and the thick proximal ends of the great lava-flows.—Contributions to the Geology of British East Africa: Part III.—The elæolite-syenite and fourchites intrusive in the coast series, by Dr. J. W. Gregory. The rocks described in this paper were given to the author by Mr. C. W. Hobley. Mount Zombo, situated in long. 39° 13′ E. and lat. 4° 26′ S., and 1519 feet high, is a massif of coarse-grained elæolite-syenite, consisting of anorthoclase, elæolite, usually allotriomorphic, and ægyrine. The rock must occur in the belt of Duruma Sandstone, unless the fossiliferous Jurassic shales run westward up the low valley of the Umba River. The sedimentary series on the coast-lands of British East Africa and Usambara are provisionally arranged by the author as follows: (5) Pleistocene reefs, limestones, alluvium, and laterites; (4) Jurassic shales and sandstones; Kimeridgian, Oxfordian, and

Callovian; (3) Possibly a pre-Jurassic part of the Duruma Sandstone; (2) Magarini sandstones; ? Triassic; (1) Sabaki shales; Upper Carboniferous.

MANCHESTER.

Literary and Philosophical Society, February 6.—Prof. Horace Lamb, F.R.S., President, in the chair.—On the conditions of propagation of a solitary wave, by R. F. Gwyther. In order to obtain mathematical formulæ capable of expressing in a few terms the equality of surface pressure over the long stretches of the solitary wave, the wave is regarded as being mainly supported by the pressure on the outskirts, any defect in the equality of pressure over the crest being looked on, under certain conditions, as overcome by a slight readjustment of the particles. Taking in $x+iy$ a term of the form tan $hm\frac{(\phi+i\psi)}{c}$, it is shown that the results agree closely with the experimental results of Scott Russell.—On the motion of the particles in certain cases of steady fluid motion, by R. F. Gwyther. It is shown that the solution of the Lagrangian equations takes the form $x+iy=f(u+ib)$, where u is to be determined in terms of a, b, and t, by a quadrature.—On internal migration in England and Wales, 1881-91, by Prof. A. W. Flux. An account is given of the results of an examination of the net inward and outward movement in each registration district of England and Wales in the interval between the censuses of 1881 and 1891. The movement of the two sexes separately was taken, as differences in intensity and direction for males and females were not infrequent. Of the 54 registration counties (the Ridings of Yorkshire being separately considered), 40 showed net efflux for both sexes, and 7 others for one of the two sexes; of the 632 districts 124 only showed net influx of population taking the sexes together, this figure being reduced to 119 for males and raised to 136 for females. The net movements within the various counties involved a transference of about 304,000 males and 350,000 females from one district to another. Movement from a district in one county to one in another county involved a transference of about 172,000 males and 230,000 females, whilst some 418,000 males and 201,000 females left the country. The previously observed greater migratory tendency of the female seems at any rate partly due to the fact that when migration is tested by records of birth-places, the excess of migratory males are not included, owing to their removal beyond the limits of the kingdom. Measuring intensity of movement by the proportion of net migration to mean population, the absorption is most marked in London suburbs, and in those of some provincial towns in only a slightly less degree, and especially is marked in conveniently situated watering-places at the seaside, Bournemouth heading the list. The absorption into growing industrial towns is less strongly shown than might have been anticipated. These movements indicate some amelioration of the evils of life in crowded cities. The districts from which efflux has been strongest are found in the south-west, in Wales, on the Scotch border, and in north-east Yorkshire and Lincolnshire. A cartogram illustrating the movements was exhibited.

DUBLIN.

Royal Irish Academy, January 22.—Dr Benjamin Williamson, F.R.S., Vice-President, in the chair.—Rev. W. R. Westropp Roberts, F.T.C.D., read a paper "On the Reduction of the Integral $\int\frac{\phi(z)\,dz}{\psi(z)\sqrt{f(z)}}$ to a number of other Integrals of the form $\int\frac{dz}{(z-n)\sqrt{f(z)}}$, where $\phi(z)$ and $\psi(z)$ are rational and integral functions of z and $f(z)$, a polynomial of the degree $2m$." The writer showed, in the first instance, the dependence of the above integral on $2m-1$ Integrals $I_0, I_1, \ldots I_{2m-1}$, and others of the form $L(z, n)$, having previously adopted the notation $I_r \equiv \int\frac{z^r dz}{\sqrt{f(z)}}$, $L(z, n \equiv \int\frac{dz}{(z-n)\sqrt{f(z)}}$, r being an integer. These $2m-1$ Integrals $I_0, I_1, \ldots I_{2-m1}$ are ultimately shown to depend on Integrals of the form $L(z, n)$, in which n is specially related to the roots of $f(z)=0$. The result finally arrived at is that there is but *one* class of elementary Integrals, as the general Integral discussed in the paper can, in all cases, be made to depend on a number of others of the form $L(z, n)$.—Prof. J. P. O'Reilly read a paper on the Epidiorites of Killiney Park, Dublin county. He called attention to the description of the locality given in the Memoir of the Geological Survey of Ireland descriptive of the district, and pointed out that no mention is made therein of these rocks, although reference is made to those met with in Howth and other parts of the district. Considering the fine exposure shown at Killiney Park, and the accessibility of the point, he thought it desirable to make a map of the point where the rocks crop out, showing their connection with the micaschists; which map was submitted with the paper. He also had analyses of the Epidiorite and of the enclosing micaschists made, and gave them in the paper. He called attention to the occurrence of similar micaschists at Bray Head, and suggested the possibility that the Killiney Park rocks may be the same beds as those of Bray Head, but in a much more advanced stage of metamorphosis.

PARIS.

Academy of Sciences, February 5.—M. Maurice Lévy in the chair.—Calculation of the orbit of a comet of which the geocentric movement is considerable, by MM. O. Callandreau and G. Fayet. Although the calculations of the orbits of the minor planets are sufficiently exact to enable the asteroid to be easily traced from day to day, considerable differences arise between the actual and calculated positions of some of the newer comets. A simplification of Olbers' method is suggested, which, with the aid of the auxiliary table suggested by M. Radau, gives very easily a good approximation.—The localisation, elimination and origin of arsenic in animals, by M. Armand Gautier. The amounts of arsenic normally present in 100 grams of the fresh organ are, for the thyroid gland, 0·75 mgr.; the mammary gland, 0·13 mgr.; for the brain, trace or nothing; thymus gland, a distinct trace, not estimated; for skin, milk, and bone, decreasing traces. The liver, kidney, spleen, muscles, testicles, pituitary gland, pancreas, mucous membranes, cellular tissue, salivary glands, subrenal capsules, ovaries, urine and faces contain no trace of arsenic. With the view of ascertaining the possible sources of arsenic in the food supply, various food stuffs were carefully examined for this metalloid: bread, meat and fish contained absolutely none, eggs gave a very doubtful trace. The author discusses the medico-legal aspect of the question.—Attempt at a mechanical theory of mountain formation. Progressive displacement of the terrestrial axis, by M. Marcel Bertrand. The view is put forward that the solid crust to the earth yields slowly to the pressures acting upon it, exactly as a liquid would do, except that the duration of the motion, instantaneous for a fluid, is exceedingly slow in the case of a solid.—On a disease of the grape-vines of the Caucasus, by MM. Prillieux and Delacroix. Previous workers on the outbreak of vine disease in the Caucasus, in 1896, have ascribed the results as due to the fungus of black rot (*Guignardia Bidwelli*), but closer examination has shown that it is another species of *Guignardia*, which corresponds to *Phoma reniformis*, which is the cause of the Tiflis disease, to which the authors attribute the name of *Guignardia reniformis*.—Observations of the comet 1899 IV. (Temple, 1873 ii.) made with the large equatorial at the Observatory of Bordeaux, by MM. G. Rayet, Féraud and Esclangon.—On the second voyage of the *Princess Alice II.*, by S. A. S. Prince Albert of Monaco.—Study of the variation of latitude at the Observatory of Teramo, Italy, by M. Jean Boccardi. The measurements were carried out by the method of Horrebow-Talcott, with an instrument of Troughton and Simms of 75 mm. aperture. For four different pairs of stars the variations of latitude found were 1″·00, 0″·84, 0″·67, and 0″·98 respectively.—On a class of transformations, by M. J. Clairin.—On the determination of all the algebraic surfaces of double circular generation, by M. Eugène Cosserat.—On anharmonic algebraic equations, by M. Antonne.—On groups of isomorphisms, by M. G. A. Miller.—On vectorial masses of discontinuity, by M. André Broca.—The X-rays and discharge: generalisation of the notion of kathode rays, by M. G. Sagnac. A sealed note deposited July 18, 1898.—Contribution to the study of stratifications, by M. H. Pellat. Some experiments designed with a view to test the hypothesis that the stratifications produced in a Geissler tube are due to the interference of direct and reflected electric waves. The result was to negative this hypothesis, there being apparently neither a reflected electric wave nor electric oscillations.—On the metallic crystallisation by electrical transport of certain metals in distilled water, by M. Thomas Tommasina.—On the surface tension of some organic liquids, by MM. Paul Dutoit and Louis Friderich. Measurements are given of the temperature coefficient of surface energy for a large number of liquids, by Ramsay and Shields' method. The average value of the coefficient found was 2·12, rising to 2·3, for hydrocarbons containing two benzene rings, and to 2·35 to 2·50 for the anilines. The general results confirm the earlier work of Ramsay and Shields on the same subject.—On the volumetric estimation of hydrogen and chemical tensions, by M. Alb. Colson. Precipitated silver oxide, dried *in vacuo* without heating, is readily acted upon by hydrogen, slowly at ordinary temperatures, and more rapidly at 100° C., the absorption being so complete in the latter case that it suffices for the volumetric determination of hydrogen in a gaseous mixture, since methane and ethane are unattacked under the same conditions. The silver oxide behaves as though it had a definite vapour pressure, the hydrogen apparently acting upon this vapour.—Action of strong ammonia solution upon the iodide of mercurdiammonium, by M. Maurice François. By the action of strong solutions of ammonia upon $HgI_2.2MH_3$, the iodide Hg_2NI is formed, the reaction being reversible.—On the borates of the magnesium series, by M. L. Ouvrard. Definite tribasic borates of manganese, cobalt and nickel can be prepared in the dry way, in a state of purity sufficient for analysis.—On the acidimetric value of the substituted malonic acids, compared with those of the corresponding normal diacids, by M. G. Massol. A thermochemical paper.—On the individuality of seminase, a soluble ferment secreted by leguminous seeds during germination, by MM. Émile Bourquelot and H. Hérissey. The presence of the new ferment, together with a little diastase, was shown in germinating seeds of fenugrec and lucerne.—Influence of a parasite upon its host, by M. C. Sauvageau.—On the first fossil plant sent from Madagascar, by M. Ed. Bureau. The fossil is a new species of *Equisetum*, which, as it was discovered by Dr. Joly, is named *Equisetum Jolyi*.—On the phenomena of metamorphism and the production of an iron mineral coinciding with the denudation of the plateau of Haye (Meurthe-et-Moselle), by M. Bleicher.—On a new group of homogeneous enclosures in volcanic rocks, microtinites, andesites and tephrites, by M. A. Lacroix.—Atmospheric optical phenomena observed at the Pic du Midi and at Bagnères, by M. Em. Marchand.—New observations on the relative wind in a balloon, by M. G. Hermite.—On the production of secondary X-rays by the human body, and on an important point of technique in radiography, by M. Th. Guilloz.—The movements of expired air during the formation of speech sounds, by M. E. Gellé. It is concluded, from the experiments given, that the intra-buccal cavity is not inert, and that the buccal cavity does not act as a resonator as is usually supposed.—On the mechanism of audition of sound and on some connected phenomena, by M. Firmin Larroque.—On a granite from the Pyrenees, by M. F. Larroque.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 15.

ROYAL SOCIETY, at 4.30.—The Genesis and Development of the Wall and Connecting Threads in the Plant Cell. Preliminary Communication: W. Gardiner, F.R.S.—Photography of Sound Waves and the Kinematographic Demonstration of the Evolutions of Reflected Wave-fronts, with Especial Reference to the Relation of the Wave-front to the Caustic: Prof. R. W. Wood.

ROYAL INSTITUTION, at 3.—Modern Astronomy: Prof. H. H. Turner, F.R.S.

LINNEAN SOCIETY, at 8.—Photography of British Plants: J. C. Shenston.—A New Land Planarian from the Pyrenees: Dr. R. F. Scharff.

CHEMICAL SOCIETY, at 8.—(1) Ammonium Amidosulphite; (2) Products of Heating Ammonium Sulphites, Thiosulphates and Trithionate: Edward Divers and Masataka Ogawa.—Note on the Refraction and Magnetic Rotation of Hexamethylene: Dr. S. Young, F.R.S., and Emily C. Fortey.—The Combination of Sulphur Dioxide and Oxygen: Edward J. Russell and Norman Smith.—Note on the Estimation of Gases containing Sulphur: E. J. Russell.—(1) Apiin and Apigenin. II. Note on Vitexin; (2) The Yellow Colouring Principles of various Tannin Matters, VII.: A. G. Perkin.

FRIDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 9.—Life in Indo-China: H. Warington Smyth.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Insanitary Property and Workmen's Dwellings in Liverpool: Dr. E. W. Hope.

MONDAY, FEBRUARY 19.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Journeys in the Chinese Shan States: F. W. Carey.

VICTORIA INSTITUTE, at 4.30.—African and Mediterranean River Valleys: Prof. Hull.

TUESDAY, FEBRUARY 20.

ROYAL INSTITUTION, at 3.—Structure and Classification of Fishes: Prof. E. Ray Lankester, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—On the Marine Fauna of Christmas Island (Indian Ocean): C. W. Andrews and others.—On the Soft Anatomy of the Musk-Ox (*Ovibos moschatus*): Dr. E. Lönnberg.—On a Species of Earthworm from Western Tropical Africa belonging to the Genus *Benhamia*: F. E. Beddard, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Papers to be further discussed:* Moving Loads on Railway Underbridges: W. B. Farr.—Note on the Floor System of Girder Bridges: C. F. Findlay.——*Paper to be read, time permitting:* Corrosion of Marine Boilers: John Dewrance.

ROYAL STATISTICAL SOCIETY, at 5.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—The Diffraction Process of Colour Photography: Prof. R. W. Wood.

WEDNESDAY, FEBRUARY 21.

GEOLOGICAL SOCIETY, at 8.—The Bunter Pebble-Beds of the Midlands and the Source of their Materials: Prof. T. G. Bonney, F.R.S.—On Further Evidence of the Skeleton of *Eurycarpus Oweni*: Prof. H. G. Seeley, F.R.S.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1899: Edward Mawley.—Results of Percolation Experiments at Rothamsted, 1870–99: Dr. Robert H. Scott, F.R.S.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Exhibition of Photomicrographic and Projection Apparatus (with Lantern Illustrations): J. W. Measures.

THURSDAY, FEBRUARY 22.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Total Eclipse of the Sun, January 22, 1898. Observations at Viziadrug: Sir N. Lockyer, K.C.B., F.R.S., Captain Chisholm-Batten, and Prof. Pedler, F.R.S.—Preliminary Note on the Spectrum of the Corona, Part II.: Sir N. Lockyer, K.C.B., F.R.S.—On the Structure of Coccospheres and the Origin of Coccoliths: Dr. H. H. Dixon.—The Ionisation of Dilute Solutions at the Freezing Point: W. C. D. Whetham.

ROYAL INSTITUTION, at 3.—Modern Astronomy: Prof. H. H. Turner, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Standardisation of Electrical Engineering Plant: R. Percy Sellon. (Adjourned Discussion.)

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Improvements in the Longworth Power-Hammer: Ernest Samuelson.—Portable Pneumatic Tools: Ewart C. Amos.

FRIDAY, FEBRUARY 23.

ROYAL INSTITUTION, at 9.—Recent Studies in Gravitation: Prof. J. H. Poynting.

PHYSICAL SOCIETY, at 5.—Prof. R. W. Wood will exhibit and describe his Photographs of Sound Waves and the Kinematographical Demonstration of the Evolutions of Reflected Wave-fronts: a New Seudoscope: Diffraction Colour-Photographs; Artificial Parhelia.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Bearing Springs: B. Humphrey and H. E. O'Brien.

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