THURSDAY, JULY 7, 1904.

THE HARRIMAN ALASKA EXPEDITION.

Alaska. Vol. iii.—Glaciers and Glaciation. By G. K. Gilbert. Pp. 231; 18 plates and 106 text figures. Vol. iv.—Geology and Palæontology. By B. K. Emerson, C. Palache, W. H. Dall, E. O. Ulrich and F. H. Knowlton. Pp. 173; 32 plates and 18 text figures. (New York: Doubleday, Page and Co., 1904.)

It is now nearly two years since we noticed in our pages (Nature, vol. lxvi. p. 176) the two handsome volumes which were the first-fruits of the scientific holiday cruise in Alaska carried out in the summer of 1899 by a party of competent observers through the liberality of Mr. E. H. Harriman. Two further volumes of the series are now before us, one recording the observations made on glaciers and glaciation during the expedition, and the other dealing with the geology and palæontology of the places visited. Though necessarily of more restricted interest than the two first volumes, which dealt with general and varied topics, these books are scarcely one whit behind their predecessors as specimens of the printer's art, except in the matter of coloured plates. Profusely illustrated, well printed on good paper, and tastefully bound, it is evident that no expense has been spared in their production, and rarely do we find technical writings bedecked in such garb. The toned plates are beautifully reproduced, but the line drawings from photographs, which constitute most of the text figures, appear to have suffered to a certain extent from the very excellence of the paper, and would probably have shown to better advantage on the heavy smooth-surfaced product that we growl over so often in American books.

Neither volume is monographic for its subject, but while giving many references to previous literature and to data accumulated by foregoing explorers, deals mainly with the direct results of the expedition. In fact, the books are essentially a series of "papers" on the geology of Alaska, and the subject-matter is treated accordingly.

The first of these volumes (vol. iii. of the series) consists of observations on the glaciers visited by the party, and on the general glacial phenomena of the region, Mr. G. K. Gilbert acting as recorder in this subject. In his lucid descriptions of the existing glaciers and in his able discussion of some of the problems connected with their past history, Mr. Gilbert presents much that is of extreme interest to the glacialist, though the opportunities for personal study were mainly confined to the lower ends of glaciers that reach nearly or quite to tidal waters. In all cases, care is taken to give details and illustrations from dated photographs, so that future observers will be enabled to determine the movement of the ice-front. In many instances, past records were in existence which permit the modern changes in the length of the ice-rivers to be discussed. Curious discrepancies between the conditions in different parts of the country are recognised, for while some glaciers are in rapid retreat—*e.g.* the Muir, which when visited in 1899 was more than a mile and a half shorter than it was nineteen years previously—others had recently advanced.

"The most conspicuous fact brought out by the comparison of local histories is that they are dissimilar. Nevertheless, there are limited resemblances. The Glacier Bay and Disenchantment Bay histories agree in including a great retreat, occupying more than a century. The Port Wells and Grewingk histories agree in a moderate retreat occupying something less than a century. The La Pérouse and Columbia histories agree in a present condition of maximum glaciation probably preceded by an important minimum" (p. 104).

The possible cause of these variations is discussed; and although no definite conclusion is reached, it is suggested "that the combination of a climatic change of a general character with local conditions of a varied character, may result in local glacier variations which are not only unequal but opposite" (p. 109).

The Columbia and La Perouse glaciers in their recent advance have invaded a mature forest-growth which had established itself near their margins. Most instructive to the glacial geologist are the illustrations and descriptions of the "push-moraines" of bouldery till full of crushed trees—in one case "not only tree trunks and branches but folds of peaty soil" (p. 77)—which, by a slight recent retreat of the ice, are left open to investigation along the devastated fringe of the forest. In looking at these pictures one might imagine that some gigantic wild boar had been uprooting the ground. Noteworthy, too, are the stream-built "waste plains" of coarse gravel which overspread the valley-floor in cases where the glacier does not reach quite to the sea, as described and illustrated in the instances of Hidden Glacier (p. 53) and Grewingk Glacier (p. 94).

It is mentioned that in 1899, soon after the visit of the expedition, Glacier Bay was choked up with floating ice, apparently due to the disintegration of the tidal ice-fronts by an earthquake shock. And since then, until the time of writing, it had been impossible for steamers to approach within several miles of the Muir Glacier.

The effect of ice-falls from the ends of tidal glaciers was observed to produce waves sufficient to erode the coast in places where wind-waves could not form; and it is suggested by Mr. Gilbert that we may thus explain the clear outlining of the shores of some glacial lakes the area of which seems to have been insufficient to produce important wind-waves.

In dealing with the Pleistocene glaciation (chapter ii.), Mr. Gilbert discusses the origin of the "hanging valleys" so abundant in this region, and accepts the view that the discordance of level between the trunk and tributary valley is in most cases due to the deeper glacial excavation of the main trough.

"It [the hanging valley] is a conspicuous earmark of the former presence of glaciers; and it helps to a conception of the magnitude of Pleistocene glacial erosion" (p. 115).

The grounds on which this assumption is based are fully stated and illustrated. Great stress is laid upon the excavating action of ice by the process of "plucking," in which "blocks of bed-rock, being partly surrounded by the ice, are forced from their bearings and rolled or slidden forward" (p. 203). Evidences of marine submergence reaching up to at least 500 feet above present sea-level are described (p. 168), and it is surmised that local uplift may have taken place in the neighbourhood of the high mountains at a period later than the chief Pleistocene glaciation (p. 173).

The observations, admittedly scanty, on the coasts of Bering Sea, though indicating local glaciers of considerable magnitude, "seemed inconsistent with the theory of a continental glacier in the Bering Sea region" (p. 192).

The chapter (iii.) on "General Considerations as to Glaciers" formulates the elementary comparison between rivers of ice and rivers of water in the manner which American geologists have made customary. It contains also, among other suggestive matter, a novel discussion as to the effect of water in buoying up the ends of "tidal glaciers" when not deep enough to float them. The conclusion is reached "that there is no important difference, as respects pressure on the rock bed, between a glacier resting on the land and one which is partly bathed by the waters of a fiord" (p. 216), with the further significant deduction that the depth to which glacial troughs have been excavated is not demonstrative of a relatively low base-level at the time of their excavation (p. 217).

We have scanty space for the notice of the second of the volumes before us (vol. iv. of the series), which, however, is for the most part severely specialised. It consists of more or less independent contributions by several authors.

Prof. B. K. Emerson gives a general account of the geology of the places visited, with petrographical notes by Dr. C. Palache. The rocks described are mostly much altered by dynamic and thermal metamorphism, so that their age is often doubtful. They include old-looking gneiss, possibly pre-Cambrian; Carboniferous; Triassic or early Jurassic ("the Vancouver Series"); radiolarian chert perhaps Jurassic or early Cretaceous; and newer volcanic rocks.

Dr. C. Palache contributes some notes on the geology of the famous Alaska-Treadwell Mine of Douglas Island; a list of the minerals collected by the expedition; and a paper on the rocks of the neighbourhood of Chichagof Cove, in the Alaskan peninsula, where beds containing abundant fossils of Lower Eocene age were discovered, a period not previously recognised in Alaska. These fossils, which include our familiar *Venericardia planicosta,* are described and figured in a separate paper by Dr. W. H. Dall, who also describes some Pleistocene shells from Douglas Island.

Mr. E. O. Ulrich deals with the fossils of the Yakutat formation, which consist mainly of very curious casts, supposed to be fucoidal. A large number of these markings are named, described and figured, the beds containing them being assigned, on somewhat slender evidence, to early Jurassic, probably Liassic, times.

A collection of fossil plants of Upper Eocene age from Kukak Bay, on the Alaskan peninsula, forms the subject of the contribution by Mr. F. H. Knowlton, with which the volume closes. Of the twenty-six forms represented in this collection, nine are described as new to science.

G. W. L.

JOSEPH PRIESTLEY.

Memoirs of Dr. Joseph Priestley. Written by himself (to the Year 1795), with a Continuation to the Time of his Decease by his Son, Joseph Priestley. Reprinted from the Edition of 1809. Centenary Edition. Pp. 132. (London: H. R. Allenson, 1904.) Price 3*s.* net.

THE story of the origin and history of this little book may be told in a few words. The greater portion was composed by the subject of it in the year 1787, when at Birmingham as minister of the New Meeting. Priestley's tenure of this office was rudely interrupted by the shameful and disastrous riots of July, 1791, when his house and laboratory, and much of his apparatus and library, were destroyed by the mob. Although many of his books and papers were burnt or otherwise made away with, the autobiography escaped destruction, and was ultimately recovered. Some years afterwards, whilst at Northumberland, in Pennsylvania, whither he removed in 1794, he resumed the story of his life, bringing it down to March, 1795, when he had completed the sixty-second year of his age. Although he lived nine years more, for the most part in fairly good health, it would appear that he added nothing to his account of himself, and it was left to his eldest son to continue his biography to the time of his death, and to see the work through the press. The first edition of the "Memoirs" was published by Johnson, of St. Paul's Churchyard, a staunch friend of Priestley's, by whom, indeed, the greater number of his works—educational, theological, and scientific—were issued. It was reprinted in 1833, on the occasion of the centenary of his birth, and it is again reprinted in commemoration of the centenary of his death.

The present edition differs from its predecessors in several particulars. It is not quite so sumptuously printed as that of 1806. It resembles the edition of 1833 in containing illustrations. In the book before us, however, these are more numerous and more interesting, from the circumstance that the reader is enabled to see in some measure what manner of man physically Priestley was at various periods of his career. Unfortunately the illustrations hardly do justice to the originals, and as process reproductions leave much to be desired. The frontispiece is taken from a copy of Opie's well known portrait, now, we believe, in the Manchester College, Oxford. The second portrait is a poor and partial reproduction of Fuseli's picture, painted for Johnson, the publisher, and one of the very few portraits which that painter made directly from a sitter. The original work was a full-length figure, and is interesting as showing Priestley at the period of his greatest scientific activity. It is interesting, too, as affording material for the statue by Stephens in the Oxford Museum, of which we have a picture in the book. The third portrait is by Artaud, a painter largely employed by the Nonconformists of his day, and represents Priestley as he appeared at the time of his leaving England for America. The last portrait is by an American artist, Stewart, and shows Priestley without his wig, and in the costume he adopted at Northumberland. We have in addition a reproduction of Williamson's statue erected in Birmingham, and unveiled by Huxley in 1874 on the occasion of the centenary of the discovery of oxygen. Lastly, there is a copy of Drury's fine statue which Leeds owes to the munificence and public spirit of Colonel Harding.

The Rev. Mr. Freeston, who is responsible for the issue of the present edition, is, no doubt, a great admirer of Priestley as one of the chief apostles of Nonconformity, as the sturdy champion of Unitarianism and the resolute defender of free inquiry and liberal thought, and this circumstance may account for the fact that, in his selection of the illustrations, the scientific side of Priestley's activity receives practically no recognition. Dr. Taylor, of Norwich, who became head of the Warrington Academy, was no doubt an eminent divine, but his connection with Priestley was of the slenderest. Dr. Andrew Kippis was of some assistance to him at times, especially in the earlier period of his career. Dr. Price, whom he succeeded at Hackney, and the Rev. Mr. Theophilus Lindsey were almost life-long friends, and no doubt exercised considerable influence on his fortunes. But so did Josiah Wedgwood, James Watt, whose association with Priestley gave rise to the famous Water Controversy, Matthew Boulton, Keir, Withering, and other members of the celebrated Lunar Society. There can be little doubt that Priestley's career as a natural philosopher, and, indeed, as a political writer and reformer, was largely the result of his connection with Franklin, for whom he had the greatest admiration and affection, and to whom considerable reference is made in the "Memoirs." Lord Shelburne, too, with whom Priestley spent some of the most fruitful years of his busy life, afforded him, in ample measure, time, money and opportunity for the prosecution of his work on pneumatic chemistry, and thereby contributed to lay the foundation upon which his fame largely rests. But although portraits of these persons are at least as accessible as those of the worthy Nonconformist divines mentioned above, and should, in all fitness, appear in any edition of Priestley's "Memoirs" in which portraits of his friends and co-workers are made a distinctive feature, they are conspicuous by their absence.

The reproduction of the view of Priestley's birthplace at Fieldhead, near Birstall, presumably made from Mr. Buckton's photograph, is interesting and pictorially unobjectionable, but that of the Nantwich Meeting House, where Priestley officiated for about three years, is simply hideous. The only thing that can be said in its favour is that it is at least as meritorious as the architectural character of the building it seeks to depict. Nor is the view of the Old Academy at Warrington much better. Priestley was, no doubt, familiar with the old building on the banks of the Mersey, although his connection with it was as slender as his association with its first head, Dr. John Taylor. Most of Priestley's life as a tutor at Warrington was spent in the New Academy, situated some distance from the building represented, and which, by the way, the author of the "History and Present State of Electricity" and of the "Essay on the First Principles of Government, and on the Nature of Political, Civil and Religious Liberty" would certainly not have recognised as here shown, mainly by reason of the imposing statue of the stalwart Cromwell and the large incandescent electric lamp which bulks so largely in the foreground. The fact is, the view represents the Old Academy as it exists to-day as the home of the Warrington Society, to the praiseworthy zeal and public spirit of which the old house has been rescued from the oblivion which was overtaking it.

We have no inclination to be hypercritical, but it is surely desirable that in the re-publication of a work which in its way may be reckoned as one of the classics of scientific biography, and is now brought out to commemorate the centenary of the death of its illustrious author, some effort should have been made to make the appearance of the book more worthy of its subject and of the occasion which has led to its re-issue.

T. E. THORPE.

A LADY ENTOMOLOGIST.

Eleanor Ormerod, LL.D., Economic Entomologist. Autobiography and Correspondence. Edited by Prof. Robert Wallace, Professor of Agriculture and Rural Economy in the University of Edinburgh. With portraits and illustrations. Pp. xx+348; plates xxx; text illustrations 76. (London: Murray, 1904.) Price 21*s.* net.

THE name of Eleanor Anne Ormerod will long be remembered for her unflagging industry and long-continued devotion to practical entomology, not surpassed in their own lines of research by Caroline Herschel and Mary Somerville, with whom she may most fittingly be compared. There can be no more fitting opportunity than the present to recall her services both to science and the world at large, when the Linnean Society (formerly so exclusive that ladies who contributed papers were not even admitted to be present when they were read) has just thrown open its full membership to women. The Entomological Society was never so exclusive; and at one time Miss E. A. Ormerod was one of the most regular attendants at the meetings, sometimes accompanied by her sister and fellow-worker, Georgiana E. Ormerod, and more rarely by some other lady friend.

By far the most interesting portion of this volume is the autobiography (occupying chapters i. ii., iv.–x.). Next in importance are chapter iii., by Miss Diana Latham, referring to Miss Ormerod's early life, and chapter xi. by the editor completing (all too briefly) the biographical sketch of Miss Ormerod's life. A very full account is given of her family, surroundings and education, with reminiscences of coaching days, the Chartist rising, and other matters which look like ancient history now, besides occasional geological and archæological notes. Miss E. A. Ormerod was the youngest of a family of ten children, and was born on May 11, 1828, and she died after a long illness on July 19, 1901, after a busy and useful life, as happy, we may well believe, as that of Miss North or Miss Cobbe.

Natural history runs in families, and besides the two sisters, Eleanor and Georgiana, one of the brothers, Dr. E. L. Ormerod, has also left a worthy entomological record behind him in his valuable work on "British Social Wasps."

Among Miss Ormerod's accomplishments was a knowledge of Russian. It would have been interesting if we had been told how she came to study a language still so little known in England.

Miss Ormerod does not appear to have specially interested herself in entomology until 1852, and it was not until 1877 that she commenced the great series of reports of observations on injurious insects, the twenty-fourth and last of which was only issued in 1900, the year before her death, so that she may be said to have died in harness, though towards the end she found herself compelled by failing health gradually to decrease her entomological activities in other directions also. The most pleasing portrait of her in the book (taken from the oil painting in the University Court Room, Edinburgh) represents her in her University costume as the first woman hon. graduate of the University of Edinburgh, an honour as much to the University as to herself, and more gratifying to her than any other acknowledgment of her entomological work could have been. The title was conferred upon her on April 14, 1900. Her sister Georgiana predeceased her in 1896.

At the time when Miss Ormerod commenced her work in agricultural entomology much had been done by Westwood and Curtis to pave the way; but the few books on the subject were either costly or little known, and no popular interest was felt in the matter.

Miss Ormerod, however, by her reports, books and lectures, revolutionised all this, and effected a work equivalent to that of Riley in America, and the importance of agricultural entomology is now universally recognised, from the Government to the School Board. She was also a good practical meteorologist, and a fellow of the Royal Meteorological Society.

But it is much to be regretted that Miss Ormerod did not live to complete her autobiography on her own lines, and we cannot congratulate the editor on the manner in which he has performed his task. As he states in the preface, "Had the book been produced on the original plan, it was proposed to name it, 'Recollections of Changing Times.' It would have dealt with a number of subjects of general interest, such as the history of the Post Office, early records of floods and earthquakes, as well as newspapers of early date. The introduction of Miss Ormerod's letters to a few of her leading correspondents was made necessary by the lack of other suitable material. The present volume is still mainly the product of Miss Ormerod's pen, but with few exceptions general subjects have been eliminated, and it forms much more a record of her works and ways than it would have done had she been spared to complete it."

Surely at the present day specialism is so great, though so unavoidable, an evil, that the wilful elimination of everything but entomology from the chapters not actually written and edited by Miss Ormerod herself is equally unfair to herself and to her admirers. Had her correspondence been utilised with her reports to compile an abstract of entomological observations supplementary to those contained in her more permanent manuals the work might have been made a more worthy memorial of her; but instead of this two-thirds, at least, of the volume is composed of letters to various entomological correspondents without any sort of order or classification except by correspondents' names, and consists of disjointed observations on insects, and references to matters like the exchange of publications, of no real permanent interest or consequence, even to entomologists. Half-a-dozen letters selected to show Miss Ormerod's epistolary style would have been amply sufficient. The only interesting portions of this section of the work (except the few letters addressed, chiefly to the editor, on personal matters like the Edinburgh degree) are the numerous illustrations of insects reproduced from Miss Ormerod's reports, &c.

The early part of the work and the illustrations render the book useful and interesting; of the latter part we can only say that it is one of the most glaring instances we have ever seen (and we have seen sufficiently bad ones before) of how *not* to edit a biography.

SOCIAL CONDITION OF ANTHRACITE MINERS.

Anthracite Coal Communities. By Peter Roberts, Ph.D. Pp. xiii+387. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1904.) Price 15*s*. net.

THE great strike of 1902, which cost 20,000,000*l*. and led to the intervention of the President of the United States, induced Dr. Roberts to make an exhaustive study of the 630,000 persons deriving subsistence from the production of the anthracite collieries of Pennsylvania, and his book should be studied by all interested in the evolution of industrial society. The coalfields are situated in the north-eastern portion of Pennsylvania, and consist of scattered deposits of anthracite covering an area of 480 square miles. The mining population represents some twenty-six different races, one-half being Slavs. Anthracite mining is about eighty years old.

In the first fifty years of the development of the industry the United Kingdom and Germany furnished the labour required. During the past twenty-five years the Slav nations have done so. Immigration into the coalfields has now virtually ceased. The present population is amply sufficient to furnish the necessary labour for the maximum tonnage that the collieries can produce. Conditions in the industry are not such as to attract labour of a high grade, and the high birth-rate of the Slav population will more than supply the labour needed in an industry that will necessarily soon be declining.

The characteristics of the Slav population are depicted by the author in lurid colours. The Slavs are, he asserts, clumsy, ignorant, drunken, superstitious, unclean and brutal. At the same time the Slav nature is good material to work upon. As the Slav comes in contact with Anglo-Saxons and learns their ways, his wants are increased and his tastes refined. The unsavoury details of squalor and vice among the Slav miners are certainly not understated by the author, who has naturally no sympathy with the ideas and aspirations of a people who, by adhering to their language and customs, remain unassimilated after years of residence in the United States. Similar statements are often made regarding the Slav immigrants in the coalfields of Scotland and of Westphalia. Probably the Slav colliers of Pennyslvania are not more debased than the mining populations of many of the European coalfields. If they are, the responsibility must rest largely with the coalowners, who provide habitations where self-respect and decency are unattainable luxuries.

The author's gloomy views regarding the social condition of the anthracite communities cannot be accepted without reserve. They are certainly not in accord with the views of the Anthracite Coal Strike Commission, who found that the social conditions obtaining in the communities made up largely of coalworkers were good, and that the number and character of the schools accessible in all these communities were fully up to the American standard. The number of churches in proportion to the population was rather above the average, and the opportunities generally for instruction appeared to be adequate.

The work is illustrated by twenty-eight half-tone plates, most of which are excellent, and there is a long bibliography of works consulted. The quotations in French, being printed without accents, are difficult for the ordinary reader to understand, and in one quotation, "Ellis il font diaque nuit," it is not apparent what language is used. B. H. B.

OUR BOOK SHELF.

Elements of Water Bacteriology. By Samuel Cate Prescott and Charles-Edward Amory Winslow. Pp. x+162. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd.) Price 5*s.* 6*d.* net.

THIS little volume is practical in its conception, and is concise in treatment. It, of course, presupposes a sound knowledge of general bacteriological methods, but the authors have undoubtedly produced a manual for laboratory use which will be of value to all intelligently engaged in the examination of water. It is up to date in the various methods described, and thirty pages are devoted to a careful index of the contents, a list of memoirs referred to in the text, and the names of authors. Perhaps the most interesting feature in the book is the "change in front," so to speak, which it indicates some water-bacteriologists are making in regard to the relative importance of the presence of typhoid and colon bacilli respectively in water. A third of the letterpress is devoted to the *Bacillus coli communis,* its detection and its significance in water, whilst the typhoid bacillus, so long the *bête noire* of sanitarians, is disposed of in a few pages. The attitude of, at any rate, American authorities is effectively summed up in the following paragraph:—

"On the whole it seems that since a positive result is always open to serious doubt, and a negative result signifies nothing, the search for the typhoid bacillus itself, however desirable theoretically, cannot be regarded at present as generally profitable."

So, because the typhoid bacillus is difficult to find and the detection of specific organisms is being clamoured for in the estimation of the bacterial quality of a water, refuge is taken in the more easily discoverable and well-nigh ubiquitous colon bacillus, or its allied forms.

It will be interesting to watch the progress of opinion on this colon-standard of water-purity in the light which it is hoped further researches may be able to throw on the detection and significance of specific bacteria in water.

The Chemistry of Coke. By W. Carrick Anderson, M.A., D.Sc. Second edition. (Glasgow and Edinburgh: Hodge and Co., 1904.) Price 5*s.* net.

THIS little volume, which has reached its second edition, contains much practical information about the chemistry and chemical analysis of coal and coke which should be useful to scientific makers of coke.

But apart from its practical side, the book would justify its publication if it served the single purpose of showing how scientific method may be applied to the problems of a relatively simple industry. That different coals of the same composition, or *isomeric coals,* as the author calls them, behave quite differently on coking is well known. This must, of course, arise from the presence of different chemical constituents. Perhaps it would have been wiser to remain content with the statement (p. 64) that "so long as the composition of coal is unknown the peculiar internal reactions of coking will assuredly remain shrouded in obscurity" than to hazard the suggestion (p. 60) that "in coking, side-chains as well as the central part or radicle reacts."

The absence of any reference to the relation of composition to by-products seems a curious omission when, as the author himself says, "the manufacture of coke without recovery of by-products is to-day frequently regarded as scarcely any longer a payable industry."

The writer would like to offer the suggestion that a careful microscopic examination of coal, which has been found so useful in other directions, might lead to interesting information both as to coking qualities as well as the nature of the by-products of different varieties of coal. Perhaps this method of investigation has already been tried and found wanting. J. B. C.

Praktischer Leitfaden der Gewichtsanalyse. Zweite Auflage. By Paul Jannasch. Pp. xvi + 450. (Leipzig: Veit and Co.) Price 8 marks.

A SECOND edition of Prof. Jannasch's well known book treating of gravimetric analysis has now appeared, and contains considerable additions of new matter. It is obvious, even from the most cursory examination, that the book differs from most of its class in that it is in no sense a compilation of old and often obsolete methods.

Prof. Jannasch is well known as the author of many new methods in analytical chemistry, and the results of his own work and that of his pupils have been made great use of in preparing the present volume.

The contents of the book are divided into nine sections, each of which deals with analyses of a particular type; thus, starting from the determination of the constituents of simple salts in the first, the second treats of the analysis of simple alloys, whilst the third, fourth, and fifth sections deal with the quantitative separation of the various metals one from another. By far the greater number of the processes recommended for these separations are those with which the author's name is connected, involving the use of hydrogen peroxide, hydroxylamine, and hydrazine.

The sixth and seventh sections contain instructions for mineral analysis, and one is struck by the very complete account given of methods by which the decomposition of the mineral is effected by heating in a current of gas, *e.g.* oxygen, hydrochloric acid, or bromine. The eighth section is taken up with silicate analysis, whilst the concluding section gives an account of the estimation and separation of the halogens and of many other analyses which do not naturally find a place in the earlier portions of the work.

Although it is clear that the author has taken great pains in the preparation of his book, it may be questioned as to whether the selection of exercises has been uniformly judicious, and as to whether the author's own processes do not occupy a too prominent position, so leading to the exclusion of standard methods of analysis with which every student should be familiar. For example, the author's process for the separation of manganese and zinc by means of hydrogen peroxide in alkaline solution, although found unsatisfactory by other investigators, is fully described to the practical exclusion of the more usual method. The same criticism applies to the larger proportion of the other "hydrogen peroxide separations" which here figure so largely. Again, in the section dealing with silicate analysis, the author's methods of decomposition, especially the one employing boric anhydride, are given at great length, whilst the ordinary method of alkali-carbonate fusion, which is constantly employed both in technical and scientific analyses, is given in a not very happily modified form, and in a subordinate position.

Although the book presents very many excellent features, and should, when used in conjunction with other works, be of great value, it is hardly considered likely that a student who derives his information solely from this source would possess a competent knowledge of the *general* methods of analytical chemistry.

H. D. D.

Practical Slide Making. By G. T. Harris, F.R.P.S. Pp. 134. (London: Iliffe and Sons, Ltd., 1904.) Price 1*s.* net.

NEARLY every photographer at some time or another makes his own lantern slides, and so numerous are the methods available, and so varied are the results that can be obtained, that another handbook on the subject is very welcome. In these pages the author successfully attempts to supply trustworthy information on the subject in a concise form, describing the best known methods for obtaining these transparencies. He lays stress on the great efficiency of some of the older processes, and with the hope that they may be revived he includes them in this book. The first two chapters deal with the apparatus for exposing the plate, and the remainder treat of the development by the several methods described, and of the various other manipulations required before the slide can be considered properly finished. No pains seem to have been spared to obtain accuracy in the formulæ and to render clear the methods of procedure, so that the book forms a trustworthy guide.

Botany Rambles. Part ii. *In the Summer.* By Ella Thomson. Pp. 130. (London: Horace Marshall and Son, 1904.) Price 1*s.*

THE young learners for whom this little book is intended are urged persistently to see for themselves, by examining plants, that what is told them in the lessons is true. They are instructed in simple language how to set about this work of verification and are urged to make use of their own eyes to find out additional facts for themselves. It is evident that the writer understands children and knows how to arrest their interested attention.

LETTERS TO THE EDITOR.

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

The Exradio Spectrum.

FROM a private communication from Mr. Baxendall, I learn that he has noticed the following correspondences between the spectrum of the emanation from radium (exradio) and the spectra of "bright line stars" (Campbell, *Ast. and Ast. Phys.*, vol. xiii. p. 468):—

"Exradio."	Bright Line Stars (Campbell).
5805	5813
5595	5593*
4690	4688
4650	4652
4630	4633

With the exception of 5593*, these stellar lines are all strong and characteristic. Another of the exradio lines, 5137, may correspond with 5135.

I am very ignorant of stellar spectra, and send this note merely to direct attention to a possible correspondence.

University College. WILLIAM RAMSAY.

The Occurrence of Radium with Uranium.

A LITTLE time back, Mr. B. B. Boltwood published in this Journal (May 26, p. 80) a preliminary notice of an investigation of the ratio of uranium to radium in various minerals. I have for some time been engaged in a similar investigation, which, though the results are not yet matured, seems to be leading to the conclusion that this ratio is constant, as in Mr. Boltwood's experiments. An interesting case is the mineral torbernite, or copper uranite. This mineral forms transparent green tetragonal crystals the composition of which is accurately represented by the formula $CuO.2UO_3.P_2O_5.8H_2O$. The substance dissolves easily in sulphuric acid, forming a perfectly clear green solution. This solution, when boiled, gives the radium emanation, and the quantity of emanation produced in one day is about the same as that yielded by the same weight of Joachimsthal pitchblende. The percentage of uranium is also about the same. If the radium in this mineral has been produced since the formation of the mineral (and the recent quantitative experiments of Sir W. Ramsay and Mr. Soddy on the absolute rate of production of the emanation seem to make that certain), there is practically no choice as to what the parent substance should be. Uranium is the only candidate. The great complexity of most of the radio-active minerals may make it difficult to obtain conclusive evidence by studying them. But here there seems to be no alternative but to conclude that uranium is the parent. R. J. STRUTT.

Residual Affinity.

SIR OLIVER LODGE's highly suggestive letter (June 23, p. 176) will be welcome to the many chemists who have been endeavouring to interpret chemical phenomena in terms of the electronic theory of the physicist. The proposition that the "Faraday tube" may be subdivided would appear to be capable of being widely applied in connection with many of the most interesting phenomena of chemistry. Thus not only would the existence of water of crystallisation and the formation of so-called molecular compounds be thereby brought into line with the more typical manifestations of valency, as pointed out in Sir Oliver's letter, but it would appear that it may possibly enable the hitherto conflicting hydrate and dissociation theories of solution to be harmonised. Thus in the case of an electrolyte such as sodium chloride, we should in the dry state regard the sodium atom united to the chlorine atom by means of a Faraday tube or bundle, as it may more appropriately be designated, the union leading to the great stability of the compound as such. On the addition of water, however, some of the constituent fibres or strands of the bundle become deflected in such a way that the sodium and chlorine atoms become respectively combined with water. With sufficient water present the original union between the sodium and chlorine atoms will become entirely severed, the Faraday bundle starting with its positive extremity on the sodium atom will terminate at its negative end *by means of a plurality of strands on a number of water molecules*, and similarly the Faraday bundle emanating by its negative extremity from the chlorine atom will terminate at its positive end in a plurality of strands also on a number of water molecules. In such a solution we should thus have independence of the sodium and chlorine atoms, or the phenomenon of ionisation. In such a solution, moreover, the union between sodium and chlorine would be entirely abolished through the complete diversion of the strands of the Faraday bundle formerly uniting them, whilst the union between the oxygen and hydrogen of the water molecules would be but slightly weakened owing to only a small fraction of the total number of strands in the bundles uniting the oxygen and hydrogen in each molecule being diverted by the sodium and the chlorine. The dissociation into its ions of an electrolyte on solution in water would thus be the consequence of the antecedent hydration of the ions.

Some of the colour changes attending the attachment of water of crystallisation may be interpreted in the same way. Thus anhydrous copper sulphate is colourless, whilst the crystallised salt containing five molecules of water is blue. The direct union of the copper atom by means of two Faraday bundles with the SO_4-group leads to the production of a colourless compound, whilst by the diversion of the strands of these bundles, through the attachment of five molecules of water, the copper atom and the SO_4-group become severed, and the blue colour characteristic of the copper ion makes its appearance.

According to this view solution should always be attended by the weakening of the union between at least one pair of bonds in the molecule of the solute owing to the diversion of at any rate some strands of the bundle or bundles, and such loosening is betrayed in the greater chemical reactivity of substances in solution.

Similarly in catalytic phenomena, the catalytic agent may be regarded as diverting some of the constituent strands of bundles, and the action of water in effecting ionisation, *i.e.* complete diversion of bundles, would thus appear as an extreme case of catalysis, leading to such an acceleration of the velocity of reaction between electrolytes that reactions between ionised electrolytes are practically instantaneous.

It is needless to say that this is merely a preliminary and very imperfect attempt to apply the electronic theory to a few of the most familiar and important chemical phenomena. Sir Oliver Lodge's suggestion with regard to the electrical interpretation of valency and bonds is indeed so luminous and stimulating that it should provoke the careful review of chemical facts by the light of this new conception of the possibility of an indefinite number of different grades of chemical union, of which the union by chemical bond, hitherto the only one generally recognised, is to be regarded merely as an extreme case.

Birmingham, June 27. PERCY F. FRANKLAND.

Science in the Common Examination for Entrance to Public Schools.

IN the interests of education, may I ask you to find room in your columns for the enclosed copy of the science paper recently set in the above examination? The average age of the candidates may be taken as about thirteen years. Comment is almost superfluous. The effect, whether intentional or not on the part of those who set the questions, of such an examination paper must be to discourage science in the preparatory schools. No boy of thirteen years of age could or should be expected to answer more than a very small portion of so advanced a paper. If headmasters of preparatory schools are led to imagine that this is the kind of thing that is expected of their pupils, in very despair they will be forced to abandon science entirely, and fall back upon its alternative in this examination—Latin verse.

This common examination has now been held for the first time, and it is important that an emphatic protest should be raised without delay. If the science paper is allowed to be of this unreasonable character, the subject will receive a set-back that will go far towards undoing all that has been tardily achieved during the last twenty years in regard to scientific teaching in our public schools.

OSWALD H. LATTER.

Charterhouse, Godalming, July 2.

June 29, 1904.—SEVENTH PAPER.
(Alternative with Latin Verse.)

COMMON EXAMINATION FOR ENTRANCE TO PUBLIC SCHOOLS.

SCIENCE.—(*One hour.*)

I.—*Physics.*

(1) A weight hangs by two strings each making an angle of 60° with the vertical. Show that the tension of each string is equal to the weight.

(2) A uniform rod 10 feet long and weighing 5 lb. is pivoted 3 feet from one end. A weight of 50 lb. is hung on the end nearer o the pivot. Find what weight must be hung on the opposite end to balance the rod.

(3) Gravity is often measured by the number 32. Explain this. A body is thrown up with a velocity of 48 f. s. In what time will it lose its velocity? In what time will it return to the hand? How high will it go?

(4) A rectangular vessel on a square base is filled with water. Find the relation between the height of the vessel and a side of the base in order that the fluid pressure on one vertical face may equal that on the base.

II.—*Botany.*

(1) Enumerate the floral whorls from outside inwards. Explain what is meant by cohesion and adhesion among floral organs. Make a careful drawing of the section through a flower in which petals and stamens adhere to the calyx tube. Name a flower in which you have observed this structure.

(2) A potato is often spoken of as a root. Is this correct? Give reasons. Name three other cases in which a similar error is made, explaining the real nature of the organ in question.

(3) Draw sections shown in cutting lengthwise through a bean (or acorn) and a grain of barley (or date stone). What difference would be observed during their early growth? Of what great divisions of plants are these characteristic respectively?

(4) What plants would you expect to find in flower in a damp wood on a clay soil in April? Describe one or more of them.

An Early Mercury Pump.

IT may interest some of your readers to know that as early as 1820 an air pump was described depending on the formation of a Torricellian vacuum, and therefore on the same principle as Geissler's and its successors. The paper is by M. Fafchamps—" Description d'une machine pneumatique à l'aide de laquelle on opère le vide sans le secours de la pompe " (*Annales générales des Sciences physiques*, Bruxelles, vol. vi., 1820, pp. 101–2).

A vertical tube standing in a trough is provided with a stop-cock near its upper end. The tube above the stop-cock has a reservoir at the top, and on each side is a stop-cock, one connected with the vessel to be exhausted and the other to a large funnel. The upper end of the reservoir is also provided with a stop-cock. To work the machine the reservoir is first filled with mercury or some other liquid which is introduced through the funnel, the air being expelled through the stop-cock at the top of the reservoir. When filled with liquid the stop-cock of the reservoir is closed, and communication with the funnel is cut off. The stop-cock on the tube is now opened, when a Torricellian vacuum is produced in the reservoir; on opening the cock connected with the receiver air is withdrawn, and so on.

The author remarks that if mercury is used, the vertical tube must be 758 mm. long; if water, the tube must be more than 10 metres, but the length of the tube may be reduced by diminishing the atmospheric pressure on the surface of the liquid in the trough below. He also remarks that a machine could be devised which would pump up the liquid and open the stop-cocks at the proper times, and thus make the action continuous.

The paper is illustrated.

July 1. HERBERT MCLEOD.

HATS AND HAIR.

PUBLIC attention has been recently directed to the head-gear of civilised man, which, it is held, is neither necessary nor advantageous. We have here one of the attempts of well-meaning reformers to regulate on rational principles the dress of man, and so to assist him in his work of self-adaptation to his surroundings and needs. The object is laudable, and in all probability the scientific truth is with the reformers, but it may be well to review the question on somewhat broad lines.

The scalp is unique among the areas of the human body where hair is abundant, for there has been a notable development of hair in both sexes in this region beyond what can have existed in any of the Anthropoidea that can be placed in the human family tree. This is the more remarkable because man's pelage is a degenerating and disappearing character, except in a few areas. We must assume that when primitive man was in the making, natural selection led to the growth of thick hairy covering on his head which conduced to success in the struggle of life by protection against excessive heat and cold, against rain, and against minor injuries. As he advanced from his ancestral arboreal home into the open, and the range of his life extended, such natural adverse influences as these would call forth useful adaptive modifications, such as increased thickness and length of hair. At a later stage his developing intelligence would bring the same character under the influence of sexual or physiological selection, and this would strongly supplement the earlier factor of natural selection. Between these two factors a very stable character of the race has been produced.

There is considerable evidence that in spite of the stability of this character, the vigour of the hair on the head of man, especially in the male sex, is declining. The complexity of the conditions of civilised life renders it impossible to prove that this is due to the cessation of natural selection and the inability of sexual selection to arrest decline, but it is highly probable that this is the case. The more immediate question is this—is a decline in the growth of hair part of a general degeneration of man's ancestral pelage, or is it due to some factor introduced by man himself? It is declared by the reformers that the wearing of head-gear is responsible for the increase of premature baldness. Hitherto the discussion of the question has consisted of little more than individual opinions and *ex-parte* statements, and it is doubtful if evidence can prove or disprove the doctrine now being advanced. Experiment is, from the nature of the case, out of the question, because of the length of time required and the general complexity of the problem. It would seem that the nearest approach to a solution must rest on analogies derived from other characters of man himself and from the lower animals. The study of adaptive modifications (the "modifications" of Lloyd-Morgan and the "ontogenic variations" of Osborn) shows that they thrive when exposed to the natural conditions amongst which they arose, so long as these do not become excessive.

The wearing of coverings for the head affects the hair which is covered in three ways—the natural forces of sunlight, free ventilation, and movement from wind are prevented, the arteries which supply the skin of the scalp and nourish the hair-follicles are compressed, and nutrition thereby diminished, and the head-dress affords a culture-ground for micro-organisms, being also itself impregnated with them. The absence for the time being of the germicidal effect of the sun's rays and of movement of air, and the warmth and moisture of the contained air are just those conditions which would be chosen for the culture of these low vegetable organisms. Very much of the premature baldness of men is due to dandriff (*Seborrhoea sicca capillitii*), a disorder of the sebaceous glands characterised by excessive secretion of sebum and its accumulation in crusts with an admixture of epithelial débris, which leads to destruction of the hair-bulbs, and this disease is essentially microbic in origin. From these various points of view it seems to be indicated that the wearing of coverings for the head slowly diminishes the vigour of the hair. If this theoretical side of the matter cannot be demonstrated, but is only extremely probable, the practical outcome of it is no less beset with difficulties. A change of custom, if desirable at all, is less called for in the case of women than of men, for in the former the head-gear is mostly of light texture and covers a very small portion of the vertex, at any rate in modern times, and a much larger surface is left exposed to sunlight and air than in the case of men. In addition to this fact it is to be remembered that the evidence for decline in the growth of hair is much less in women than in men. Those whom the practical matter chiefly concerns are children of both sexes, young adults, and all male adults, and to these the reformers speak from a sound physiological basis. Whether or not their advice will be taken, or ignored as a counsel of perfection, remains to be seen, and the change advocated is certain to be the occasion of extravagant partisanship.

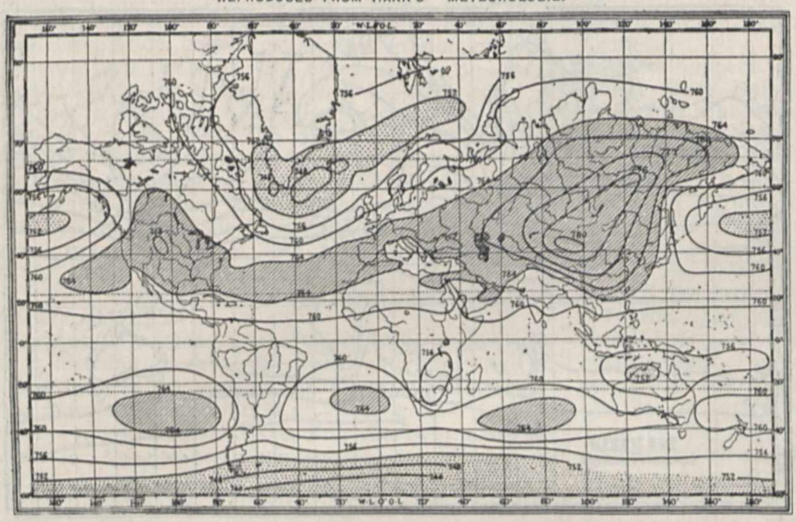
Certain objections to it may be anticipated and removed. First, it will be declared to produce "colds." It is most unfortunate that this name is given to what modern medicine calls "catarrh." The belief that "colds" are produced by exposure to draughts or cold winds is dying hard, and is fortified by the old name so long applied to them, but it is to stultify the great teachings of bacteriology to invoke some casual draught as the cause of disorders of which a nasal catarrh is a type. This danger may be entirely disregarded. It would indeed be for the benefit of the public in more ways than one if they became imbued with the knowledge that pathogenic bacteria of some undetermined species are the efficient cause of all catarrhs. Secondly, it may be feared that inflammatory complaints, such as neuritis or "rheumatism" in the head, would arise from uncovering the head. This is highly improbable considering how large a surface of the head is always uncovered, and that there is no greater protection from hair in the parts uncovered than there is on the vertex. Thirdly, there is undoubtedly some danger, even in temperate climates, from exposure of the head to great sun-heat, and against this danger special precautions are and always would be taken. Fourthly, there is the danger from septic organic matter in towns. This can hardly be reckoned as important, for the area which is necessarily exposed to it is considerable, and proper hygiene of the hair would render it unimportant. Fifthly, injury to the texture of the hair from heat and cold winds is feared, and this again is negligible in view of the fact that the already uncovered parts of the head are better provided with vigorous hair than the covered parts.

Whether the reformers have scientific truth on their side or not, it is possible that the æsthetic aspect of the matter will prove the stronger.

THE MECHANICS OF THE ATMOSPHERE.[1]

THE motion of the atmosphere at any time is admitted to be so complicated that any approach to a workable representation of it must necessarily be by steps. The motion at any time must be regarded as a temporary divergence from the average motion, and the question naturally arises, What is the nature of the average state of motion about which the

FIGURE 1. SURFACE ISOBARS FOR JANUARY. REPRODUCED FROM HANN'S "METEOROLOGIE."

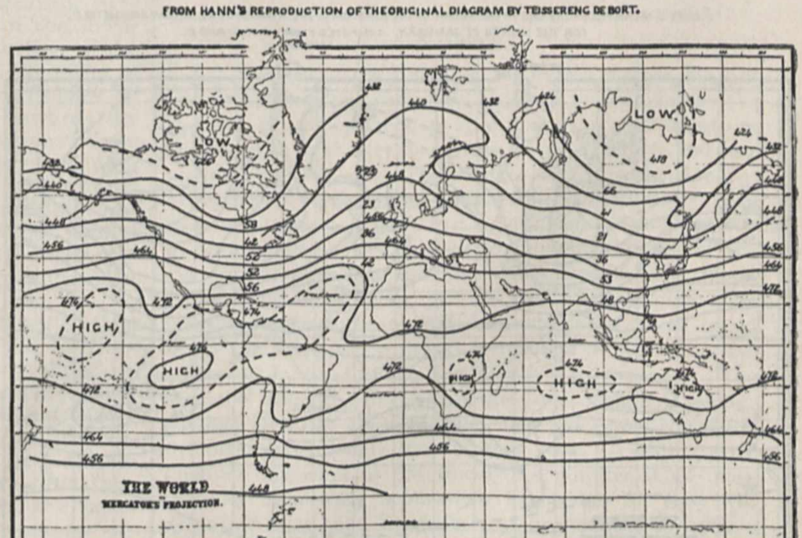


actual state of motion fluctuates? We may approach the solution of this question in either of two ways; we may find out what the motion actually is or we may find what the forces are which, so far as we can tell, cause the motion, and trust to our knowledge of dynamics to compute the average motion from the average forces. As regards the latter method, it may be said that the dynamics of an elastic fluid moving on a rotating spheroid, however interesting, is beset with an extraordinary number of temptations to error, and the more humble ambition of trying to find out what the motion really is, although painfully laborious, has advantages which may be compared with the advantages which walking has as compared with the use of a flying machine.

In the early 'seventies of the last century, Clerk Maxwell set a question in a Cambridge examination to which I owe the inspiration of a number of lectures and examination questions. It was this:—"Show how by observations of the motion of a body the resultant force acting upon it may be determined," and he added the luminous rider (I quote from memory), "A fish weighing 10 lb. swims through the water with a uniform velocity of 10 miles per hour, always in the same direction; find the resultant action of the water on the fish." As soon as one begins to think of answering these questions, and in particular of applying them to the relation between the controlling forces of pressure and the motion of the atmosphere, one realises what pitfalls await the unwary. The most obvious remark in relation to the first question is that the motion at any instant tells us absolutely nothing whatever about the forces acting. Unless observations sufficient to determine the change of motion have been dealt with, nothing about the cause of motion is known. Yet, in spite of this rudimentary fact of dynamics, obvious enough when it is stated, I cannot help wondering how many students of elementary dynamics ever really get rid of the notion that if you find a body moving in a certain direction you must look for a force in that direction too; we are surrounded with examples to the contrary, but the study of dynamics, being mainly deductive, usually passes them by.

In meteorology it is impossible to avoid the consciousness of temptation to the converse error of expecting to find the motion of air in the direction of the recognised forces. The most obvious force is that due to pressure, and who can resist the temptation of thinking that the flow of air from a high-pressure area to a low-pressure area must be the dominant feature of atmospheric motion? Yet the one great inductive statement in connection with meteorology, Buys Ballot's law, warns us that if we trust to the direction of forces to indicate the direction of motion we shall certainly be misled. Motion along isobars, perpendicular to the gradient, is a closer representation of the actual state of things than motion along the gradient, along, that is to say, the direction of resultant forces.

FIGURE 2. ISOBARS AT THE LEVEL OF 4000 METRES FOR JANUARY. FROM HANN'S REPRODUCTION OF THE ORIGINAL DIAGRAM BY TEISSERENC DE BORT.



Pressures in millimetres: velocities in miles per hour, corresponding to the acceleration for different gradients resulting from the Earth's rotation.

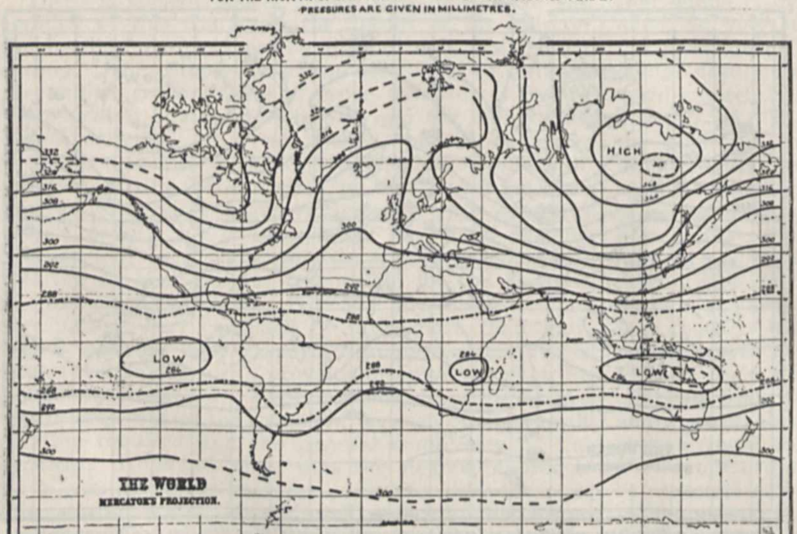
There is no doubt that if we could arrest for a time the motion of the atmosphere, without altering the pressure, and let the air start again from rest, the direction of initial motion would be along the pressure gradients from high to low, but we have to deal with an atmosphere that has been moving for countless ages, and all that existing forces do is to maintain or disturb the average, or steady motion; if in those

[1] Based upon a paper on the "General Circulation of the Atmosphere in Middle and Higher Latitudes," read before the Royal Society on June 2 by Dr. W. N. Shaw, F.R.S.

circumstances we find the motion taking place in the direction of the forces, we find a condition of things which ought not to be expected, and one which requires explanation.

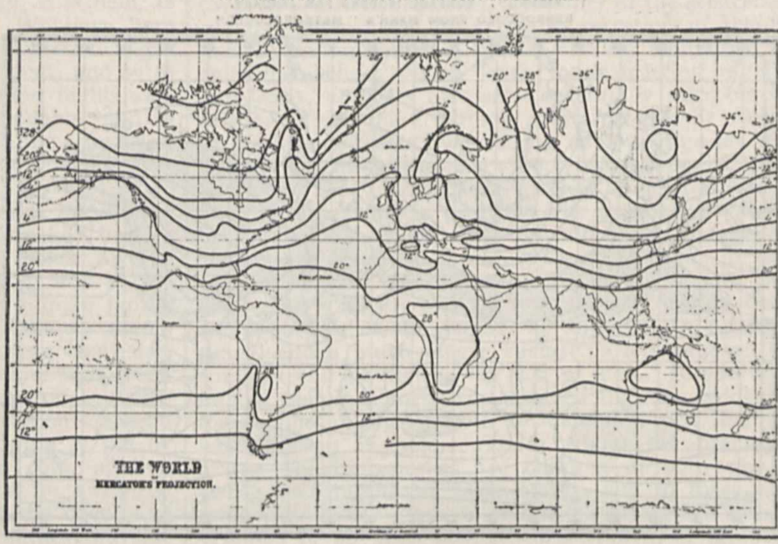
The question arises as to what one ought to expect the steady motion to have become in course of time. To afford some idea of the answer to this question, let me refer to the four diagrams here reproduced. The first gives the average isobars for January at the earth's surface, and discloses no simple representation of steady conditions. There are the well known high-pressure areas about the tropics, and isolated regions of low pressure over the North Atlantic and Pacific; but when we look at Fig. 2, the isobars computed by Teisserenc de Bort for the 4000-metre level, there is an indication of comparatively simple steady motion, namely, a motion round the polar axis from west to east, somewhat deviated, however, to south or north by land or sea areas. Now if we assume that the motion is along the isobars thus represented, so that the lines of the diagram practically represent lines of flow of air, we must remember that the motion on a rotating earth implies a certain normal acceleration of the air to keep it in its path, just as the bob of a conical pendulum requires an acceleration towards its equilibrium position to maintain its motion in a circular path. The effective horizontal acceleration of the air is $2\omega V \sin \lambda$, where ω is the angular velocity of the earth, V the velocity of the wind, and λ the latitude.

FIGURE 3. MEAN PRESSURE DUE TO THE WEIGHT OF THE STRATUM OF THE ATMOSPHERE BELOW 4000 METRES. FOR THE MONTH OF JANUARY. COMPUTED FROM FIGURES 1 AND 2. PRESSURES ARE GIVEN IN MILLIMETRES.



Of the velocity at the 4000-metre level we can only form an idea from the observed motion of clouds, and, so far as we know, the only forces available to give the necessary acceleration are those due to the pressure distribution which Teisserenc de Bort has plotted. By equating the pressure gradient to the product of the density and acceleration we can determine V, and the values thus computed are shown in miles per hour by figures between the isobars on the diagram. They must not be confused with the pressures, which are given in millimetres. The average wind velocities thus computed are not at all unreasonable, and it follows that motion along Teisserenc de Bort's isobars at about 50 miles per hour is not at all an unreasonable representation of the average steady motion of the atmosphere at that level in the month of January. That the directions of motion are appropriate is confirmed by Hildebrandsson's report on cloud motion to the International Meteorological Committee.

FIGURE 4. MEAN TEMPERATURE AT THE EARTH'S SURFACE. FOR THE MONTH OF JANUARY. IN CENTIGRADE DEGREES.



So much for the upper air; the motion is comparatively simple. Then it might be supposed that the complexity of the surface motion is due to extreme complexity of pressure in the lower stratum. The pressure due to the weight of the lower stratum is shown in Fig. 3, which gives the pressure differences between Figs. 1 and 2. There is, strange to say, no more complexity about this distribution than there is about the pressure of the upper layer; in fact, the lines of the two are extraordinarily similar, only the pressure gradients run in opposite directions. Writing "high" for "low," the one diagram would not be an unsatisfactory duplicate of the other, except that the lower stratum has a dislocation of the pole of high pressure from the geographical pole to north-eastern Siberia. Applying the same principle of motion to this diagram as to Fig. 2, it would represent, with suitable velocities calculated in a similar manner, a circulation from east to west in each hemisphere round the pole of cold.

Compare both these diagrams with Fig. 4, representing the surface isothermal lines—the similarity is again conspicuous. The intervals are for every 8° C. of temperature instead of 8 mm. of pressure, and speaking broadly of the temperate latitudes. starting from a suitable datum temperature or pressure, the lines might be interchanged, a step of one degree of temperature (Fig. 4) corresponding to a step of one millimetre of pressure in the same direction for the upper layer (Fig. 2), and in the opposite direction for the lower layer (Fig. 3).

The complexity of the surface pressure arises, therefore, not from the upper layer alone, nor from the lower layer alone, but from the superposition of the two. We can resolve the surface pressure into two components, one due to the upper stratum above 4000 metres which, if it acted alone, would produce a general circulation from west to east around minima of pressure near the poles; the other, due to the lower stratum, which, if it acted alone, would produce a circulation from east to west. Both circulations would correspond closely with the surface distribution of isotherms. Where the one is predominant, in the lower middle latitudes, we get resultant westerly circulation; where the other is predominant, near the poles of cold, we get an easterly circulation. Between the two we get a region of minimum pressure and a merging of the two circulations which gives rise to the circular storms of the northern and southern temperate zones.

It appears, therefore, that we ought to regard the surface distribution of temperature as giving rise to a distribution of pressure in the lower stratum tending to maintain a circulation of air from east to west round the poles of cold. Extending this idea, a region of cold in the northern hemisphere should tend to maintain a clockwise circulation round its centre in the lower atmosphere, and a region of heat a counter-clockwise circulation.

The reciprocity between the pressure distribution of the upper and lower layers is of course not fortuitous. Hann has shown that the expansion of the lower layer by heat increases the pressure at a given level in the upper regions, without altering the pressure at the surface, by the mere thrusting of part of the air upwards; so that the observed effect of expansion over a large area is to diminish the pressure of the lower stratum and increase, by an equal amount, that of the upper. Referring to the diagrams again, the effect of increased surface temperature upon the isobars of Fig. 3 would be a bulge of the isobars towards the region of low pressure—the equatorial regions; upon the upper isobars there would be a corresponding bulge towards the region of higher pressure, again the equatorial regions. Thus the lines of both diagrams would be affected geographically in an exactly similar way and to the same extent; they would thus preserve their similarity in spite of temperature variations at the surface.

It would be interesting to consider what the effect of the daily solarisation of the earth should be from this point of view. Primarily it should produce no pressure variation at the surface; but inequalities of motion in the upper and lower air would probably alter the relative phase or magnitude of the disturbance of the two components, and hence give rise to daily variations of pressure at the surface, and thus necessarily produce a diurnal variation of the barometer.

Other consequences follow from the treatment of the distribution of pressure due to the weight of the lower layer as producing, or rather maintaining, a circulation in the one direction or the other about the colder or warmer regions, as the case may be, instead of flow from cold regions to hot.

One important result as regards the formation of circular storms in our latitudes may be inferred from this method of analysing the distribution of surface pressure. Friends have frequently suggested to me that our circular storms are like the eddies formed when water flows through a bridge; and to them I have always put the question, What in the atmosphere stands for the bridge? I am now prepared to recognise that the caps of relatively cold air in the north and south polar regions form an adequate representation of the piers of the bridge. In the lower air, where the pressures of the polar caps are dominant, they stop the westerly currents which still flow in lower latitudes, and replace them by currents from the east. Between these two currents is a field where mixing must take place, and circular eddies may be formed.

What happens in the equatorial regions is another story. Buys Ballot's law shows that the equator is subject to a peculiar meteorological condition. If you stand with your back to the wind north of the equator, the low barometer is on your left; south of the equator, it is on your right. There must be a transition region where the law ceases to apply, as, indeed, one would expect if Buys Ballot's law is the practical expression of motion with an acceleration due to the rotation of the earth, and varying as the sine of the latitude.

In the upper air of the equatorial regions there is probably a persistent flow from the east, as shown by observations of clouds and of the Krakatoa dust. In respect of the formation of eddies, this current will act like an intermediate pier of a bridge. Hence, in January, the river in which, upon this analogy, atmospheric eddies may be expected is a stream of air flowing round the earth in middle latitudes, divided by the equatorial belt with its region of doldrums below and easterly current above, and bounded north and south by easterly currents which correspond with the circulation of the lower atmosphere induced by the predominant influence of the polar caps of cold air. Eddies may be looked for between the easterly and westerly currents, and they are sometimes found there.

W. N. SHAW.

NOTES.

THE trustees of the Carnegie Institution met on May 18 and transacted the necessary business to provide for the transfer of all matters to the Carnegie Institution of Washington, a charter for which passed Congress and was approved on April 28. The trustees named in the Act met at once and reorganised under the new charter. The by-laws of the Carnegie Institution were adopted as the by-laws of the new organisation, and the officers of the old organisation were elected. General resolutions adopting all the obligations, &c., of the old institution were passed. Under the new charter no questions can be raised as to the competency of the institution to carry on the operations outlined in the deed of gift of the founder. The executive committee of the Carnegie Institution of Washington met after the reorganisation, and practically completed the making of grants for the year 1904. It will greatly facilitate the work of the executive committee if all those thinking of making applications for grants for 1905 will do so not later than September, as applications for grants for 1905 will then be taken up.

A SLIGHT but decided earthquake, which lasted about a second, was experienced at Derby at 3.22 p.m. on July 3. The vibration was not nearly so pronounced as on the occasion of the seismic disturbance a year ago. A similar shock was felt in the mid-Cheshire district about the same time. In Leftwich, near Northwich, the tremors were very distinct. The shock, which was also felt in Northwich, lasted two seconds, and at Sandbach four seconds. Two shocks were felt in Sheffield and the surrounding district. The tremor was from west to east. At Matlock Bath there were shocks running from north-east to south-west. The tremor appears to have been felt almost simultaneously throughout Derbyshire, south Yorkshire, Cheshire, and Staffordshire. Writing from Leek, Staffs, Mr. G. H. Martyn says the disturbance occurred there at 3h. 22½m. ± 1m. p.m. "It seemed to be a succession of about a dozen shocks in three seconds. The shocks increased to a maximum at about the third, and then diminished until imperceptible." Dr. Davison found a very slight record of the disturbance upon his seismometer at Birmingham.

THE death is announced of Prof. T. Bredichin, formerly director of the Pulkowa Observatory.

THE Vienna Academy of Sciences has awarded its Baumgarten prize, of the value of about 160*l*., to Prof. Walter Kaufmann, for his investigations on the theory of electrons.

THE first meeting of the trustees of the Percy Sladen fund for the assistance of scientific research (see p. 182) was held at the Linnean Society last week. The trustees will not meet for the consideration of the first applications before November next, and such applications should be addressed to the clerk to the trustees of the Percy Sladen Memorial Fund, care of the Linnean Society, Burlington House, London, W., by the 1st of that month.

THE Congress of the Royal Institute of Public Health will be held at Folkestone on July 21–26, the Earl of Radnor presiding. In the preventive medicine section, Dr. Nash, medical officer of health, Southend, will open a discussion on a clean milk supply. In the section of bacteriology, Dr. Klein, the president, will give an address on the aim and scope of bacteriological analyses of water and shell-fish with reference to sewage pollution, and the report of a committee appointed to inquire into the methods of bacteriological analysis of water will be presented by Prof. Hewlett. Valuable papers and discussions are promised in the other sections—engineering, child study, and tropical medicine.

AT the second annual general meeting of the fellows of the British Academy, held on June 29, Lord Reay was re-elected president, and the following corresponding fellows were elected, this being the first occasion on which such fellows have been elected:—Count Ugo Balzani, Prof. H. Diels, M. le Comte de Franqueville, Prof. M. J. de Goeje, Prof. I. Goldziher, Prof. T. Gomperz, Prof. J. L. Heiberg, Prof. K. Krumbacher, Prof. F. Leo, M. Paul Meyer, M. Georges Perrot, M. Georges Picot, and Prof. C. H. Salemann. Sir Richard Jebb read a paper on Bacchylides, dealing chiefly with three topics—the illustrations of his mythology supplied by ancient art, the traces of earlier or contemporary literature in his poems, and his relation to Pindar.

A BANQUET was given to Mr. Chamberlain on June 30 by the Royal Institute of Public Health, in recognition of his services to preventive and tropical medicine. In acknowledging the honour, Mr. Chamberlain referred to the progress made in recent years in medicine and surgery. He remarked in the course of his speech that the light which had been thrown on the origin of disease justified the belief that "we are on the eve of great discoveries which will relieve the human race from some of the greatest scourges which have affected it. Now, at any rate, the importance of securing healthy conditions of life is recognised by everybody who cares for the welfare of his fellow-creatures. Preventable disease, at this moment, is, as we all know, a great agent for filling our workhouses, for raising our taxes, for weakening the fibre of the people, for preventing us from competing successfully in that eternal struggle for existence which must go on as long as the world shall last. In peace it is of the utmost importance, in war the same cause destroys more of our soldiers than the bullets or the swords of the enemy, and meanwhile the administration of the Army is lessened in efficiency by the preventable disease to which the agents of the Empire are constantly subject. It is to the efforts of men like Sir Patrick Manson, Major Ross, Prof. Haffkine, and others who have been devoting their time and atention to tropical medicine, to research into the causes of tropical disease, with the remedies for those diseases—it is to that branch of the science that my attention is chiefly directed."

DURING a recent expedition under the auspices of the Geographical Society of Baltimore for the purpose of making scientific researches in the Bahamas, Mr. O. L. Fassig made some interesting experiments with kites at Nassau, one of which was made from a steamer hired for the purpose. The ascents were made in the early part of July, 1903, and the results are published, with diagrams, in the *Monthly Weather Review* for December last. From an average of four ascents and seventy observations, there was a decrease of 1° F. for each 100 feet of elevation up to an altitude of 500 feet; from 500 feet to 1000 feet the decrease was 1° in 143 feet; from 1000 feet to 1500 feet 1° in 167 feet; between 1500 feet and 4000 feet the average decrease was 1° for each 191 feet of elevation. As regards relative humidity, there was a steady increase from the surface (73 per cent.) up to 4000 feet (96 per cent.), with the exception of a small drop near the 3000-feet level; this drop was probably due to an excessive value caused by the kite passing through clouds just below the 2500-feet level on several occasions.

WE have received from Mr. H. Arctowski, a member of the Belgian Antarctic Expedition, a summary of the meteorological results made on board the *Belgica* during its detention in the pack-ice. The paper in question is an excerpt from the *Annuaire météorologique* of the Brussels Observatory for 1904; the volume containing the hourly meteorological observations is now in the press; five memoirs dealing with other special matters have already been published. The *Belgica* entered the "pack" on February 28, 1898, and left it on March 14, 1899; during this period the ship was drifting over an area about the size of the Kara Sea. The author has discussed the daily and monthly means of the observations during a year, as if they were made at one fixed point; the results, therefore, can only be taken as approximately correct. The mean temperature of the year was 14°·7 F., maximum 36°·5 on December 27, minimum −45°·6 on September 8. The diurnal variation was notably different in the several months; grouping the three summer months together (December to February), the amplitude of the variation was 3°·8, while in winter (June to August) it was only 1°·1; in November it amounted to 8°·5. The amount of precipitation is not given; snow fell on 260 days and rain on 20 days. Between March and September auroræ were observed on 61 occasions; the phenomenon was last seen during the night of March 12–13, 1899. Fog or mist was observed on 261 days.

WE have received two important papers dealing with extensions of the theory of Bessel's functions. One is by Prof. C. Cailler, in the *Mémoires* of the Geneva Physical and Natural History Society (xxxiv., 4), and contains an application of the operation designated by M. Schlesinger as Laplace's transformation; the other is a contribution by the Rev. F. H. Jackson, of H.M.S. *Irresistible*, to the Edinburgh *Transactions* (xli., 1), and deals with generalisations of certain expansions in terms of Bessel functions.

IN the *Atti* (xxxvi., 2) of the College of Engineers of Milan, Dr. G. Finzi and Dr. Nicola Soldati describe some interesting experiments on the resistance of bodies moving through air, which should have an important application to the problem of aërial navigation. The chief point of interest consists in the application of the so-called "manometric" method as opposed to the ordinary "dynamometric" method, whereby the present writers have determined the pressure at different points of planes, aërocurves, cylinders and spheres, instead of merely measuring the intensity of the resultant thrusts. For determinations of the variations in the position of the line of action and centre of pressure, such calculations should be of great value, and it is largely in these determinations that the solution of every problem in aërial navigation must lie. A gold medal has been awarded to the authors.

THE March number of the *Mémoires* of the Physical and Natural History Society of Geneva contains a general report of the work of the society for 1903 drawn up by the president, M. Paul van Berchem. The society has completed a new agreement with the municipal authorities, superseding the old agreement of 1855, which will afford the members additional facilities for the use of the town library, in which the publications of the society are deposited. Obituary notices are given of M. Alphonse Pictet, the traveller; of M. Théodor von Heldreich, the botanist; and of M. Théodore de Saussure. Profs. René Blondlot (Nancy) and Walther Spring (Liège) have been elected honorary members, and the *Mémoires* include an important paper by Marc Micheli on the Leguminosæ collected in the Mexican States by Eugène Langlassé.

WE have to acknowledge the receipt of three fasciculi (Nos. 1376–8) of the *Proceedings* of the U.S. National Museum. In the first of these Mr. H. G. Dyar catalogues the Lepidoptera of the Kootenai district of British Columbia, while in the second Messrs. Jordan and Snyder publish notes on fishes collected in Oahu and Laysan Islands, of the Hawaii group, with descriptions of new species.

IN the *Atlantic Monthly* for June, Mr. T. C. Smith records the results of his efforts to reproduce in musical notation the song of the various local phases of the American bird commonly known as the wood-thrush. The score will not enable the musician to reproduce the actual timbre of the song, all that it attempts being to symbolise roughly the tones of the musical scale to which the notes of the bird approximate.

THE Hon. Walter Rothschild has presented to the British (Natural History) Museum a female of the basking shark (*Cetorhinus*, or *Selache, maximus*) from Bergen, which has been set up by Messrs. Brazenor Brothers, of Brighton, and measures 26½ feet in length. The new specimen has replaced the male which has for some years been exhibited in the fish gallery, and is now somewhat the worse for wear. The male measures 28 feet, and is mounted with the mouth open, while Mr. Rothschild's specimen is shown with the jaws closed.

THE *Field-Naturalists' Quarterly* for June is a good number, containing interesting articles on British social wasps, protective coloration in plumage, and on the means of recognising our commoner birds. Mr. Aflalo also contributes a paper on south coast museums, which, if a little wide of the scope of the journal, conveys some useful information on their contents. The editor takes occasion to urge that in future the British Association should assign either a day in each of the sections devoted to subjects in which the field-naturalist is interested, or a special section to field natural history.

BIRMINGHAM University has issued an exhaustive report, by Mr. W. E. Collinge, on the "big-bud" disease which of late years has played such havoc among black-currant bushes in this country. The disease is produced by the black-currant gall-mite (*Eriophyes ribis*), the larvæ of which display unrivalled powers of spreading themselves over plantations. Although some success has attended the use of soap and sulphur spray, the author is of opinion that growers must rely largely on the aid of natural enemies of the pest, or on root and branch extermination of the affected bushes.

THE *Zoologist* for June contains an interesting paper by Mr. J. H. Gurney on birds and bird-migration in Norfolk and the east coast generally in 1903. As regards migration, it is pointed out that the prevalence of east winds is an important factor in producing an influx of visitors to this country, and also that while birds may leave Norway with a favourable wind *en route* for England, they are often driven from their course by encountering contrary breezes as they cross the North Sea. A notable incursion of waxwings during the year affords occasion for the remark that these birds do not visit England on account of excessive cold, but come under the category of late occasional migrants. Other rarities include a young sea-eagle, a flock of Nyroca ducks, half a dozen spoonbills, an avocet, and a blue water-hen. Spoonbills have made their appearance on the east coast continuously since 1897, and hopes are now entertained that they may once more breed in this country. To the same journal Mr. G. Renshaw contributes notes on the Amsterdam Zoological Gardens, in the course of which he repeats his mis-statement that the mounted quagga in the museum came from Knowsley.

IN the report for 1903, the trustees of the South African Museum take occasion to direct attention to the apathy displayed by the wealthy residents of South Africa to the institution under their charge, thereby presenting a regrettable contrast to their fellow millionaires in the United States. During the last twenty years all that the museum has received in the way of bequest and donation is the paltry sum of 295*l*., of which 100*l*. was given by an Indian gentleman. So far as its limited means permit, the museum appears to be making steady progress.—During the past year, according to the report, the attention of the staff of the Horniman Museum was largely directed to the development of the aquaria and vivaria which form such an attractive feature of that institution. A large number of British marine, land, and fresh-water animals have been from time to time on show during the year in the tanks and cases. Dr. Haddon's series of lectures appears to have been fairly well attended.—In the report of the Marlborough College Natural History Society, the secretary has to deplore the disastrous effect of the wet summer of 1903 on collecting and field-work generally, which has made itself felt in a decline of membership. The one compensation was the abundance of land molluscs, which was taken advantage of to compile a list of the local fauna. In other respects the society continues to flourish.

IN NATURE of February 11 (p. 349) we gave some particulars of the great rock-slide which occurred last year at Frank, in Alberta Territory, Canada. A full and interesting report on the subject, by Messrs. R. G. McConnell and R. W. Brock, has since been issued by the Geological Survey of Canada (part viii., Ann. Rep. for 1903). The conclusions arrived at fully confirm the explanations previously given by Mr. Brewer, but the authors add that recent earthquake tremors no doubt hastened the time of the final disruption. They regard the present state of Turtle Mountain as dangerous, and recommend the removal of the town of Frank to a site higher up the valley of the Old Man River. The report is illustrated by map, sections, and numerous pictorial views.

THE Geological Survey of India has revived the publication of its *Records*, a serial which was established in 1868, and amalgamated with the *Memoirs* in 1897. In justification of this step, the director, Mr. T. H. Holland, points out that during the course of the survey work many observations are made from time to time that it would be advisable to publish as promptly as possible, on account of their bearing on current scientific problems or of their economic value. The present number (vol. xxxi., part i.) contains accounts of coal-deposits, copper ore, sapphirine-bearing rock, together with miscellaneous notes on tin-ore, gem sands, &c., and selections from assays made in the laboratory relating to coal and manganese-ores. Mr. Holland expresses the hope that contributions will be made by private workers, to whom the *Records* will be open for original observations on geological subjects.

IN the April *Bulletin* of the Johns Hopkins Hospital (xv., No. 157), Dr. George Dock discusses vaccine lymph and vaccination especially as regards American practice. Dr. Watts Lee publishes studies of the sinus frontalis of man and of certain mammals, carried out both by dissections and by means of lead casts, and Dr. Hastings describes a new blood stain possessing advantages over the Romanowsky and Leishmann stains, which should prove very useful, as it is permanent in the preparations, and the solution keeps well.

IN NATURE of March 17 (vol. lxix. p. 467) a review was given of the anti-malarial operations at Mian-Mir. A second report on the subject has now been published, and gives additional details (*Sc. Mem. of the Gov. of India*, No. 9, by Lieut. S. R. Christophers, I.M.S.). The conclusions are in accordance with those expressed by Captain James, I.M.S., in the first report. It is found that the destruction of the anopheles mosquito within an area by attacking their breeding places is extremely difficult, the mere obliteration of local breeding places being useless. Thus at Mian-Mir, although large numbers of pools were filled up and drained, and almost complete absence of breeding was ensured to a distance of half a mile, adult anopheles still appeared in large and increasing numbers, apparently due to immigration from without. Although a distinct effect was produced on the incidence of malaria among the troops and on the endemic index of the native bazaars, it was only evident at the beginning of the fever season, and could not be maintained. The value of quinine administration was found to depend on the efficiency of the supervision exercised; when quinine was regularly taken the admission rate for fever was much reduced. The conclusion is formed that although some effect on malaria was produced by anti-mosquito measures, these are not those best adapted at Mian-Mir to the eventual reduction of malaria.

THE third issue of *The Central*—the journal of the Central Technical College Old Students' Association—is an excellent number. Prof. Armstrong, F.R.S., contributes the first of a series of short articles on the mechanism of combustion. Among other articles we notice two which are illustrated—one on popular motor cars, by Mr. M. O'Gorman, and the other by Mr. R. W. Sindall, on the manufacture of wood-pulp.

A SECOND edition, revised and enlarged, of the "Student's Handbook of British Mosses," by Mr. H. N. Dixon, the first edition of which was reviewed at length in our issue of September 10, 1896 (vol. liv. p. 434), with illustrations and keys to the genera and species by Mr. H. G. Jameson, has been published by Mr. V. T. Sumfield, Station Street, Eastbourne. Since the publication of the first edition of the book, some thirty species or subspecies of British mosses have been detected, together with a corresponding number of varieties. These additions have been interpolated in the second edition, and notes also have been provided where recent knowledge necessitated their inclusion. Some slight alterations, too, have been made in the general arrangement of the book.

OUR ASTRONOMICAL COLUMN.

THE NUMBER OF THE STARS.—In No. 114 of *Popular Astronomy*, Mr. Gavin J. Burns makes some calculations and deductions as to the number of stars in the entire sky from the various star catalogues and photometric durchmusterungs which have been published. On the assumption that, on the whole, the stars are evenly distributed, he deduces from the plates taken for the Greenwich zone of the Astrographic Chart that there are 38 stars brighter than the second magnitude, 13,421 brighter than the seventh, and 8,325,000 brighter than the fifteenth. The ratio of the total number of stars brighter than any one magnitude to the number brighter than the next magnitude fainter is fairly constant at about 3·4 until the tenth magnitude is reached, but beyond that there is a sudden drop to 1·9, which ratio continues down to magnitude 15. From this discussion there is strong presumptive evidence that the stars thin out as their distance from our system increases.

RADIAL VELOCITIES OF THE PLEIADES.—From an investigation of a series of plates taken with the Bruce spectrograph, using only *one* prism, Mr. W. S. Adams, of the Yerkes Observatory, has determined the radial velocities of the Pleiades stars as follows:—

Name.	Bessel's number.	Mag.	Mean vel. in km.
Electra	17 Tauri	3·8	+15
Taygeta	19 ,,	4·4	+ 3
Merope	23 ,,	4·2	+ 6
Alcyone	25 ,,	3·0	+15
Atlas	27 ,,	3·8	+13

Measurements of seven spectrograms of Maia (20 Tauri) indicate that this star has a variable velocity ranging from −7·4 km. (October 30, 1903) to +20·9 km. (December 25, 1903). The lines in the spectrum are well defined, so that although the range of variability is not very large, it is almost certainly real.

The spectra of Maia and Taygeta are at variance with what we should expect to find for stars associated with a nebula, and they engender a suspicion that these stars may not be physically connected with the surrounding nebula (*Astrophysical Journal*, No. 5, vol. xix.).

AN EXPEDITION FOR SOLAR RESEARCH.—With the aid of a grant of 10,000 dollars from the Carnegie Institution, the Yerkes Observatory has sent an expedition to Mount Wilson (altitude 5886 feet), near Pasadena, California, for the purpose of making special investigations of the sun.

The Snow horizontal telescope is to be the principal instrument erected. One of the concave mirrors of the coelostat reflector, having a focal length of 145 feet, will give a solar image 16 inches in diameter, and will be used for special spectroscopic studies of sun-spots and other solar phenomena. A spectroheliograph of 7 inches aperture and 30 feet focal length is also to be used in connection with this mirror. A stellar spectrograph provided with a large concave grating is to be used to obtain, if possible, spectra of the brighter stars. The expedition is under the immediate direction of Prof. Hale.

THE ORBIT OF COMET 1889 IV.—The following elements for comet 1889 IV. have been calculated by Dr. Guido Horn, of Trieste, and are published in No. 5, vol. xxxiii., of the *Memorie della Societa degli Spettroscopisti Italiani*:—

$$
\begin{aligned}
T &= 1889 \text{ July } 19{\cdot}32298 \text{ (M.T. Berlin)}\\
\infty &= 345^\circ\ 52'\ 42''{\cdot}83\\
\Omega &= 286^\circ\ \ 9'\ 18''{\cdot}31\\
i &= 65^\circ\ 59'\ 11''{\cdot}17\\
\log q &= 0{\cdot}0169197\\
\log e &= 9{\cdot}9990087\\
\log a &= 2{\cdot}6590039\\
\text{Period} &= 9738{\cdot}81 \text{ years.}
\end{aligned}
$$

A table showing the similarity of the orbit of this comet to those of six others which have appeared since 1684 is also given.

NEW LISTS OF VARIABLE STARS.—*Circular* No. 79 of the Harvard College Observatory contains a list of 19 new variable stars situated in the constellations Orion and Carina, and a list of 57 new variables in the region of the small Magellanic Cloud. A careful examination of 1167 star images, contained in a region 30′ square, on two plates of the Trifid nebula revealed no variables.

Circular No. 80 gives the positions and spectral characters of six new variables discovered by Mrs. Fleming on the Draper memorial photographs.

Circular No. 81 is devoted to some notes on eight variable stars of long periods prepared by Miss Cannon from her observations with the 6-inch telescope. The notes contain short comments upon the individual observations and on the agreement of the observed magnitudes on different dates with the various published elements for each star.

THE EDUCATION OF THE AMERICAN ENGINEER.

THE growing success of American and German manufacturers in the international competition for the world's markets has in recent years commanded alike the earnest attention of our industrial leaders and of our educational authorities. As numerous articles in these columns have testified, many serious attempts have been made during the past few years by expert observers from this country to try to discover the precise connection between foreign industrial success and the educational systems of the countries the competition of which has been brought home to us most decidedly; and the greatest attention has perhaps been given to the manner in which foreign engineers are prepared in schools and colleges for their life's work. It is little more than a year ago that Prof. W. E. Dalby laid before the Institution of Naval Architects and the Institution of Mechanical Engineers the results of his commission from Mr. Yarrow to report on the training of engineers in other countries, and as recently as May 5 the report of the Mosely Educational Commission, which dealt at some length with the same subject, was reviewed in NATURE. The most recent contribution to this important subject is a paper by Dr. Mullineux Walmsley read before the Institution of Electrical Engineers, and published in the *Journal* of that society for May. Dr. Walmsley was given leave of absence by the governing body of the Northampton Institute, of which he is principal, and was instructed to investigate the methods of higher engineering education in the United States and Canada, and more particularly the effect, so far as it could be ascertained, of the education on the engineering industries, the views of the great manufacturers and employers on the value of the products turned out by the schools, and the attitude generally taken up by them towards these schools. The paper embodying the chief conclusions at which Dr. Walmsley arrived and the more important of his observations runs to fifty pages, and a few typical examples only can be given in the space available.

The paper is divided into six sections, the first five of which are concerned with higher mechanical and electrical engineering education to the practical exclusion of other branches of engineering instruction. It was originally intended to include a chapter on the training of bench hands, fitters and erectors, but eventually Dr. Walmsley contented himself with the statement that in many respects "our arrangements here for the training of bench hands, &c., are better than the corresponding facilities provided in the United States and Canada."

The engineering schools and their resources are first described. The number and extent of the buildings devoted to higher engineering education exceeds, says the paper, anything that we can show in this country, but more often than otherwise Dr. Walmsley found that the supply of buildings was proving inadequate. There is evidence throughout these American schools of lavish expenditure on equipment on a scale to which we are, as yet, quite unaccustomed. The laboratories and workshops are packed full of apparatus and machinery for the use of students. The author states, "it is difficult within the limits of a paper not dealing exclusively with equipment to convey an adequate idea of its complexity or extent to those who have not visited the actual laboratories." The special needs of teachers and students engaged in research work receive particular attention by those who are responsible for the equipment of engineering workshops and laboratories, and the apparatus and fittings available include delicate instruments unlikely to be required by the ordinary student, but available for special investigations. It is interesting in this connection to quote an expression of opinion by Prof. Armstrong in the discussion on the paper:—"There may be a good deal of provision made for research, but there is not much evidence of research work being done. What the colleges are suffering from very largely is great over-provision of appliances and under-provision of teachers and well-prepared students."

Dr. Walmsley's remarks on the staffs of American engineering institutions agree with expressions of opinion to be found in the reports of Profs. Ayrton, Maclean, and Ripper in the volume dealing with the Mosely Educational Commission. It may be said to be generally admitted in America that professors of engineering must be practical men possessing a modern working acquaintance with engineering processes on a commercial scale rather than men possessed of high academic qualifications. It is recognised by Transatlantic authorities, too, that it is all to the advantage of the students if the professor is also actively engaged in engineering practice, either as an advising expert or in some other capacity.

Financial considerations are given great prominence in the paper, and much the same ground is covered as that traversed by an article in NATURE of May 14, 1903, on "The University and the Modern State," though Dr. Walmsley, in addition, makes an interesting attempt to separate the expenditure on engineering from that on higher education as a whole. Many of the conclusions arrived at by Sir Norman Lockyer in his Southport address to the British Association are quoted and substantiated by the author's own observations.

A comparison is instituted between the mental stock-in-trade with which American and English young men respectively start their engineering training, and though Dr. Walmsley does not claim that the school training provided in the United States is perfect, he has little doubt of the greater suitability of the American training for boys intending to become engineers: "both because of the later age of entrance, and also because their general education, as a rule, has been carried to a higher point, it follows that the candidate for entrance into the technical courses in America is better equipped than those in this country to take advantage of the training of the professional school." Here, again, we find Prof. Armstrong dissenting; he is inclined to doubt altogether whether the average product which enters the colleges in America is in the least degree superior to the average product coming up to our colleges.

Under the heading "The Work of the Schools," much valuable material as to the characteristics of the engineering courses in the colleges of the United States is brought together. The rule is that in the first two years of the course—which generally lasts four years—a fair amount of time is given to mathematics, English, modern languages and experimental science, and it is chiefly in the workshop and drawing office that the specialisation towards engineering is apparent during these two years. Specialisation begins to show itself prominently early in the third year, and mechanical technology and electrotechnics are more or less taken up in the mechanical and electrical engineering courses. In the fourth year a crowd of engineering subjects is frequently introduced. An important part of the work of the fourth year is the preparation of a graduation thesis. The original intention, we find, of including such work in the time-table was undoubtedly to stimulate each student to produce, before he left the institution, a piece of original work which should be of some value in the development of science or of industry. In actual practice, however, the amount of original work produced is not very great, and it can be said fairly that only the best students do work which may be correctly dignified by the name of research. In most of the colleges post-graduate courses are organised, and in these the best work of the college is done.

But in no respect are American conditions more different from those at home than in the attitude of the employers of labour towards higher education. Just as the engineering experts on the Mosely Commission were unanimous in praising the interest shown by American manufacturers in the work of the colleges, so Dr. Walmsley testifies to the same fact. "Without exception the officials interviewed asserted that, far from having any difficulty in placing the graduates turned out year by year from the engineering courses, for the last few years the graduate class has had every one of its individual members engaged for remunerative work before the completion of the course at college." Later it is stated, "many of the large employers have made it a *sine quâ non* for entrance to any position which may lead eventually to a place on the scientific staff, that the candidate should have passed satisfactorily through the full four years' course at an approved technical institution." More than this, no premium is demanded, and living wages are given from the beginning, and these are raised as soon as the young beginner shows himself to be worth more.

Dr. Walmsley concludes his valuable paper with a summary of the respects in which this country is behind the United States so far as the education of its engineers is concerned. He enumerates the following deficiencies:— First, the comparative lack of support and encouragement of the work of the colleges by our leading manufacturers; secondly, that even were our employers ready to adopt the American plan of securing the services of students from the engineering schools, our present schools are neither equipped nor staffed to produce in sufficiently large numbers the trained men who would be wanted; and thirdly, that parents and guardians in this country have not yet been educated to understand how essential, in view of recent developments, a college training is to the success in the future of a candidate for the engineering profession.

As Mr. Buckmaster remarked during the course of the resumed discussion on Dr. Walmsley's paper, it "will be for a long time to come a sort of mine into which each of us will dig." This report together with the others to which reference has been made are more than sufficient to show educational authorities the direction in which our systems of instruction can be improved, and it is earnestly to be hoped that these and similar warnings will not have been uttered in vain.

A. T. S.

ARCHÆOLOGICAL INVESTIGATIONS IN RUSSIAN TURKESTAN.

DR. D. C. GILMAN, president of the Carnegie Institution of Washington, has received a letter in which Prof. R. Pumpelly describes some interesting results of his investigations upon ancient sites, at Anau, near Aschabad, in Russian Turkestan. The following extract from this communication will be welcomed by all who are interested in prehistoric and archæological researches:—

We have explored more than 136 feet of successive culture strata, containing at least four almost uninterrupted culture stages, extending apparently for thousands of years through the Neolithic and Bronze into the beginning of the Iron stage, and we have correlated the stages of culture with important events in the physiographic history and with the introduction of irrigation.

The streams that rise in the high mountains of northern Persia emerge on to the Turkoman plains forming fans, or subaërial deltas, covering many square miles, and each making an oasis. The water is all used in irrigating these fertile spots. Beyond them is the desert. Anau, where we have excavated, is on one of these fans.

Here at Anau, about seven miles east of Aschabad, there are two great tumuli, and the ruins of a city—Anau—surrounded by moat and wall, and occupied until within the last century. The two tumuli, nearly half a mile apart, are nearly equidistant from the city at a distance of less than a mile. We have explored both of these tumuli, and I have done some work in the city.

The northern and older tumulus rises 40 feet *above the plain*; the southern and younger tumulus rises 52 feet *above the plain*. Both of these start with their lowest culture strata on slight elevations in the same original plain-surface—more than 20 feet below the present surface of the surrounding plain. That is to say, the plain has grown up more than 20 feet since the settlements began. I will show, further on, the different phases of this growth.

In the older tumulus, we find a culture occupying the lower 45 feet, and distinguished by the technique and decoration of its wholly hand-made and interesting pottery. This is succeeded in the upper 15 feet by a more advanced culture in which some remnants of bronze implements and lead beads (all wholly altered to salts of the metals) show a beginning acquaintance with bronze, while the still hand-made pottery has changed and become more developed. Throughout this tumulus we have found nothing recognisable as a weapon of offence in either stone or metal, though flint knives abound.

The southern, younger tumulus, starts with a developed wheel-made pottery, unpainted, and of a technique wholly different from that of the older tumulus—though some hand-made pottery occurs not wholly unlike some of the younger products of the older tumulus.

From its base under the plain to its summit this tumulus has 74 feet of culture strata. There are evident here at least two successive cultures. Of these, that of the lower 62 feet is wholly in the bronze stage (but with survival of flint implements), while the upper 14 feet are marked by decided changes and by the introduction of iron, of which the wholly oxidised remnants of some implements were found.

We have thus at least four distinct cultures occupying 136 feet, with a break in the column between the end of the old and the beginning of the new tumulus. We do not know how great this gap may be.

Through all the cultures except the last—that of the iron stage—there ran a remarkable and characteristic burial custom. The children—at least certain children—and seemingly only children, were buried in the houses, under the floor, on a layer of fire-hardened earth.

In addition to the work on the two tumuli, I have sunk four shafts to the culture strata (30 to 40 feet thick) of the city of Anau, to try to determine its age relative to that of the youngest culture of the tumuli, and to get facts for use in deciding as to when irrigation was introduced. The results prove that Anau was wholly in the iron stage, while its wheel-made pottery is wholly different from any in the tumuli; but, in addition to this, fine-glazed faience was found plentifully in the upper three-quarters of all three shafts. These were not found at all in the tumuli, excepting in the case of two or three isolated and very doubtful pieces.

The history of the whole series of culture strata is sharply characterised by the following four periods in the history of the plain or subaërial delta:—

(1) The north tumulus when founded stood on a hill at least 7 feet, and probably more, above the plain surface, its culture spreading down the slopes. The plain was aggrading, and continued to grow until it had buried the base of the tumulus to a depth of 2 feet. By that time, or soon after, the north tumulus was abandoned, and the south tumulus culture founded, on an elevation about 2 feet above the plain. The plain continued to grow until it had buried the base of the south tumulus to a depth of 14 feet.

(2) Then followed a change of conditions. The plain was cut down at least 19 feet.

(3) This was followed by another change which caused the refilling of the cutting to the amount of 8 feet, 7 feet of this last growth having occurred after the deposition in

its sediments of the thoroughly characteristic pottery of the youngest (the iron culture) of the south tumulus.

(4) After this, and apparently contemporaneous with the founding of Anau, irrigation began through which the plain was raised 15 feet, bringing it to its present condition, in which the north tumulus stands embedded to a depth of 27 feet, the south tumulus to the depth of 22 feet, and Anau to 15 feet.

EFFECT OF SOUND ON WATER JETS.[1]

THE structure of water jets was first investigated by M. Savart, who in 1833 published a series of beautiful papers in the *Annales de Chimie et de Physique*. Since then it has received the attention of many experimenters, notably M. Plateau and Prof. Magnus, while of later years our knowledge of the subject has been much added to by the observations and mathematical researches of Lord Rayleigh. The older experimenters had to content themselves with observing the jet through a revolving disc with radial slots, but by means of an electric spark and rapid plates we can now secure photographs of the jet at any desired instant. The eye shows us that a jet of water consists of two parts, (1) a clear column, and (2) a troubled portion. The spark reveals to us that the troubled portion, though apparently continuous, is really a succession of drops, which move too rapidly for the eye to perceive them as such while under continuous illumination.

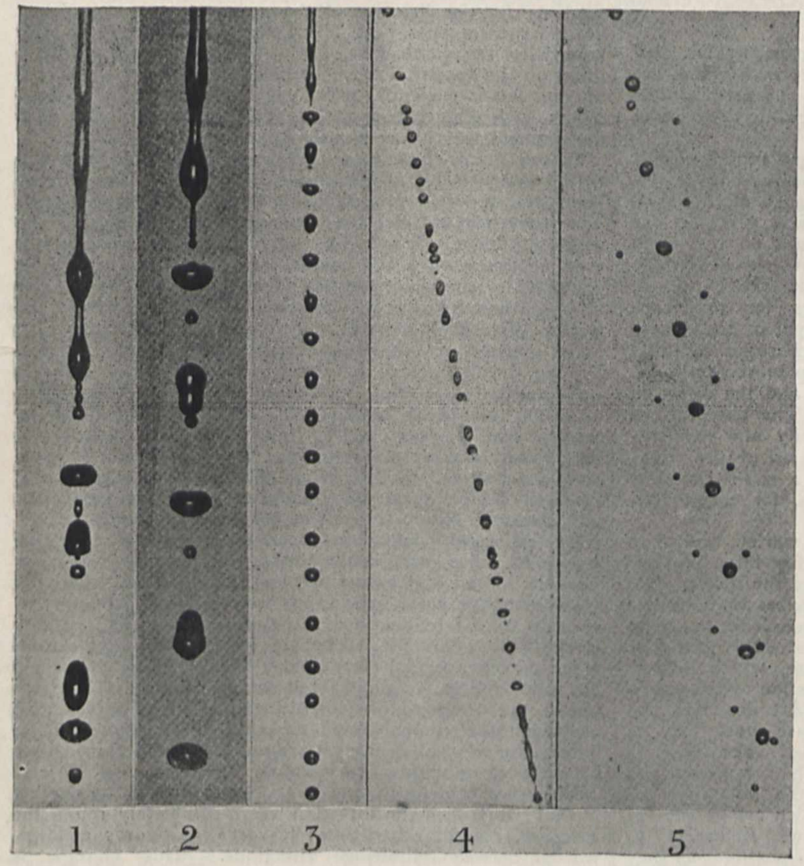


FIG. 1.—Some Instantaneous Photographs of Water Jets.

Towards the lower part of the clear column of water the jet presents alternate swellings and contractions, and at the very extremity a drop is cast off, leaving behind a connecting ligament, which separates and forms a smaller drop (Fig. 1). If the jet is falling freely, and subject only to accidental tremors and disturbances, the formation of drops is by no means regular, and the sizes and shapes of the drops vary much. If a vibrating tuning fork be held in contact with the stand, and if the pressure of water and the diameter of the orifice be suitable, the jet will appear like a vibrating string, a succession of nodes and loops being formed. The effect of the tuning fork is to render the separation of the drops regular, a drop being cast off with each vibration of the fork. If the jet be falling vertically, as the drop leaves the end of the clear column it is extended in a horizontal direction, but as it falls it oscillates about the spherical form, being alternately elongated and compressed under the action of the surface tension of the liquid (Fig. 2).

Prof. Magnus explained that the wavy appearance of the jet under the action of the tuning fork was due to all the drops which arrive at any given point of space being in the same phase; at the middle of a swelling they are most elongated horizontally, and midway between the broadest portions of two consecutive swellings they are most elongated vertically.

These remarks apply to a jet of water about 2 mm. in diameter. If the diameter of the jet be much less than 1 mm., swellings are not produced in it. The effect of a tuning fork is to render the drops practically equidistant and uniform in size (Fig. 3). If a fine jet be projected upwards (Fig. 4) it will be seen to consist of irregular drops, while the effect of a tuning fork upon it is often to cause it to break up into several distinct streams (Fig. 5).

[1] "The Structure of Water Jets, and the Effect of Sound thereon." By Philip E. Belas, Royal College of Science, Dublin. With photographs. Abstract of paper read before the Royal Dublin Society on March 15.

THE POISON OF THE BANDED KRAIT.[1]

THERE is an unbounded field in India for the study of the venoms of the many species of poisonous snakes met with in that country, and the Government of India has been well advised to devote to this subject certain of its scientific memoirs now being issued from time to time. Captain Lamb, I.M.S., the author of the one under review, has already done good work in this branch of research.

The venoms of various snakes, though all composed of the same class of chemical substances (coagulable proteids and proteoses) in varying proportion, differ markedly in their physiological actions, and it can be shown not only physiologically, but also by certain test-tube reactions, that the proteids and proteoses are different in the different venoms.

Thus the blood serum of an animal that has been injected with cobra venom causes a precipitate when mixed with an aqueous solution of cobra venom, but has no such action when mixed with a solution of the venom of the Australian tiger snake. As regards the venom of the banded krait (*Bungarus fasciatus*), with which this memoir deals, Captain Lamb's researches show that cases of poisoning may be divided into three classes:—(1) those in which after a large dose rapid death follows from the occurrence of extensive blood coagulation in the blood vessels; (2) those which are fatal after two or three days, and present acute

[1] Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India. No. 7, 1904. "Some Observations on the Poison of the Banded Krait (*Bungarus fasciatus*)." By Captain George Lamb, M.D., I.M.S. (Calcutta: Government Printing Office, 1904

nervous symptoms; and (3) those which run a chronic course and end fatally between the sixth and twelfth days after poisoning. In these, histological examination shows a well marked primary degeneration of the cells of the central nervous system, and to this the fatal issue is due.

The venom of the krait was found to be much less toxic than that of the cobra or of the daboia, and, unlike the former, has only a slightly destructive action on the red blood corpuscles. It, however, markedly increases blood coagulability, and may cause extensive intravascular clotting. Cobra and tiger snake anti-sera possess no neutralising action for the krait venom. The use of anti-sera, the only efficient antidotes for snake bites, must, therefore, unfortunately be limited, for it is necessary to have an anti-serum for the venom of every species. R. T. HEWLETT.

CURRENTS AROUND THE COASTS OF NEWFOUNDLAND.[1]

IN the course of the investigations described by Dr. Bell Dawson, a number of points were met with which are of general interest, as they probably characterise the currents on the margin of any large or oceanic area under similar conditions.

The currents in the above regions were examined last season from May to September, under the personal supervision of Dr. Dawson, the engineer in charge of the Tidal and Current Survey. Special attention was given to the question of indraught into the larger bays on the south coast, and to the behaviour of the Polar current which follows the eastern coast. For this work, the D. G. S. *Gulnare* was equipped with appliances for deep sea anchorage, and apparatus of a modern type, in some ways specially devised for the purpose. At anchorages carefully chosen, which were made in all depths up to 100 fathoms, the speed of the currents was measured, and the direction noted every half hour, day and night. The observations also included the under-current, the density and temperature of the water, the mileage and direction of the wind, and a continuous record of the tide on a self-registering gauge placed in a harbour in the region, for comparison with the set of the current.

The behaviour of these currents is very varied, and they were found to be so weak as to be readily influenced by the wind; but by a systematic reduction of the results, Dr. Dawson has prepared a report which describes the currents as concisely as possible, while avoiding technicalities. The report is divided into two parts; the first deals with the currents met with on the steamship route, which follows the south coast for 180 miles, and the question of indraught into the larger bays; and the second part describes the character of the Polar current on the east coast, and its possible change of direction when disturbed. The report is illustrated by nine diagrams and maps, which represent the results graphically. From this report, the following descriptions and explanations are culled, which are of general interest from a hydrographic point of view. References to the local geography are omitted as far as possible, as they might be inconvenient to follow without the map which accompanies the report.

Nature of the Currents.—The currents were almost invariably less than one knot. As a rule, they veered widely and were irregular in direction; and with so low a speed they were readily influenced by the wind. There were three elements to distinguish:—(1) Any general tendency to set in one direction more than in others. (2) Any tidal influence, which might show itself either as a marked change in the direction of the set, or as a period in which a variation in velocity would recur. (3) The influence of the wind in disturbing the usual behaviour of the current. From the observation, the effect of any storms which occur during the summer season seldom extends to a greater depth than 5 or 10 fathoms; and it was therefore found that the behaviour of the under-current at 15 to 30 fathoms afforded a most valuable indication of the normal character of the current. In these currents, the tidal element is almost invariably present in some form, more or less distinct; and this is almost always combined with a tendency to make on the whole in some one direction. It is not therefore possible to maintain an arbitrary distinction between "constant currents" and "tidal streams"; but the only natural distinction is to use the term *current* for all horizontal movements of the water, and *tide* for the vertical movement from high to low water.

The following features in these currents will be interesting for comparison with the behaviour of currents elsewhere, on the open coast of the ocean:—(1) When more than five miles from shore, there are no currents at any time throughout the season which exceed one knot in any direction. The only exception to this is the Polar current, in which a maximum speed of 1·15 knots was observed. (2) On the south coast, when within four or five miles of the shore, the current is chiefly governed by the tide, and sets in the two opposite directions alternately; but the farther out the point of observation, the greater the tendency for the direction of the current to veer completely around the compass. (3) The Polar current sets very constantly to the south-west, for a width of thirty or forty miles off the eastern coast. During times of disturbance, it may set south-eastward, or even be reversed, on the surface. When such disturbance occurs, it is usually for part of a day immediately before a gale comes on.

In the Polar current the influence of the tide was distinctly marked by a fluctuation in velocity, the current being 24 per cent. stronger during flood tide on the average. The under-current had the same general direction as the surface current. It set constantly to the south-westward, even at times when the current on the surface was most disturbed by the wind, judging from numerous observations at 40 fathoms, or about one-half the total depth of the water. The fluctuation in velocity with the tide was even more marked in the under-current than on the surface. During the flood tide, the strength from 15 to 40 fathoms was unusually constant, and at 40 fathoms it was always as strong and often stronger than on the surface. During the ebb tide it slacked below, as it did on the surface, and was usually weaker at the greater depths. When slackest, at about half-ebb, it fell below one-fourth of its greatest strength during flood tide, but even then the movement was distinctly felt to a depth of 60 and 75 fathoms.

Off the south shore, at an anchorage at an offing of seventeen miles, the behaviour of the current was very variable. During a period of nine days in June, when 158 hours of continuous observations were secured, a variety of weather conditions obtained, although the wind did not ever exceed twenty-one miles an hour. To understand the nature of the current, careful comparisons with the tides and winds are undoubtedly required; but the continuity of observations, taken every half hour day and night, affords a good basis for the comparison, and with an anemometer on board, the wind observations are much better obtained than by comparison with an observatory on shore.

The most evident change in the behaviour of the current is that sometimes the direction veers completely round the compass, and at other times it veers backwards and forwards between limiting directions. This change is evidently due to the variation in the amount of tidal influence with the springs and neaps. The veer completely around the compass occurs at neap tides, this being well marked at the moon's quarters on two different occasions. The veer is then continuously to the right, and the period in which a complete revolution occurs is just about sixteen hours. This period is quite definite, as deduced from six complete revolutions which were observed. It appears to result from a combination of the tidal period with a general movement of the water to the westward. This appears to be the only possible explanation, in accordance with the principles of rotary movement. This sixteen-hour period has been met with at other stations during the season, as well as in other regions in former years. At other times in the month, when the tidal influence is stronger, the current veers to the right and left through a range which varies from eight points to half a circumference. The complete period in which it veers and backs is from ten to fourteen hours. It is not impossible that this veer would be found to correspond with the tidal period if an average were taken which would be sufficiently long to eliminate other disturbing causes. On the other hand, at

[1] "The Currents on the South-eastern Coasts of Newfoundland. From Investigations of the Tidal and Current Survey in the Season of 1903." By Dr. W. Bell Dawson.

the neap tides, when the tidal element has the least influence, the sixteen-hour period throws the direction of the current entirely out of correspondence with the time of the tide.

Wind Influence.—It would be quite erroneous to suppose that the wind always causes a drift in its own direction. On the contrary, the set is primarily due to the nature of the current, and if it has any definite direction of its own, owing to the tide or other causes, it takes a strong wind a considerable time to overcome this, even with currents such as these, which do not exceed one knot.

A set of the current towards the point from which a wind is about to come is in accord with the universal testimony of the fishermen throughout these regions. Of all the signs of bad weather, it is the one which they appear to find the most trustworthy. In the summer, bad weather usually comes from the south-east and "blows itself out" from that direction; but later on, in the autumn, the wind chops round to the north-west before the storm is over. Along the south shore, it is only during ebb tide that there is a weak set to the south-east. Any strong set to the south-east or south is a sign of bad weather. The fishermen regard this as an unfailing indication, and at once run for shelter. The main feature is the fact of the current setting "into the weather," as they express it, and it is difficult to give a satisfactory explanation for this. The actual direction of the current is necessarily modified by local conditions and guided by the trend of the shore, but the greater scope and freedom the current has, the more directly it appears to set towards the coming wind. And further, it will set in either direction in accord with the expected wind. If this behaviour is due to difference of barometer, it is not easy to understand why the water should be the first to feel a change, before the wind itself begins to blow.

Density and Temperature of the Water.—Extended observations of density and temperature were taken during the season. This was done in the hope of tracing the movement of the water, as this method had proved so serviceable in the Gulf of St. Lawrence. The density of the water was taken at the surface only. The variation did not prove sufficient, however, to be relied upon as an indication of direction of movement. The temperature was taken to a depth of 30 fathoms, and more was expected from the temperature than from the density, as it was hoped it would serve to trace the course of the Polar current. The depth of 30 fathoms was found sufficient, as the water was there at the freezing point throughout the region examined, both south and east of Newfoundland, during the whole season from May to September. All the change which took place during the progress of the season or from other causes was between the surface and 30 fathoms. The change of the temperature of the water also afforded an interesting valuation for the amount of wind disturbance, and the depth to which it extended, under given conditions.

Two results were arrived at, which made the temperature observations of little value for the purpose of tracing the movement of the water by its temperature, and which it will therefore be sufficient to mention briefly:—(1) The temperature of the water at 30 fathoms is practically at the freezing point in all parts of this region, from the mouth of Placentia Bay to St. Johns. It varied only from $30\frac{1}{2}^\circ$ to 34° F., and there was no change from one month to another, from May to September. (2) The water of the Polar current warms up quite as much on the surface as the surface water elsewhere in this region. The general increase of the surface temperature along the south shore, from St. Pierre to Trepassey, was from $36\frac{1}{2}^\circ$ in May to 50° in September, and the surface temperature of the Polar current rose from an average of $34\frac{1}{2}^\circ$ at the end of May to $50\frac{1}{4}^\circ$ at the middle of August. Whether this increase of the surface temperature takes place during the progress of the current southward, or whether this warmer surface water flows over it from elsewhere, we have not sufficiently extended observations to determine. But for the guidance of the mariner, it is evident that the lower temperature cannot be depended on as an indication of the current-belt itself.

A very interesting result was met with, however, on account of the rapid fall in temperature from the surface downwards. The temperature proved to be a valuable indication of wind disturbance. During heavy winds, especially when off-shore, the surface water was driven out to the offing, and the cold under-water came up to the surface. A heavy fall in temperature would thus occur. For example, towards the end of August, the surface temperature over the area from Cape Spear to Cape Race was 50°. There followed during three days 1312 miles of westerly winds, ranging from north-west to west-south-west, when the surface temperature within three miles of the shore fell to 36° and 34°, and in a belt ten miles wide along the windward shore it was below 45°. Careful observations and some special runs were made to ascertain the amount of lateral displacement of the current and the depth of disturbance due to a measured mileage of wind. This was done without loss of time, as the weather was then too heavy to carry on work at anchor. Later, when the weather moderated, the temperature again furnished a basis for a very fair estimate of the rate at which the current-belt moved back laterally to resume its usual course.

Ice as an Indication of Current.—To infer the behaviour of a current from the drift of ice with any certainty, the indications given by flat ice and by icebergs must be carefully distinguished. The flat or pan ice runs with the surface current, and is much influenced by the wind, whereas the icebergs indicate the average movement of the body of the water as a whole, and the wind has no appreciable effect upon them. This distinction is well known to sealers, and they habitually take advantage of it. When working against a gale of wind, they will moor their vessel to an iceberg, and lie in its lee while the small ice goes past with the drive of the wind, because, as they express it, the wind takes no hold on an iceberg at all. They thus save a long drift to leeward. It is thus from the icebergs rather than from the flat ice that we can find indications of value.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The following is the text of the speeches delivered by Prof. Love in presenting recipients of the degree of D.Sc. *honoris causa* at the Encaenia, June 22, in the presence of the Chancellor of the university:—

THE HON. CHARLES ALGERNON PARSONS.

Duobus fere millibus abhinc annis Heron Alexandrinus turbinem quemdam per ludum excogitavit, qui vapore calido actus per tubos inflexos afflante converteretur. Carolus Algernon Parsons inter Hibernos nobilissimus, scientiae etiam laude insignis, ita Heronis vestigiis institit ut, quod ille ludendi causa finxerat, ipse in usum nostrum converteret, quo facilius homines naturae imperarent. Optime sane meritus est de omnibus qui urbes habitant, quibus vias et domos luce electrica hoc invento usus illustravit, neque minus profuit Nerea temptantibus, cum his turbinibus impulsae per altum naves celeritate inaudita ferantur recta semper carina adeo ut navigantium incommoda magna ex parte adleventur.

SIGNOR GUGLIELMO MARCONI.

Hic est ille magus, Gulielmus Marconi, qui modum invenit signorum ab ora in oram, a nave ad navem trans maria immensa transmittendorum. Docuerat quidem Maxwell, civis noster, vim electricam per aethera omnia permeantem quasi fluctibus quibusdam perferri. Accessit etiam Hertz, Germaniae ornamentum, qui ostendit quo modo hi fluctus ita regerentur ut tanquam procella quaedam electrica procul exorta aliis in locis satis longinquis agnosceretur. Marconi tandem, qua erat ingenii audacia, id excogitavit ut his subsidiis usus locos disiunctissimos quasi colloquendi quadam facultate coniungeret. Sollertia igitur maxima, patientia vero admirabili praeditus, singula impedimenta quae spei exsequendae obstabant felicissime pervicit, iamque potest nullo vinculo, nullo filo intercedente, quod vel oculi vel tactio deprehendere possint, super dimidiam orbis terrarum partem signa transmittere.

SIR WILLIAM SELBY CHURCH.

Salutat Academia nostra unum ex alumnis suis, olim inter nos artis medicae doctorem, nunc Collegii Universitatis socium honoris causa creatum, Willelmum Selby Church. Academiae etiam personam gessit in communi illo medicorum Britannico consilio, penes quod regimen est examinationum in arte medica habendarum. Multos annos insignis est inter medicos qui mercede vel parva vel nulla accepta egentes in maximis valetudinariis Londinensibus curant: permulti etiam qui hodie in omni parte regni medicinam exercent hoc magistro et auctore studiorum usi sunt. Plurimum auctoritate valet in Regali medicorum Collegio, cui nuperrime Praeses iterum factus est: praemium denique singularium erga artem medicam et cives suos meritorum accepit Baronettus a regina nostra Victoria et Eques de Balneo a rege nostro Edwardo creatus.

SIR ANDREW NOBLE.

Asclepium iure sequitur Mavors, plurium nisi fallor interfector. Ubicunque homines diras illas machinas moliuntur, quae novos bello terrores addiderunt, in honore est Andreas Noble, vir honoribus et insignibus a multis regibus, inter quos noster numeratur, saepe donatus propter operam in omni apparatu bellico praecipuam. Qui cum in exercitu Britannico summa laude meruisset iam rude donatus multos per annos maximae illi prope Tynam officinae praefuit ubi immania Vulcani tela et naves urbis instar habentes in usum nostrum et aliarum civitatum Cyclopes novi fabricantur. Sed quamvis Martis cultor insignis Minervae etiam acceptus est: hoc enim praeter ceteros operam dante et hortante Laboratorium maximum scientiae Physices augendae causa nuper institutum est, novo sane exemplo, unde patet rectores nostros, quantum civium utilitatibus prosit rerum naturalium scientia, aliquando intellegere.

SIR WILLIAM CROOKES.

In multis generibus quaerendi fructus magnos adsecutus est Willelmus Crookes. Ut a Chemia incipiam, novis analyseos modis usus a Kirchhoff et Bunsen in Germania excogitatis, qui substantias a luce quam ardentes emitterent aliam ab alia dignoscerent, ipse novum quoddam elementum, Thallium dico, invenit, prima spolia eademque opima his armis nactus. Eiusdem autem Thallii atomos etiam expendere potuit, quo nihil subtilius, nihil admirabilius. Primus etiam illud divinavit corpora materialia ita posse existere ut neque solida neque liquida neque vapora sint. Hoc demonstravit cum e tubulo aera extraheret donec spatium illud intra tubulum inclusum materia fere omni vacaret. Neque ipse solum in hoc curriculo feliciter versatus est, sed alii ex iisdem carceribus emissi alias palmas reportaverunt. Illud vero non silendum esse arbitror eum, cum de hoc genere quaereret, instrumentum quoddam effinxisse ad vim radiorum solis emetiendam, quod iure omnes inter miracula habent.

SIR DAVID GILL.

In extremo Africae meridionalis promontorio sub tutela navium Britannicarum surgit turris ad siderum motus observandos destinata. Illic plus viginti iam annos magno astronomorum omnium emolumento caeli signa perscrutatus est David Gill. Illic rem quater de integro aggressus id adsecutus est ut distantiam, quae inter solem et nostram terram intercedat, accuratius quam quivis e prioribus emetiretur, adeo ut hodie omnes astronomi eius rationes pro veris habeant. Idem eodem modo distantiam inter solem et quindecim ex stellis, quae fixae vocantur, definivit. Accuratissimam etiam descriptionem fecit earum caeli regionum, quas non nisi Australe latus orbis terrae incolentibus spectare concessum, et in tabulis maximis faciendis, quibus variae caeli partes cura exquisitissima depinguntur, cui operi praeclaro omnes ubique gentes hodie incumbunt, rem felicissime navavit.

SIR JOHN MURRAY.

Alia ex Colonia transmarina ad nos venit Ioannes Murray, qui quamquam origine Scotus media in Canada et natus et institutus est. De aqua marina, de animalibus mare habitantibus nemo est illo doctior. Harum rerum investigandarum causa navigationes plurimas fecit. Triginta quidem abhinc annos, cum novi quidam Argonautae a rectoribus nostris publice missi sunt, qui ex omni mari materiam scientiae colligerent, ipse inter delectos heroas fuit. Fructus vero illius navigationis quinque et quadraginta magnis commentariorum voluminibus continentur, quibus omnes usi sunt, qui de natura salis, de calore maris, de marinorum animalium formis et agendi rationibus postea scripserunt. Maximas profecto gratias habent omnes qui rerum naturae student Ioannae Murray horum commentariorum editori.

PROF. ALFRED MARSHALL.

Academia nostra particeps est laudis quam adsecutus est Aluredus Marshall. Cum enim in litterarum commercio ea ratione semper uberetur quam hic in rebus venalibus constantissime vindicavit ut amico portu advenas omnes reciperet, hunc virum magno cum fructu inter suos adscivit, quamquam Cantabrigiae olim mathematicae studuit et in eadem Academia nunc Oeconomias Professor est. Primus hic inventus est qui rationibus mathematicis fretus, quae antea tantum ad naturam rerum cognoscendam a physicis adhibitae sunt, de commercio hominum et societate quaereret. Cum in omni analyseos genere doctissimus esset, symbolis tamen parcissime est usus, et diviti cuidam ratiocinandi venae rerum minutissimam cognitionem addidit, unde factum est ut opus illud maximum de Oeconomias principiis non solum scientiae maturae et perfectae artis sed etiam sapientiae altissimae monumentum exstet.

PROF. J. J. THOMSON.

Inter Naturae venatores qui experimentis faciendis praecipue incumbunt Iosephus Ioannes Thomson dux est et signifer. Qui rationibus felicissime conceptis id demonstravit, quod nonnulli prius suspicati sunt, atomos illas, e quibus constat materia rerum, e minutissimis quibusdam et fere innumerabilibus corpusculis conglutinatas esse, quae tamen ipse et enumerare et expendere potuit. Neque hoc tantum adsecutus est, sed in vi electrica et magnetica et in natura atomorum cognoscenda se semper exercuit. Nos qui audivimus luculentissimam eius orationem cum nuperrime in hac Academia contionatus est, qui vidimus pulcherrima illa experimenta, quibus rationes suas probavit, minime mirabimur, cum omnes ex omnibus gentibus huius scientiae avidos se Cantabrigiam conferre, tum ex eius fontibus tot discipulos uberrimo cum fructu suos hortulos irrigare.

PROF. HORACE LAMB.

Et hic et apud Antipodas summam laudem adeptus est Horatius Lamb, qui et in Academia de Adelaide, cum in Australia versaretur, et Mancuniae in Academia Victoriana mathematices optimos studendi modos ostendit. Neque solum in rebus Academicis gubernandis maxime floret, sed de rationibus physicis secundum mathematicam artem tractandis libros optimos scripsit, quos omnes in manu habent, velut de fluidorum motu, de luce, de vi electrica, de sonitu, de scientia machinali: nuperrime etiam de terrarum motibus luculentissime disseruit. In his operibus ita tenuissima illa analysi, quae mathematicorum propria est, ad rationes physicas expendendas usus est, ut saepe res tenebris ante sepultas nova luce illustraret. Pauci sane hodie sunt qui de tot scientiae generibus egerunt: qui melius et probabilius de ullo scripserit, nemo est.

PROF. A. R. FORSYTH.

Scientiam mathematicam qualis hodie est tanquam monumentum esse videtur multorum laboribus multis in terris sensim aedificatum: inter quos locum insignem tenet Andreas Russell Forsyth, non solum quod ipse huic praeclaro operi multos lapides imposuit, sed quod haec omnia quasi calce et caemento conglutinavit. Augustinus Cauchy, Bernardus Riemann, Carolus Weierstrass, hi Germani, ille Gallus, analyseos problemata tribus viis aggressi, quisque pro se summi momenti res reppererant: quae inventa ut in unam rationem congruentem conflaret, ut vinculis et nexibus coniungeret, ut his tribus quaerendi modis usus cognitionis humanae fines promoveret, inventus est Andreas Forsyth. De quo illud affirmare possumus si Fata eum insignem inter mathematicos non fecisset, insignem in re publica gubernanda fecisset Natura, adeo eius consilia in rebus Academicis Cantabrigienses sui petunt, tanti eius iudicium ab omnibus aestimatur.

PROF. J. DEWAR.

Liquidone de aere loquitur quis? Occurrit menti Iacobus Dewar. Quid enim? Partem aliquam aeris circumambientis corripere, secernere in vasculo, cogere ut modo fluat sicut aqua, modo congeletur sicut glacies, nonne haec ultra ingenii humani fines videntur? Quae tamen posse fieri iamdudum notum est: immo, aliquando facta sunt, sed in tenui erat et labor et successus. Ulterius vero progressus est Iacobus Dewar, qui cum neque impensae neque labori neque cogitationibus suis parceret, instrumenta exquisitissima perfecit, quibus vis aliqua maior vel aeris vel tenuissimarum illarum substantiarum ipsum aera subtilitate superantium modo liquida modo solida fiat. Ita nova quaedam et potentissima Naturam investigantibus subsidia, quibus ipse maximo cum fructu usus est, aliis tradidit, cum materia qualis sit omni fere caloris particula ablata homines iam cognoscere possint.

PROF. J. LARMOR.

Newtonus ille, "qui genus humanum ingenio superavit," solem terram lunam planetas nutu quodam et pondere contineri docuit, et motus suos conficere hac vi compulsos. Cui successit his diebus Iosephus Larmor, cathedrae Newtonianae novissimum decus, qui vir ingenio Hibernus, mathematices scientia vere Cantabrigiensis, id fecit ut in omni omnis corporis atomo mundi imaginem expressam videremus, cum doceret particulas minutissimas, e quibus corporum atomi constent, vi electrica contineri et hoc momento coactas quasi per orbitas agitari. Quae doctrina non modo in ordinem convenientem redegit quidquid antea de luminis natura de vi electrica et magnetica compertum est, sed nodos difficillimos, quibus implicantur ii qui experimentis faciendis se totos dant, omnes exsolvit.

AT presentation day of the University of Manchester on July 2, the honorary degree of D.Sc. was conferred on Prof. B. Brauner, of the Czech University of Prague, Dr. Ludwig Mond, F.R.S., and Dr. W. H. Perkin, sen., F.R.S.

THE Schunck Laboratory, which was bequeathed to Owens College by the late Dr. Schunck, and has been removed from his residence at Kersal and rebuilt in the college precincts as nearly as possible in its original form, was formally opened by Dr. W. H. Perkin, F.R.S., last week.

WE learn from *Science* that at the recent commencement exercises of Columbia University a gift of 50,000*l*. from Mr. Lewisohn was announced, to be used for a building for the School of Mines. It is also reported that the sum of 65,000*l*. has been collected for MacAlaster College in Minnesota. The largest gifts were 20,000*l*. from Mr. C. D. Dayton and 10,000*l*. from Mr. J. J. Hill.

THE first volume, January to June, 1904, of *School*, the new educational periodical published by Mr. John Murray, has now been issued. It contains a good supply of articles on educational subjects of theoretical interest which will appeal to the student of pedagogics. Matters of educational administration, and notes on the way in which the recent Education Acts are being utilised by local authorities, are given a prominent place. The teaching of science, and topics of especial interest to those engaged in this part of school work, receive but little attention.

IN connection with the opening of the new laboratories and workshops by Sir William H. White, K.C.B., at the Merchant Venturers' Technical College, Bristol—which was announced in our issue of June 9—the governing body has issued a lavishly illustrated "Souvenir," which provides an excellent account of the work and equipment of the enlarged institution. In tracing the growth of the college during the last fourteen years, the pamphlet shows that during this period the number of adult students attending the day classes has increased five-fold, the number in attendance in 1890 being 48, and this year 242. It is only necessary to read the descriptions of the workshops provided for the technical instruction of printers, bookbinders, painters, plumbers, and engineers of various kinds to appreciate how much is being done in Bristol to train fully qualified workmen for the city's industries, and the large number of students who attend the courses of work provided shows that the men themselves appreciate what is offered. The provision of classes in the branches of science associated with these technical subjects is also satisfactory.

THE recently published "Besuchs-Statistik" for the semester ending in March last shows that there were 37,854 matriculated students studying in German universities, including 3093 foreigners (this is the highest total ever reached by the non-German element); the number of non-matriculated students was 9187, thus making a sum total of 47,041. Of the different universities, Berlin easily stands first with 7503 matriculated and 6353 non-matriculated students. The next in numerical order are Munich with 4609, Leipzig with 3772, and Bonn with 2294 students of all classes. Breslau and Halle have each more than 1500, and the following nine universities more than 1000 students:—Tübingen, Göttingen, Heidelberg, Strassburg, Freiburg, Würzburg, Münster, Marburg, and Giessen. Of the foreign students 2620 are Europeans, consequently leaving 473 who hail from the other continents. Among these 2620 European students, Russia, with 986, sends considerably the largest contingent; then follow Austria and Switzerland. It is a remarkable fact shown by the statistics that by far the largest proportion of non-matriculated to matriculated students, viz. 42 per cent., is to be found in Berlin. The weaker sex, represented at all the universities except Münster, Greifswald, and Rostock, forms a seventh part of the total of non-matriculated students. Berlin claims the largest portion of Germany's lady students, for 42 out of every 100 prefer to study in the Imperial capital, the universities next in favour being Breslau, Bonn, and Strassburg, but here their numbers never exceed 100. The total number of students at the French universities for the semester ending in March was 30,405. Here again the university in the capital easily heads the list with 12,948 students. Then come Bordeaux, 2320; Toulouse, 2191; Montpellier, 1707; Nancy, 1327; Rennes, 1190; Lille, 1164; Aix-Marseille, 1080; Dijon, 880; Poitiers, 863; Caen, 752; Grenoble, 705; Besançon, 333; and Clermont, 299. 10,972 belonged to the law faculty, 6686 to the medical, 4765 to the science, 4384 to the arts, 3014 to the "pharmaceutical" faculty. The numbers of foreigners, amounting to nearly 2000, included 450 Russians, 200 Persians, 175 Roumanians, 165 Germans, 109 Bulgarians, 113 Turks, 83 Egyptians, 57 Americans, and 35 English students. The sum total of women students amounted to 1125, of whom 677 were of French nationality and 448 foreigners—almost entirely of Russian birth.

THE Senate of the University of London, at a meeting on June 28, considered a report from the committee appointed to deal with the offer of the Goldsmiths' Company to transfer to the university the Goldsmiths' Institute at New Cross. The Senate decided to accept the munificent offer of the company, and an *ad interim* committee was appointed to carry out the reorganisation of the institute. To meet the needs of the county councils of London, Middlesex, Kent, and Surrey, and the borough council of Croydon, it is proposed that a day training college for about 400 students shall be opened in the Goldsmiths' Institute in the autumn of 1905. In connection with this college it is considered important that day classes should be held preparatory for the intermediate examinations, or up to the standard of the intermediate examinations, in arts and science. This scheme will absorb the funds at the disposal of the university, which will thus be unable to carry on other classes unless it receives further financial support. Should such support be forthcoming, it is prepared to carry on at New Cross the higher part of the work of a polytechnic, and to continue the existing school of art. It will not be possible for the university to continue the social and recreative side of the institute. The scheme has received the full approval of the Goldsmiths' Company. The Education Committee of the London County Council has also had the affairs of the Goldsmiths' Institute under consideration, and on Tuesday the council accepted its recommendations to inform the Goldsmiths' Company that the council would view with regret the closing of the Goldsmiths' Institute and the termination of its educational work as a polytechnic, and inviting the company to consider whether some arrangement cannot be come to by which the work of the institute could be continued in its present polytechnic form. Another recommendation accepted states, among other points, that, in the event of its proving impossible to secure the continuance of the Goldsmiths' Institute as a polytechnic, the council would regard it as of great importance to secure its retention as a centre of evening instruction in as many subjects as possible, especially in the higher grades, and to arrange for the continuance of an efficient department of mechanical and electrical engineering for evening students.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 9.—"The Fossil Flora of the Culm Measures of North-west Devon, and the Palæobotanical Evidence with regard to the Age of the Beds." By E. A. Newell **Arber.** Communicated by Prof. McKenny Hughes, F.R.S.

The Carboniferous rocks of Devonshire, generally known as the Culm Measures, are divided into an Upper and a Lower division. The Upper Culm Measures, which are of Upper Carboniferous age, form by far the thickest portion of this Carboniferous series. Plant remains, although abundant in these beds, are rarely sufficiently well preserved to admit of identification. A number of species have, however, been obtained, some of which are new to Britain, from the one horizon in the Upper Culm Measures in which coal, known locally as culm, is found. This flora is identical with that of the Middle Coal Measures elsewhere in England, and consequently the horizon on which the coal or culm occurs in the Bideford district is the equivalent of the Middle Coal Measures, a higher horizon than has been previously assigned to these beds.

There is also evidence that the Culm Measures at Instow, which occupy a lower horizon than the Culm Measures of the Bideford district, are probably the equivalents of the Lower Coal Measures. Thus both the Lower and Middle Coal Measures are represented in Devonshire, and, as the higher beds of the Culm Measures are as yet unexplored, possibly even higher horizons may eventually be found to be represented.

It is pointed out that the Culm Measures of Devon, which have been regarded by several geologists as essentially a Lower Carboniferous formation, are in reality chiefly, but not entirely, of Upper Carboniferous age. Consequently, the term "culm" or "kulm" generally applied to certain deposits in Germany, Austria, and elsewhere on the Continent, which are entirely of Lower Carboniferous age, is peculiarly unfortunate, for these beds are not of the same age as the great bulk of the Devonshire Culm Measures.

June 16.—"The Decomposition of Ammonia by Heat." By Dr. E. P. **Perman** and G. A. S. **Atkinson.**

Ammonia gas was heated in a porcelain globe placed in a muffle furnace, and the total pressure of the ammonia and decomposition products was read by means of a mercury manometer at equal time intervals, the volume being kept constant. The temperature was measured by a Callendar-Griffiths pyrometer, and was maintained constant within 1° or 2°; in the various experiments it varied from 677° to 1111°.

At the end of each experiment the temperature was raised to about 1100°, and maintained at that point until the decomposition of the ammonia was practically complete; the pressure was then read again, and from it was calculated the initial pressure of the ammonia in the globe.

Let p_1 be the pressure of the ammonia at any instant during the decomposition, p_1' that of the nitrogen, p_2' that of the hydrogen, P the total pressure at the same instant, p_0 the initial pressure of the ammonia, then $p_1+p_1'+p_2'=P$, $p_2'=3p_1'$, and $p_1'+p_2'=2(p_0-p_1)$; from these equations it follows by substitution that $p_1=2p_0-P$, *i.e.* the pressure of the ammonia at any instant is double the initial pressure minus the total pressure at the instant of observation. The experimental data furnish values of P and $2p_0$, and values of $2p_0-P$ have been calculated and tabulated; from the latter were calculated $\Delta P/\Delta t$; but $\Delta P/\Delta t=dP/dt$ approximately, and $dP/dt=dp_1/dt$, so that the rate of change of pressure of the ammonia at various pressures becomes known. Two series of curves have been drawn showing the variation of the rate with the pressure. The most noteworthy features of the curves are:—(1) at the highest temperatures they become straight lines; (2) they all run towards the origin; (3) they become much steeper when certain metals (mercury, iron, or platinum) are present in the globe. The chief deductions are:—(1) the decomposition is monomolecular; (2) and (practically if not completely) irreversible; (3) the rate of decomposition is much increased by the presence of certain metals.

Some experiments were made also on the effect of sudden change of pressure on the rate of decomposition; the results confirmed the conclusion that the reaction is monomolecular. The irreversibility of the reaction was confirmed by passing nitrogen and hydrogen through a red-hot glass tube containing porcelain, when no ammonia was found to be produced.

Royal Astronomical Society, June 10.—Prof. H. H. Turner, president, in the chair.—Mr. A. R. **Hinks** read a paper on the reduction of 295 photographs of Eros made at nine observatories during the period 1902 November 7–15, with a determination of the solar parallax; 110 of the plates were taken at Cambridge, the remainder at Algiers, Lick Observatory, Northfield Observatory, Oxford, Paris, and other observatories. The author described the method employed in the reductions, &c., and gave as the resulting value for the solar parallax $8''\cdot7966\pm0''\cdot0047$, a result nearly in accordance with that obtained by Sir D. Gill from heliometer observations of minor planets.—Mr. M. E. J. **Gheury** read a paper on the gyroscopic collimator of Admiral Fleuriais. In this instrument the principle of the gyroscope was employed to furnish an artificial horizon for sextant observations at sea. The instrument was shown to the meeting, and its construction and method of employment were described.—Mr. Bryan **Cookson** gave an account of his paper on the mass of Jupiter, and corrections to the elements of the orbits of the satellites, from heliometer observations made at the Cape Observatory during the years 1901 and 1902. The methods of observation and reduction were explained, and a brief account given of the results.—Mr. E. W. **Maunder** read a paper on the distribution of sun-spots in heliographic latitude during the years 1874 to 1902. The author considered Spoerer's law for the distribution of sun-spots to be true within the limits of its enunciation—that there is only one spot zone in either hemisphere except during the brief period just after minimum.—The Rev. A. L. **Cortie** read a paper on the variation of latitude of the greater sun-spot disturbances, 1881–1903. Dr. Lockyer briefly replied, contesting some of Mr. Maunder's conclusions.

Chemical Society, June 15.—Prof. W. A. Tilden, F.R.S., president, in the chair.—The following papers were read:—The mechanical analysis of soils and the composition of the fractions resulting therefrom: A. D. **Hall.** The object of the investigation was to ascertain the effect of introducing into the mechanical analysis of soils a preliminary treatment of the soil in dilute acid followed by ammonia, as first suggested by Schlœsing. Eighteen soils of known history were selected from the Rothamsted experimental plots, to give comparisons of the same soil in an unmanured condition and when rich in humus through the accumulation of organic matter. With these soils the method involving a preliminary treatment with acid showed the essential identity of soils from the same experimental field whatever the manuring had been, whereas the analyses made on the raw soil gave very different results, depending on the treatment the various plots had received.—The effect of the long-continued use of sodium nitrate on the constitution of the soil: A. D. **Hall.** On reviewing the results of the mechanical analysis of the Rothamsted soils, it was observed that those which had been manured with sodium nitrate every year gave abnormal results for the last fraction. The removal of the finest particles from the surface soil is attributed to deflocculation induced by the use of sodium nitrate, and followed by the washing of the finest particles into the subsoil.—The decomposition of oxalates by heat: A. **Scott.** It is shown that the decomposition of oxalates by heat is less simple than is generally supposed, and that, except in the case of magnesium oxalate, the oxalates of the common metals generally yield a small quantity of carbon.—Some alkyl derivatives of sulphur, selenium and tellurium: A. **Scott.** A description of the derivatives obtained by the action of various alkyl iodides on these elements.—The ultra-violet absorption spectra of certain *enol-keto*-tautomerides, part i., acetylacetone and ethyl acetoacetate: E. C. C. **Baly** and C. H. **Desch.** From comparative observations of the absorption spectra of these compounds under various conditions, the conclusion is drawn that with acetylacetone, ethyl acetoacetate, and their metallic derivatives, a state of dynamic isomerism exists in the solutions, and that this isomerism is evidenced by a characteristic band in the spectra.—The action of acetyl chloride on the sodium salt of diacetylacetone and the constitution of pyrone compounds: J. N. **Collie.** A description of three isomerides obtained in this reaction, from the study of which the author has been led to assign a new constitution to pyrone and its derivatives.—Our present knowledge of the chemistry of indigo: W. P. **Bloxam.** Some observations on the purity of commercial indigotin and on the composition of indirubin were made.—$\Delta^{1:3}$-Dihydrobenzene: A. W. **Crossley.** A description of the formation and properties of this substance is given.—The absorption spectrum of *p*-nitrosodimethylaniline: W. N. **Hartley.** The absorption caused by *p*-nitrosodimethylaniline at the less refrangible end extends into the infra-red, and at the more refrangible far into the ultra-violet. The transmitted rays are thus restricted to a band of yellow and green light bordered on either side by a band of intense absorption. The alkyl-substituted phenols and anilines absorb varying quantities of the ultra-violet, the absorption not extending into the visible spectrum; but it is also shown that the introduction of the NO, as distinguished from the NOH group, extends the absorption far into the coloured rays.—The influence of solvents on the rotation of optically active compounds, part vi., the relationship between solution-volume and rotation of the dialkyl and potassum alkyl tartrates in aqueous solution: T. S. **Patterson.**—The constitution of hydrastinine: J. J. **Dobbie** and C. K. **Tinkler.** Solutions of hydrastinine in ether or chloroform are colourless, and their absorption spectra are practically identical with the spectra of hydrohydrastinine. From this it is argued that the carbinol formula should be preferred to the open-chain or aldehydic formula of Roser. On the other hand, the aqueous or alcoholic solutions of hydrastinine give spectra which agree with those of the hydrastinine salts, whence it would appear that, under the influence of these solvents, hydrastinine changes from the carbinol to the ammonium base.—The influence of moist alcohol and ethyl chloride on the boiling point of chloroform: J. **Wade** and H. **Finnemore.** Chloroform made from alcohol contains, in addition to alcohol, a small quantity of ethyl chloride, both of which depress the boiling point.—Limonene nitrosocyanides: W. A. **Tilden** and F. P. **Leach.** The nitrosocyanide described by Tilden and Burrows as a liquid is found to be a crystalline optically active solid having m.p. 90–91°, and $[\alpha]_D + 165°$.—Photochemically active chlorine, ii., a preliminary notice: C. H. **Burgess** and D. L. **Chapman.** —Additive compounds of anhydrous magnesium bromide with organic oxygen and nitrogen compounds: J. J. **Sudborough,** H. **Hibbert,** and S. H. **Beard.**—Differentiation of primary, secondary, and tertiary amines. A preliminary note: J. J. **Sudborough** and H. **Hibbert.**—Influence of radium radiations on labile stereoisomerides: J. J. **Sudborough.** The results indicate that *allo*-cinnamic acid and its α and β bromo-derivatives are transformed more readily under the influence of sunlight than by prolonged exposure to radium radiations.—Notes on analytical chemistry: G. T. **Morgan.** The separation of arsenic by distillation in hydrogen chloride. The estimation of carbon by oxidation with chromic acid.—Nitrogen chlorides containing two halogen atoms attached to the nitrogen: F. D. **Chattaway.**—Sulphonphenylchloroamides and sulphontolylchloroamides: F. D. **Chattaway.** —Stereoisomeric glucoses and the hydrolysis of glucosidic acetates: E. F. **Armstrong** and P. S. **Arup.** It was shown that the acetyl groups are removed with unequal readiness from the penta-acetates of glucose and galactose and from sucrose octaacetate, and with equal readiness from the tetra-acetates of the methylglucosides and galactosides.—The colouring matter of the flowers of *Butea frondosa*: A. G. **Perkin.** This dye-stuff is shown to contain two substances, *butin* and *butein,* which are closely related in constitution, the former being a chalkone compound and the latter the corresponding flavonone isomeride.—Cyanomaclurin: A. G. **Perkin.** This product, which exists in jackwood, closely resembles the catechins in constitution, and is probably derived from them by the replacement of a catechol nucleus by resorcinol. —The determination of acetyl groups: A. G. **Perkin.** A description of a hydrolytic method of estimating acetyl groups in organic compounds.—Note on the catechins: A. G. **Perkin.** A description of the acetyl derivative of the catechin (*acacatechin*) derived from *Acacia catechu* is given.—A constituent of Java indigo: A. G. **Perkin.** It is shown that the yellow colouring matter present in Java indigo is identical with kampherol.

Royal Microscopical Society, June 15.—Dr. D. H. Scott, F.R.S., president, in the chair.—A direct proof of Abbe's theorems on the microscopic resolution of gratings: Prof. J. D. **Everett.** The image of the grating formed by the objective is the resultant effect of the disturbances in the image plane due to the diffraction spectra formed in the focal plane. The optical path measured from a plane wave-front, before incidence on the grating, to the spectrum of order o, is unaffected by displacement of the grating. The path to a spectrum of order 1 is altered by $\lambda x/s$, and to a spectrum of order n by $n\lambda x/s$, by a shift x of the grating, s denoting the distance between rulings. At a fixed point P in the image plane, the interference of the spectrum of order o with a spectrum of order n goes through a complete cycle, while x increases by s/n. That is, n lines in the image move across P during a displacement s of the grating. Similar reasoning applies to the interference of any two of the spectra, and gives Abbe's results. A displacement x towards either side diminishes the paths to the spectra on this side, and increases the paths to the spectra on the other side. When only one spectrum operates, there is no interference and no alternation of brightness.—The recent Foraminifera of the Malay Archipelago: F. W. **Millett.**—Nature's protection of insect life: F. **Enock.**

Physical Society, June 24.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—Chemical dissociation and electrical conductivity: A. E. **Garrett** and Dr. R. S. **Willows.** It has been shown by Beattie (*Phil. Mag.*, 1899) that a mixture of salt and iodine, when placed on a zinc plate and heated, gives rise to electrical conductivity, although separately no such effect is produced. This is shown to be due to the formation of zinc iodide. Following on this the electrical conductivity produced by heating various salts is investigated under different conditions of temperature and electric field. A large excess of positive electricity is found in nearly every case.—The magnetisation of iron in bulk: Dr. W. M. **Thornton.** The paper is in three sections. The first describes a method of measuring large quantities of magnetism by the use of an exploring coil placed around the core and an exciting coil in series with a recording milli-voltmeter. The second section deals with the curves of rise of magnetising currents, when the core is solid and when laminated, as affected by the reaction of the core-currents, and also by the change of permeability during magnetisation. In the last section an example is given of the sudden dip in the curve of rise observed only with large cores.

PARIS.

Academy of Sciences, June 27.—M. Mascart in the chair.—Researches on cyanogen: solubility and polymerisation: M. **Berthelot.** There is no true coefficient of solubility of cyanogen in water or alcohol, a slow chemical reaction taking place from the first. With other solvents, such as acetic acid, turpentine, chloroform, and benzene, the ordinary laws of solution are obeyed.—Researches on cyanogen and on its reaction with potassium cyanide: M. **Berthelot.** An attempt to prepare polycyanides corresponding to the triiodides was not successful. Cyanogen is rapidly absorbed by a solution of potassium cyanide, but no compound corresponding to potassium triiodide was obtained, the gas being partly hydrolysed and partly polymerised.—On the distribution of time at a distance by means of wireless telegraphy: G. **Bigourdan.** The experiments described have been successful up to a distance of 2 kilometres, and there seems no reason to suppose that the signals could not be easily sent over much longer distances.—On the distillation of a mixture of two metals: Henri **Moissan** and M. **O'Farrelley.** Alloys of copper, lead, zinc, cadmium, and tin were heated in carbon boats in the electric furnace. The alloys behaved exactly as in an ordinary fractional distillation, the composition varying with the time of distillation and the quantity of metal distilled. Thus with alloys of zinc and copper, cadmium and copper, lead and copper, a residue could be obtained after a certain time consisting of pure copper.—The influence on the rotatory power of certain molecules exerted by non-saturated radicals. The allyl ethers of borneol, menthol, methylcyclohexanol, and linalool: A. **Haller** and F. **March.** With one exception, the ethers possess a higher rotatory power than the active alcohols from which they are derived. With the same exception, the molecular refractive powers found are in accord with those calculated.—Muscular work and the expenditure of energy in dynamic contraction: A. **Chauveau.**—Improvements in the photographic method for recording the action of the *n*-rays on a small electric spark: R. **Blondlot.** The improvements on the method previously described include the use of an aluminium lens for concentrating the rays from the Nernst lamp on the spark gap, together with some details necessary for the working of the spark. Very slow development of the negative is required to bring out the effect clearly.—The action of magnetic and electric forces on ponderable emission; the effect of air in motion on this emanation: R. **Blondlot.**—M. Maquenne was elected a member of the section of rural economy in the place of the late M. Duclaux, and Prof. Waldmeyer a correspondant in the section of anatomy and zoology in the place of Prof. A. Agassiz, elected foreign associate.—On certain classes of isothermal surfaces: L. **Raffy.**—On a class of partial differential equations of the second order: J. **Clairin.**—Remarks on the propagation of percussions in gases: E. **Jouguet.**—On a new aërial helix: H. **Hervé** and H. **de la Vaulx.**—The dielectric cohesion of the saturated vapour of mercury and its mixtures: E. **Bouty.** The experiments were made in a fused silica flask, which satisfied the necessary condition of possessing no conductivity at the temperature of the experiment. The cohesion of mercury vapour is only 0·85 that of air, which, having regard to the high density of the vapour, is remarkably small. The effect of introducing various gases with the mercury vapour was also studied.—The transport of ultramicroscopic particles in the current: A. **Cotton** and H. **Mouton.**—On a new method of three-colour photography: R. W. **Wood.**—On the yellow and red varieties of thallium iodide and the determination of the normal point of their reciprocal transformation: D. **Gernez.** The transition point was determined as 168°, or 22° lower than the figure usually accepted.—On the nitrate and nitrite of thallium: U. **Thomas.** Thallous nitrate is decomposed at 450°, furnishing nitrous anhydride and a well crystallised sesquioxide, without any appreciable amount of nitrite being formed. The nitrite is decomposed in an analogous manner. It was found that thallous nitrate can be partly volatilised without decomposition.—The total synthesis of rhodinol, the characteristic alcohol of essence of roses: L. **Bouveault** and M. **Gourmand.** Ethyl geraniate, treated with sodium and absolute alcohol, gives a mixture of two alcohols, one of which is rhodinol. This alcohol possesses a strong odour of roses, and, except that it is inactive, shows all the properties of the rhodinol extracted from essence of roses and essence of pelargonium. A crystalline semicarbazone, melting at 112°, has been prepared from its pyruvate, and this has been found to be identical with the similar compound prepared from the natural rhodinol.—On two homologues of pyrocatechol: R. **Delange.** The preparation of ethylpyrocatechol and isopropylpyrocatechol is described, and their physical properties given.—On a new class of ether-oxides: Marcel **Descudé.** By the action of sodium ethylate upon dichloromethylether, the ether

$$C_2H_5—O—CH_2—O—CH_2—O—C_2H_5$$

is obtained. In its chemical and physical properties it approximates to the formals.—On methylarsenic: V. **Auger.** Solutions of sodium methylarsenate reduced by heating in the water bath with sodium hypophosphite give a yellow oil of the empirical composition CH_3As. This can be purified by fractional distillation in a vacuum, and cryoscopic determinations in benzene solution show that its molecular weight is four times that of the simple formula. It polymerises readily in presence of hydrochloric acid, giving a brown powder which has been mistaken for arsenic.—On some mixed phosphorus acids derived from hypophosphorous acid: C. **Marie.**—Additional ammoniacal compounds of the rosanilines: Jules **Schmidlin.**—Study of the variation of the mineral matters during the ripening of seeds: G. **André.**—Researches on plant acidity: Eug. **Charabot** and Alex. **Hébert.**—The action of heat and acidity on dissolved amylase: P. **Petit.** The diastatic power of a malt may be increased by altering the acidity of the solution to the point corresponding to coagulation by heat.—Abnormal developments independent of the medium: C. **Viguier.**—On an unknown animal met with in the Bay of Along: M. **L'Eost.** An account of an animal, apparently a sea serpent, seen from the gunboat *Décidée* on February 25. Its length was estimated at 30 metres.—The complete extraction of water and gases from seeds: Paul **Becquerel.**—A resonance method for the determination of the frequency of nervous oscillations: Augustin **Charpentier.**—On the urinary chromogen due to subcutaneous injections of skatol: Ch. **Porcher** and Ch. **Hervieux.**—The action of salts of the alkaline metals upon the living substance: N. C. **Paulesco.** The limiting quantities of salts of the alkalies which act upon yeast under fixed conditions are proportional to their molecular weights.—On the problem of "statical work": hydrodynamical and electrodynamical paradoxes: Ernest **Solvay.**—On the laws of the so-called "statical work" of muscle: Ch. **Henry.**—On the toxic action of intestinal worms: L. **Jammes** and H. **Mandoul.**—Observations at the Franco-Scandinavian captive balloon station at Hald: L. Teisserenc **de Bort.**

CONTENTS.

PAGE