THURSDAY, APRIL 21, 1910.

THE CORRESPONDENCE OF OLBERS AND GAUSS.

Wilhelm Olbers, sein Leben und seine Werke. Im Auftrage der Nachkommen herausgegeben von Dr. C. Schilling. Zweiter Band, Briefwechsel zwischen Olbers und Gauss, Zweite Abtheilung. Pp. vi+758. (Berlin: J. Springer, 1909.) Price 16 marks.

TEN years have elapsed since the first part of this volume appeared (NATURE, vol. lxi., p. 486), the editor having been prevented by other occupations from completing his work, until he secured the co-operation of Dr. Kramer. The present part (or rather volume) comprises the years from 1820 to the death of Olbers in 1840. Although it forms part of a publication intended to keep alive the memory of Olbers, the real hero of this volume is Gauss, not only because he was a greater man than his correspondent, but also because the scientific work of Olbers was almost finished before 1820. All the same, the volume serves to complete the picture of the charming personality of Olbers with which previously published letters had supplied us, while it almost forms a diary of the scientific work of Gauss during the years 1820–40.

At the beginning of 1820 the new transit circle by Reichenbach had just been mounted at the Göttingen Observatory, and Gauss was busy studying what was practically a new form of instrument. Though he was very fond of observing, the Göttingen Observatory did not accomplish as much as might have been expected, considering the devotion of the director to astronomy and the fine instruments at his disposal. This was partly caused by the various other pieces of work in practical science which occupied so much of his time, partly by his never having an assistant until the death of Harding (in 1834), who held a rather anomalous position. Geodetic work soon came to occupy most of Gauss's time. The continuation of the Danish survey southward through Hanover was finally decided on in 1820, and the work in the field was carried out during the summers of the next five years, most of it by Gauss himself, who, both on this and on the computation of the results, spent a vast amount of time. One cannot help regretting that so great a mathematician should have been obliged or found it necessary to do so much routine work himself instead of merely supervising its execution by others. No doubt this work gave rise to several theoretical investigations of great value, and occasioned the invention of the heliograph by Gauss, but these results would have been produced equally well by his brain if the fatiguing work in the field and the arithmetical drudgery at home had been done for him. Attempts were repeatedly made at Berlin, especially in 1824, to get a post created for Gauss in connection with the Academy of Sciences, but they were never successful. At Berlin he would have been relieved of all teaching work, which he greatly disliked, and his time would have been almost altogether his own. The work on the survey continued to drag on; the present volume gives full details about the various stages of it, but everything of permanent interest has already been given in excerpts from these letters in Gauss's collected works.

During the second half of the period in question Gauss devoted himself chiefly to researches on terrestrial magnetism, and continued to keep Olbers posted on the progress of this work. Naturally the electromagnetic telegraph which was established in 1833 between the observatory, the Johannisthurm, and the physical laboratory, a distance of several thousand yards, is described with pride and in full anticipation of the great possibilities of the invention. The cooperation of Gauss and Weber in the magnetic work came to an end in 1837, when Weber, as one of the seven professors who had protested against the King's violation of the constitution, had to leave Göttingen. In his letters, Gauss expresses himself with great caution about this unpleasant affair, because, as he says himself, it was not at all unlikely that letters were tampered with while they were on the way.

Though Olbers in his letters had no great investigations to describe to his friend, he had always something of interest to say about the current scientific events of the day. It is interesting to see him occasionally give his opinion about some of his contemporaries. Thus he considered W. Herschel "a good mathematical head, but too much wanting as regards scientific education, though his, so to say, natural mathematics generally guided him in the right direction." As to Schröter, Olbers thought that though Mädler had spoken rather too severely of him, he certainly had very exaggerated ideas as to what his telescopes could show, and believed that no one but Herschel could verify what he himself saw or imagined he saw.

As a sort of running commentary on the progress of astronomy, Olbers's letters are of great interest, but their value to most readers would have been much increased if the editors had been more liberal with footnotes giving references to astronomical literature. Thus, when Gauss sets forth his grave doubts as to the alleged fraud of d'Angos, it should have been stated that Gauss much later wrote a short paper on this subject, which was printed after his death; also that the researches of d'Arrest and Gyldén have rendered it at least extremely doubtful whether any fraud had been committed. Similarly, when Olbers assumes it to have been proved that Hell falsified his observations of the transit of Venus, it should have been pointed out that Newcomb most thoroughly established Hell's innocence. The nebula mentioned on p. 43 is N.G.C. 7293, and the mysterious nebula of Cacciatore (p. 461) is N.G.C. 6541, as to which J. Herschel showed long ago that Cacciatore had simply made a blunder in identifying a star (Gen. Cat., p. 37).

This correspondence fills two stout volumes in large octavo, 1500 pages in all. Is it really worth while to print every single word that a great man puts on paper? It is natural that a man should tell his intimate friend at some length that his wife and children have measles, or repeatedly give vent to his sorrow and indignation at the conduct of a good-for-nothing

son; but it goes without saying that he does not want all this printed. A judicious selection from these 734 letters would have been very much more valuable than this unsifted mass of important and unimportant matter. There is an excellent index, which will be of great use to a reader desirous of referring to any particular subject. In an appendix are given some letters about the negotiations to get Gauss an appointment at Berlin, and three very interesting letters from Bessel to Olbers from the year 1812, which have only recently been found. J. L. E. D.

COLONIAL FRUIT-GROWING.

Fruit-ranching in British Columbia. By J. T. Bealby. Pp. viii + 196. (London: A. and C. Black, 1909.) Price 3*s*. 6*d*. net.

THIS is a practical work on the subject of fruit-growing in British Columbia, and we recommend it to any who have the intention of emigrating for the purpose of engaging in this healthful and interesting pursuit. But not to these alone, for the style in which it is written is sufficiently good to make the reading agreeable to the general public. It sets forth in plain but picturesque language the reasons that led the rancher to select British Columbia for the scene of his operations; it describes his journey out, relates the difficulties the new settler had to overcome, and proceeds to describe the measure of success that soon attended his labours.

This success enabled him, not only to win prizes for fruit at exhibitions in British Columbia and in the United States, but also to send excellent apples to the Royal Horticultural Society's shows in London, and gain for them the Society's gold medal!

The figures relating to the crops obtainable per acre in British Columbia are almost bewildering to the cultivator in this country, who can never be certain, even of a moderate return, until the danger of spring frosts is past at the end of May. The difference is explained by the sunnier skies, freedom from violent winds and storms, and the presence of a most fertile soil. The allurements these things offer are only to those who are content to undertake the hard work inseparable from colonisation. Unless the "tenderfoot" possesses a sufficient capital to enable him to purchase an estate already planted, he must commence by clearing away the trees and under-shrub from his plot, and in this and all other work he must improvise ways and means for carrying out the details which are simple enough in a more thickly populated country, but very difficult in parts of a colony in the first stages of development.

In these matters the reader will find much interesting information in Mr. Bealby's work. He will realise how important it is that the work of preparing the ground shall be done in a thorough manner, and that careful consideration shall be given to the planting of suitable trees. The settler has to take into account the kinds of fruit most likely to yield profitable returns, and having decided thus far he must select the best varieties of each kind. He must study his market, the means that exist for sending the fruits to market, and the length of time they will be on transit. The advice given on such matters as these is perfectly sound, and therefore calculated to assist settlers very materially, provided that instead of slavishly following them in detail they wisely modify them to suit best their own circumstances.

Mr. Bealby probably underestimates the cost of preparing the land, but this may be expected to vary in different districts, and he appears to place too much importance upon the fact that in the Kootenay and Okanagan districts the fruit plantations are more free from insect and fungal pests than in other localities. The explanation of this comparative immunity will probably be found in the newness of the land. Pests are seldom epidemic unless the host-plants are present in large numbers and so facilitate the spread of insects or fungi, but they usually appear when the cultivator has planted vast areas with the same kind of tree, or crowded them into a hot-house, as is the case with tomato and cucumber culture in our own country.

For this same reason, the best preventive is to plant thinly, allowing each tree as much isolation as can be spared with due regard to the yield per acre. It is satisfactory from this point of view to note that, so far as can be seen from the excellent illustrations contained in the book, it is not the practice to crowd the trees together in British Columbia. The trees depicted appear to have plenty of space around them, therefore they are exposed well on all their sides to the good influences of sunshine and air, which are conducive to healthy growth and a free cropping habit.

The evidence the book contains of the enormous help the settler in British Columbia may expect to receive from the Department of Agriculture and the British Columbia Fruit-Growers' Association should be an extra inducement to emigrants to select this country for their new home. We hope Mr. Bealby will return to the subject when he has gained further experience, for it has to be noted that he has only been engaged in the industry since 1907, a fact that may cause some to receive his recommendations with a certain amount of reserve, especially so far as they relate to yields, prices, and returns.

STEAM TABLES.

Tables and Diagrams of the Thermal Properties of Saturated and Superheated Steam. By L. S. Marks and H. N. Davis. Pp. 106. (London: Longmans, Green and Co., 1909.) Price 7*s*. 6*d*. net.

AN immense amount of painstaking work is represented by this little volume, which will, we think, be of undoubted use to all physicists and engineers who have to deal with problems involving the influence of heat upon water and steam. The two authors are connected respectively with the engineering and physical sides of the great American University of Harvard, and they have evidently formed a combination well suited for such an investigation as this. Until quite recently the only authoritative experiments over a considerable range of steam pressures and temperatures were those made by Regnault more than sixty years ago. We now have, however, the results of later experiments by Dieterici, Smith, Griffiths, Henning, Joly, Grindley, Peake,

Griessmann, Knoblauch, Thomas, and others. As the result of a careful weighing of these various experiments, the authors present the following formula connecting the total heat of one pound of dry saturated steam with its temperature (Fahrenheit):—

$$H = 1150{\cdot}3 + 0{\cdot}^{\sim}45(t-212) - 0{\cdot}000550(t-212)^2.$$

The equation heretofore in use was $H = 1082 + 0{\cdot}305t$, which may also be put in the more directly comparable form of

$$H = 1147 + 0{\cdot}305(t-212).$$

It will be seen that there is a considerable difference in form between these two statements, although as one is of the second degree and the other of the first it is not easy to tell at sight by how much they would differ over the working range. The best way of comparing them is to set the figures in the old steam tables side by side with those in the new. This we have done for each increase of 50 lb. in the pressure. The figures in brackets are those of the old tables, as taken from such a standard book as Perry's "Steam Engine," and the remaining figures are those of the tables now published.

Pressure lb./in.²	Temperature ° F.	Sp. Vol. Cu. Ft. per lb.	Latent Heat	Total Heat	Entropy of Steam
1	101·83	333·0	1034·6	1104·4	1·9754
	(102)	(333·2)	(1043)	(1113·0)	(1·987)
50	281·0	8·51	923·5	1173·6	1·6581
	(280·8)	(8·34)	(916·6)	(1167·6)	(1·649)
100	327·8	4·429	888·0	1186·3	1·6020
	(327·6)	(4·356)	(882·9)	(1181·8)	(1·596)
150	358·5	3·012	863·2	1193·4	1·5692
	(358·2)	(2·978)	(860·6)	(1101·2)	(1·566)
200	381·9	2·290	843·2	1198·1	1·5456
	(381·6)	(2·273)	(843·4)	(1198·3)	(1·545)
250	401·1	1·850	826·3	1201·5	1·5276
	(401)	(1·84)	(—)	(1204)	(1·529)
300	417·5	1·551	811·3	1204·1	1·5129
	(417·5)	(1·55)	(—)	(1208·9)	(1·515)

It will be seen that at the ordinary steam-engine pressures of 150 to 250 lb./in.², there is very little difference between the two sets of figures, but that at lower pressures there is some variation, although in no case is it extreme. On the other hand, many calculations involve the estimation of differences of heat content, and in those cases it is essential to allow for any such corrections in the received steam tables. It is, therefore, hardly too much, perhaps, to suggest to those who have made important calculations with the old tables that they should recalculate their results on the basis of these later fiures.

Anyone reading carefully what the authors are able to say in support of the figures they give must concede that their researches have produced tables based on what is probably the most accurate data procurable at the present time. The theory of the steam engine will be considerably aided thereby, and one cannot but regret that there are no tables of equal accuracy applicable to the working fluid in the internal-combustion engine.

We regret that the authors should have presented the bulk of their results in the unscientific Fahrenheit scale. All who know the pitfalls which beset the paths of students will agree that, of them all, the most common and dangerous is the elusive "32" in the Fahrenheit scale. To have such a constant is never of any use, and its avoidance is the great merit of the centigrade scale. We should like to see these tables published throughout in the scientific temperature scale.

The book contains two sheets of very useful curves, which enable large numbers of simple problems to be solved by mere inspection. Among the illustrations given we quote the following:—

(*a*) A vessel of 4 cu. ft. capacity contains 0·2 lb. of water and 0·8 lb. steam. What is the pressure?

(*b*) What is the entropy of 1 lb. of steam at 100 lb. pressure and 450° F.?

(*c*) Steam of 140 lb. pressure, superheated 120° F., expands adiabatically with a ratio of expansion of 6. What are the pressure and quality at the end of expansion?

(*d*) Steam at 100 lb. pressure, superheated 60° F., expands in a nozzle to a pressure of 2 lb./in.². What is its final velocity?

(*e*) Steam in a throttling calorimeter with a pressure of 17 lb./in.², and a temperature of 265° F. The initial pressure of the steam was 100 lb./in.². What was its initial quality?

It will be admitted that the ready facility with which such problems can be solved by two simple sheets of curves is a great gain, and many workers in science and engineering will be thankful for this help.

H. E. WIMPERIS.

SNAKE VENOMS.

Snake Venoms. An Investigation of Venomous Snakes, with Special Reference to the Phenomena of their Venoms. By Dr. Hideyo Noguchi. Pp. xvii+315. (Washington: Carnegie Institution of Washington, 1909.)

IT is now forty years since Fayrer and Weir Mitchell laid the experimental foundations of knowledge of the chemical characters and physiological actions of snake venoms, their investigations being inspired largely by the desire to combat the high annual death rate from snake-bite. The study of snake venoms has, however, obtained a greater interest since the publication, about fifteen years ago, of observations demonstrating the possibility of producing a high degree of immunity in animals and proving the antidotal properties of the serum of the immunised animals. These phenomena in regard to snake venoms, having been brought into line with similar phenomena in regard to bacterial toxins especially, have been bound up with, and have contributed largely to, the elucidation of the problems of immunity which have in so many directions influenced modern medical thought. Hence there has arisen in regard to snake venoms a literature of high importance, and, from its involving scientific investigators in many countries, a literature necessarily extensive and dispersed.

As the author of this book states, there is at this time, in the English language, no single work which treats of the zoological, anatomical, physiological, and pathological characteristics of venomous snakes with special reference to the properties of their venoms. As something more than a mere summary of the position

of the present knowledge concerning snake venoms, Noguchi's publication merits high praise, and it possesses in addition a vitality which can belong to such a work only when its author has taken a living part in the researches by which this knowledge has been acquired.

It is impossible here to do more than indicate the scope of the book. The earlier sections deal especially with the morphology and geographical distribution of venomous snakes, and with the description of their poison apparatus. The toxic secretions, their physical and chemical properties, and the effects of various physical and chemical agents upon them are then discussed. A summary is given of the symptoms produced by snake-bite in man and by experimental poisoning in animals, and the intimate nature of these effects on the different systems is then taken up in detail. The last sections deal with the problems of immunity to venoms—artificial immunisation, the specificity and therapeutic value of antivenins, the interaction between venom and antivenin, natural immunity, and the treatment of snake-bite.

It may be pointed out that the logical sequence of the last chapters is marred by the somewhat irrelevant interpolation of sections on the effects of venom on cold-blooded animals, plants, &c., between the chapter on natural immunity and that on the treatment of snake-bite. We believe improvement would be obtained by considerable rearrangement of the order of the sections.

The book contains many excellent illustrations, especially of the different species of venomous snakes, their anatomical features, and the pathological changes induced in the tissues by venoms. Several of the illustrations are reproduced from Fayrer's classic work, but many are original. For a book so well illustrated, the binding, in the form we have seen it, is inadequate.

As being the most important practical outcome of the researches epitomised in this publication, the problems concerned with the treatment of snake-bite call for special mention. In regard to the nature of antidotism, Noguchi definitely adopts the view, first propounded, and supported by convincing proof, by Fraser, that this antidotism is not of the nature of a vital action, but of a chemical reaction, between the antivenin and the venom. This view has subsequently been adopted by Calmette, who at first insisted on its being a vital process, and also by Ehrlich in relation to the closely allied antidotism of pathogenic toxins by antitoxins. In its relation to venoms it has also received further support from experiments by Martin and Cherry, and by Stephens and Myers, respectively summarised in pp. 248 and 140 of Noguchi's book.

With respect to treatment, the author chiefly favours specific treatment by antivenins, and expresses the hope and expectation that sufficiently powerful antivenins may yet be produced to cure more severe cases of snake-bite than can yet be done. He emphasises the necessity, as Fraser had experimentally demonstrated, of using large quantities of antivenin, a general principle now being extended to the therapeutic use of antitoxins in disease. He places in a subordinate position all non-specific agents, such as permanganate of potash or chloride of gold, the antidotal effects of which he believes to be very restricted, but still of some value as being quickly and conveniently applicable.

We may further mention that the book contains a good workable bibliography. It is a book which will be of great service to future investigators.

THE EVOLUTION OF MAN'S STRUCTURE.

History of the Human Body. By Prof. H. H. Wilder. Pp. xii+573. (New York: Henry Holt and Company, 1909.) Price 3 dollars.

PROF. WILDER defines the twofold purpose of his book, as, "*first*, to present the results of modern anatomical and embryological research relative to the human structure in a form accessible to the general student, and, *secondly*, to furnish students of technical human anatomy with a basis upon which to rest their knowledge of details;" and there can be no doubt that, as the founder of a village newspaper would express it, he has "supplied a long felt want."

So much technical knowledge has to be acquired by the modern medical student in the brief span of time between matriculation and graduation that there is an ever-insistent tendency to curtail the preliminary scientific subjects in the medical curriculum. The effects of a scamped education in biology are becoming more manifest every year in the writings of anatomists and physiologists, when, as so often happens, the results of long and arduous researches are thrown away for the lack of a modicum of zoological or morphological knowledge.

Prof. Wilder's book, if placed in the hands of the medical student, will help him to bridge the gap between his biological and anatomical studies, and, in the later stages of his career, will help to save him from solecisms such as are being perpetrated far too frequently at the present time.

The wide scope of the work is indicated by the titles of its chapters, which deal with "the continuity of life," "the phylogenesis of vertebrates," "the ontogenesis of vertebrates," the integumentary, skeletal, muscular, digestive (and respiratory), vascular, urogenital, and nervous systems, the sense-organs, and "the ancestry of vertebrates," and an appendix on the classification of vertebrates.

The first chapter explains the fundamental principles implied in the terms phylogenesis and ontogenesis, which form the subjects of the second and third chapters respectively.

The account given in these three chapters (*a*) of the factors which played some part in the evolution of man, and (*b*) of the line of man's ancestry, is lucid, and, on the whole, satisfactory. The author has entirely failed, however, to realise and to set forth the immense importance which must be assigned to the Dipnoi in supplying evidence for explaining the evolution of the Amniota.

In chapters iii. to xi. (inclusive) the author has clearly stated the facts of comparative anatomy which throw light upon the morphology of the various systems of the human body, which I have already enumerated. These portions of the work are of considerable value, not only to the student of human

anatomy who wants to learn how the organs of man's body have come to assume their form and structure, but also to the zoologist, who will find in this book a concise statement of the light thrown upon the structure of vertebrates in general by the detailed study of the anatomy and development of one mammal.

The scope of the work is so wide that the reader cannot expect to find accuracy in every detail, or a freedom from time-worn and conventional errors; but, in his preface, "the writer craves the indulgence of those who have directed their special attention to any one of the subjects touched upon," and the impartial reviewer is bound to admit that the merits of the broad view of animal structure given in this book far outweigh its defects, which, on the whole, concern matters of detail only.

But when it is noted that in the second chapter Prof. Wilder properly insists that "the one line of development by which the Primates have become differentiated is in that of their central nervous system, and especially that of the cerebrum" (p. 41), the reader has a right to expect something more than the rather perfunctory account of this system, the influence of which has been paramount in making man what he is. Nor is it too much to expect that a zoologist, even if he has not "directed his special attention" to the question of the distribution of animals, should know that the monotremes do not "occur in New Zealand" (p. 33), and that Galeopithecus is not "found in Madagascar" (p. 37)!

In the final chapter a concise and impartial account is given of (*a*) the Annelid, (*b*) the Nemertean, (*c*) Gaskell's (though the name of its author is not mentioned), and (*d*) the Protochordate theories of the origin of vertebrates; and the author ends his interesting handbook with the quotation from Korschelt and Heider:—"The origin of vertebrates is lost in the obscurity of forms unknown to us. G. E. S.

MAPS OF THE THAMES BASIN.

The Basin of the Thames. (Lettered and Unlettered.) (Edinburgh: W. and A. K. Johnston, Ltd., n.d.) Price 12*s*. each.

THIS publication consists of two maps, with and without names. The map containing names is well designed and should be of great value for schools.

Contours are shown at 800, 600, 400, 300, 200, and 100 feet, and the areas of equal elevation are distinguished by shades of brown. The rivers are printed in blue, and stand out distinctly from the light brown tints. The names have been carefully selected, only initial letters being shown for towns, while physical names have been printed in a clear but subordinate type. These have followed the lines suggested in a recent map prepared by the Royal Geographical Society.

Local names, such as the New Forest, the Chilterns, the North and South Downs, have been necessarily retained, but to these have been added other names, not so generally well known, but descriptive of physical features. Such are the "Forest Ridges" of Sussex, Battle Ridge, the Western Downs, the Plain of Selsey, &c. It is to be hoped that these names, which are now generally accepted as being most suitable, will be used in all future maps, as a reasonable uniformity of nomenclature will avoid much confusion in teaching.

Railways, British and Roman roads, and the sites of Roman towns are shown in red. A most instructive lesson will be possible by the use of this map on the difference between ancient and modern lines of communication, and the sites chosen for Roman and modern towns. The map shows clearly that the Roman roads largely followed ridges and avoided river valleys, or, at any rate, kept along the edge of high ground. The Fosse Way, on the eastern margin of the Cotteswold Hills, and the Icknield Way, on the northern slope of the Chilterns, are excellent examples. Most of the Roman towns were situated on higher ground, away from the forests of the valleys, and in positions suited for defence.

The companion map, with no names except initial letters of towns, is disappointing. It was probably essential, for reasons of expense, to keep the representation the same as on the named map, but we feel that it might have been made much more effective if all the contours had been shown from 100 feet to 800 feet, and if the areas they enclose had been marked by clearly defined brown lines. The omission of the 500 feet and 700 feet contour lines means that steep escarpments, such as the southern front of the North Downs, fail to stand out clearly; and the higher valleys, such as those of the Chilterns, are only distinguishable by a close examination of the map. For a map intended for physical teaching the shapes of hill regions are of the first importance, and these need presentation in sufficient detail to give some clue, in connection, of course, with geological maps, to their formation.

It is to be regretted that no county divisions have been placed on the named map. A dotted line, sufficient for reference, would not have spoilt the clearness of the representation and would have been welcome to many teachers.

County boundaries, as studied from political maps, have certainly played too important a part in past teaching, but the regions which they define cannot be ignored in any systematic study of the regional geography of England or in that of local geography.

EARLY VIEWS ON INSECT LIFE.

Experiments on the Generation of Insects. By Francesco Redi, of Arezzo. Translated from the Italian Edition of 1688 by Mab Bigelow. Pp. 160. Portrait, facsimile of original title-page (1768), and 29 plates, besides illustrations in the text. (Chicago: Open Court Publishing Co.; London: Kegan Paul and Co., Ltd., 1909.) Price 2 dollars.

IN the early days of modern science much pioneer work had to be done in clearing away all manner of crude notions and legends, partly based on ideas and faulty explanations of facts or fables handed down from classical times, and partly on popular notions of later date. More than any writer of his period, Redi,

physician to the Court of Florence, and also a poet of considerable eminence, set himself to refute the old doctrine of spontaneous generation, and was mainly instrumental in proving that maggots, &c., did not arise spontaneously in the surroundings where they are met with, but originate from eggs deposited by the parent insect. In fact, Redi accomplished a similar service to science to that performed by Darwin and his coadjutors in our own time, when they gave the death-blow to the analogous doctrine of special creation, though, in the latter case, the task was much more difficult, depending rather on logical inference from facts than on actual experimental demonstration.

We are glad to welcome a translation of one of Redi's most important works, his "Esperienze intorno alla Generazione degl' Insetti," which attracted much notice at the period, and went through many editions in Italian and Latin between 1668 and 1688, and was reprinted frequently afterwards in his collected works.

After setting forth various classical theories of the origin of life on the earth, Redi continues :—

"Although content to be corrected by anyone wiser than myself, if I should make erroneous statements, I shall express my belief that the Earth, after having brought forth the first plants and animals at the beginning, by order of the Supreme and Omnipotent Creator, has never since produced any other kind of plants or animals, either perfect or imperfect; and everything which we know in past or present times that she has produced, came solely from the true seeds of the plants and animals themselves, which thus, through means of their own, preserve their species. And although it be a matter of daily observation that infinite numbers of worms are produced in dead bodies and decayed plants, I feel, I say, inclined to believe that these worms are all generated by insemination, and that the putrefied matter in which they are found has no other office than that of serving as a place, or suitable nest, where animals deposit their eggs at the breeding season, and in which they also find nourishment; otherwise, I assert that nothing is ever generated therein."

In proof of these statements, Redi proceeds to describe the breeding of flies from maggots found in dead animals, dung, fruit, &c. He also discusses the question of the bees in the carcase of Samson's lion, and thinks that they made their hive in the dried skeleton; an explanation which is perhaps not quite impossible, though the general view nowadays is that in this (as certainly in some other cases where bees are supposed to have been generated from dead carcases) the insects were not bees, but flies (*Eristalis tenax*), which were mistaken for them.

In a similar manner, Redi discusses the origin of wasps and scorpions; the effect of the sting of the latter; the cannibalism of lions; the habits of spiders; the breeding of frogs, and the tenacity of life in Mantis. He was, however, puzzled by galls, the insects from which are very difficult to rear; and was much perplexed about their origin. The last portion of the book discusses lice and other animal parasites. The illustrations of these and other animals are excellent, especially considering the period at which they were produced.

OUR BOOK SHELF.

(1) *Smithsonian Mathematical Tables. Hyperbolic Functions.* Prepared by G. F. Becker and C. E. Van Orstrand. Pp. li+321. (Washington : Smithsonian Institution, 1909.)

(2) *Tafeln für numerisches Rechnen mit Maschinen.* Herausgegeben von O. Lohse. Pp. vi+123. (Leipzig : W. Engelmann, 1909.) Price 12 marks.

(1) THE increasing importance of hyperbolic functions in several branches of science and technology has led the Smithsonian Institution to furnish the computer with a more complete set of tables of these functions than was previously available. In the handsome volume before us are printed the natural values to five decimal places of the hyperbolic sine, cosine, tangent, and cotangent of u expressed in radians. The argument u advances by ten-thousandths from 0 to 0·1, by thousandths from 0·1 to 3·0, and by hundredths from 3·0 to 6·0. The logarithms of the above values are also given in separate tables. In order to facilitate interpolation the first derivatives of the functions multiplied by the tabular interval are tabulated in units of the last decimal place. To meet the rare cases in which higher values than six radians occur in calculations, some very high values of exponential $\pm u$ are appended to the seven-place tables of the exponential and its logarithm which are printed later on in the volume. To aid the computation of hyperbolic functions of complex variables, such as sinh $(u \pm iv)$, the values of the circular functions sin u and cos u, and of their logarithms to five decimal places, are provided with u expressed in radians. Tables are also provided of the gudermannian of u to seven places in radians, and also in degrees, minutes, and seconds. A few supplementary tables are printed for the convenience of the computer, one of which gives the natural logarithms of numbers from 1 to 1000, and another provides for the conversion of radians into angular measure and *vice versa*.

In preparing this volume a good deal of independent computation has been necessary in order to attain completeness and accuracy. In the introduction there is a useful compendium of formulas and integrals involving hyperbolic functions.

(2) Prof. Lohse, of the Astrophysical Observatory, Potsdam, has published these tables of reciprocals in order to simplify and extend the use of calculating machines in scientific computations. These machines deal readily with addition and multiplication, but in order to grapple with division it becomes necessary to take first the reciprocal of the divisor and then to multiply, *e.g.* to exhibit $n \div 1{\cdot}759$ as $n \times 0{\cdot}5685$. In this volume we have provided for us five-place values of the reciprocals of the natural numbers from 1 to 5000, and of the reciprocals of the trigonometrical functions of angles from 0° to 90° for every hundredth of a degree. Appended to the above are a few shorter tables, the most important of which is one of square roots, giving the values of $\sqrt{a}$ and $\sqrt{10a}$ side by side, very conveniently, for values of a from 1 to 1000.

Lehrbuch der praktischen Physik. By F. Kohlrausch. Elfte Auflage. Pp. xxxii+736. (Leipzig : G. B. Teubner, 1910). Price 11 marks.

IT is not necessary in general to say anything in praise of a book which reaches its eleventh edition, but there are special circumstances accompanying the appearance of the eleventh edition of the late Prof. F. Kohlrausch's "Lehrbuch der praktischen Physik" which justify a few remarks. In the first place, the preparation of this edition was one of the latest occupations of its author, who died in January (see NATURE, February 3), a few days after its appearance. Through-

out the forty years the work has been in the hands of students of physics, it has remained the pet child of its creator, and every page bears evidence of the care he bestowed on it. In the work of revision for the present edition, Kohlrausch was assisted by a number of his former pupils, now distinguished for their researches in special branches of the subject, so that it embodies the experience of the leading physicists in Germany. As an example of a section of the book only possible under a system of collaboration of this kind, that on radio-activity, by Prof. E. Dorn, may be mentioned as of special value. As a result, we have a book thoroughly up-to-date, which, as a work of reference for the physical laboratory, stands in a unique position, both on account of the large amount of valuable matter it contains, and for the completeness of its references.

In the second place, the author gives us in the preface a glimpse at the physical laboratories of Germany fifty years ago. There were then about two dozen professors of physics, a dozen assistants, and possibly about two dozen senior students engaged in research in the whole of the country. Apparatus was scanty, and had to be purchased out of a very meagre annual grant. A new professor who could bring with him his own apparatus, was regarded as a special windfall. Systematic instruction in practical physics was given at Königsberg, Berlin, and Heidelberg Universities only, but the need for better organisation of the universities in this respect soon became pressing, and was met by the appointment, in the later 'sixties, of a number of professors who had received their practical training in the above laboratories under Neumann, Magnus, and Kirchhoff. The change which has come about since then is remarkable. There are now many single laboratories in which a greater number of senior students are engaged in research than were so occupied in the whole of the laboratories of the country half a century ago.

The Schoolmaster's Year-book and Directory, 1910. A Reference Book of Secondary Education in England and Wales. Pp. lxxi+448+700. (London: The Year-book Press, c/o Swan Sonnenschein and Co., Ltd., 1910.) Price 7*s.* 6*d.* net.

THIS is the eighth annual issue of what has become an indispensable source of information to the educational worker. It consists of three parts, containing respectively general information, alphabetical lists of secondary schoolmasters, and a list of secondary schools. We are able to say from experience that the educational particulars provided by this work are accurate and up-to-date. Among new features of the book this year are important alterations in the section dealing with county and borough education authorities. It is interesting to note that the directory now contains more than 14,000 names, and that the list of secondary schools numbers about 1500. Altogether, the book deserves a wide circulation.

Egypt and the Egyptians. By the Rev. J. O. Bevan. Pp. xxii+224. (London: George Allen, 1909.) Price 5*s.* net.

THIS is a compilation of miscellaneous information about "Egypt and the Egyptians, their History, Antiquities, Language, Religion, and Influence over Palestine and Neighbouring Countries," written in old-fashioned style. It has no particular plan, and meanders about from one subject to another, but not unpleasantly. Sir G. H. Darwin, who disclaims "anything more than the superficial knowledge of Egypt which is open to any hurried tourist," has done Mr. Bevan the honour of writing a preface to his little book, which will no doubt give considerable pleasure, and convey a good deal of information and instruction to many readers.

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 Term "Radian" in Trigonometry.

DR. THOMAS MUIR, in his letter in NATURE of April 7 (p. 156), corrects the misapprehension implied in the "New English Dictionary," viz. the supposition that the word "*radian*" was first introduced in the "Treatise on Natural Philosophy" by Thomson and Tait.

Dr. Muir says he used the word in 1869 in St. Andrews, and goes on to say that it was after conversation with my father, the late Prof. James Thomson, in Glasgow, that the word was finally adopted in 1874.

I should like to point out that my father adopted the word some years before he came to Glasgow and before he met Dr. Muir. I have a memorandum in my father's writing saying that this name was proposed by him in July, 1871, and it appears in the printed examination questions set by him in the general class examination in Queen's College, Belfast, on June 5, 1873, and published, I believe, in the college calendar.

I well remember several conversations between my father and Dr. Muir with regard to the use of this and other words, but "*radian*" had already been adopted publicly by my father, and apparently had been already independently used by Dr. Muir. JAMES THOMSON.

22 Wentworth Place, Newcastle-on-Tyne, April 12.

The Yellow Colour in the Stoat's Skin.

IN her letter to NATURE of March 24 Miss I. Sollas remarks on the "canary-yellow" colour "in members of the stoat family when the winter whitening is incomplete," adding, "there can thus be little doubt that the yellow body produced artificially in the fur of the albino rat is a substance similar to the yellow pigment of the stoat's winter coat. . . ." I do not know whether it has been recorded, though I should have thought so, that a stoat's fur of the purest white will, after exposure to light in a museum case for a time, varying with the intensity of the light, invariably turn distinctly yellow—fainter, however, than "canary-yellow." I have made no chemical or microscopical examination of fur so yellowed, but the usual reason assigned for the change is the absorption by the hairs of a small amount of fat out of the skin, induced by the light and heat of summer. I understand, also, that ermine kept in a dark chamber or box the temperature of which is high will also turn yellow. Stoats in this part of the country often become white early in the season before any real cold weather has occurred. HENRY O. FORBES.

The Museums, Liverpool, April 12.

Transit of Halley's Comet across Venus and the Earth in May.

I BEG to direct attention to the following:—

It is my intention, at Kaafjord, in Finmarken (in the north of Norway), together with my assistant, Mr. O. Krogness, to take magnetic and atmospheric observations during the period May 7 to June 1 next in connection with the transit of Halley's comet across the sun's disc on May 18–19.

It is conceivable that the tail of the comet may consist chiefly of electrical corpuscular rays; and, if this be so, we should expect that these rays, owing to earth-magnetism, would be drawn in, in the Polar regions, in zones analogous with the aurora zones, assuming the tail of the comet to be of sufficient length to reach the earth.

These rays will then, in such a case, exercise, amongst other things, magnetic influences and electric inductionary effects, especially strong in the Polar regions, and it is particularly such effects we are desirous of tracing. The tail of the comet, if it should consist, as above assumed, of such radiant matter, will alter its shape at a very considerable distance from the earth, and we may expect to

see similar formations of light to those which occur during my experiments with kathode rays around a magnetic terrella.

In my work, "The Norwegian Aurora Polaris Expedition, 1902–1903," descriptions will be found in several places of these phenomena, but to elucidate the subject here I append a few new illustrations, which show very plainly the shape of these formations of light.

Figs. 1 and 2 show how the rays are drawn in in belts around the magnetic poles of the terrella, corresponding with the polar-light zones on the earth. They are taken looking along and perpendicular to the magnetic axis. Fig. 1 shows the spiral rings of light around a magnetic north pole, corresponding to the south pole of earth magnetism. We find these belts of light sometimes, as here, with a tolerably even strength of light like a continuous band, and at other times we find the rays concentrated in three limited streaks, with well defined positions around the magnetic poles of the terrella.

FIG. 1.

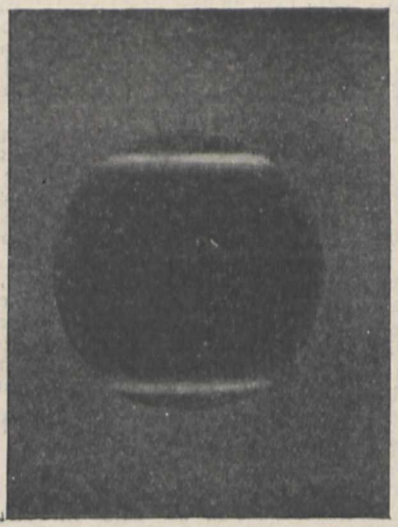


FIG. 2.

FIG. 3.

Fig. 3 also shows an equatorial ring. This phenomenon of light is magnificent, but unstable; it is difficult to produce; it may suddenly appear and suddenly vanish, as the rays which run round the terrella at the equator are difficult to obtain sufficiently concentrated for the rarefied gas to illuminate them. At the lower part of Fig. 3 and on Fig. 4 a characteristic pointed tongue of light will be seen, which is drawn in, and shows the manner in which the rays here come into the terrella. The magnetic equator is indicated on the terrella by a dark line.

FIG. 4.

It may now be imagined that analogous formations of light may be observable around the earth of the rays from the comet's tail on May 18–19. The downward rays in the Polar regions will, it is true, be difficult to observe in northern parts owing to the northern declination of the sun, but in Antarctic regions there may be more hope of doing so, and the phenomenon would then probably appear somewhat similar to the aurora australis. At night, in low latitudes, one may conceive the possibility of a ring like the equatorial ring being observable.

About May 2 the comet will be in the vicinity of Venus (see *Bulletin de la Société astronomique de France*, February, p. 57), and it is not impossible that indications of an alteration in those parts of the comet's tail nearest the planet may be noticeable.

We may then possibly expect to find traces of the rays being drawn in towards the polar regions of Venus in a manner similar to that demonstrated by the experiment shown in Fig. 4, or a more or less distinct bending of the comet's tail, assuming Venus to be magnetic.

The probability of such being visible must, however, be admitted to be small, as the central line or the tail, if it is directly away from the sun, will be at a considerable height above the planet; but I desire, nevertheless, to direct the attention of astronomers to these conditions, as Venus, if as strongly magnetised as our earth, must be expected to exercise a noticeable influence on the tail of the comet at a distance of several million kilometres, especially if the rays in the tail are easily deviated by magnetic force.

This phenomenon may, in case it is present, be determined by astronomical observations of the comet's tail and Venus in the period May 1–3, and I beg, therefore, to ask astronomers, in the interests of science, to make arrangements for the necessary observations, if possible, and to favour me with a short account of the results.

KR. BIRKELAND.

Universitetets Fysiske Institut, Christiania,
March.

Neutral Doublets at Atmospheric Pressure.

IN his papers on magneto-kathode rays, Prof. Righi assumes the presence of neutral doublets, formed of a positive and negative ion in more or less stable combination. Sir J. J. Thomson has independently put these in evidence very clearly in his experiments on positive rays. Working independently, we have made some observations which point to the existence of such doublets at atmospheric pressure. Ionised gas is drawn through two insulated metal tubes; along the axis of each a thick insulated wire electrode is fixed. These wires can be connected in turn to a Dolezalek electrometer, and the current between tube and electrode measured. The ionised gas is produced by splashing mercury, or by heating lime or aluminium phosphate on a strip of platinum foil. With a certain blast, in one case, the current reached its saturation value on the first electrode with a voltage of 320, being then 130 in arbitrary units. Raising the voltage to 656 did not increase this by one division; the extreme readings at the intermediate voltages were 128 and 130, so that the observations were quite regular. Nevertheless, with 656 volts on the first electrode a current can be detected at the second, this in some cases amounting to as much as 10 per cent. of the original.

Lime gives a large excess of negative, mercury and aluminium phosphate of positive, ions, but in each case

tried the currents on the back electrode were practically the same, independently of the sign, while the same ionising agent was used. The saturation curves also present a peculiarity in a large number of cases. The curves become nearly horizontal at about 240 volts, after which they rise again rather rapidly, and finally become flat at about 320 volts. Each of these results is readily explained if we assume the presence of neutral doublets, which are broken up either by collisions or by the action of the field. Further experiments are being made.

A. E. GARRETT.
J. J. LONSDALE.

Cass Institute, E.C., April 13.

The Etiology of Leprosy.

IN NATURE of April 7 I have read with interest the article on Dr. Ashburton Thompson's report on "Leprosy in New South Wales." In that report Dr. Thompson (one of our foremost authorities) has repeated a statement made in several of his former papers avowing distrust in the doctrine of contagion and in the efficacy of isolation as a preventive measure. In commenting, with surprise, on his opinion, the writer of the article says:—"One would have thought that the success which has attended the practice of isolation in Norway during the past forty years afforded sufficient evidence of its value even to the most sceptical."

Now I am quite with Dr. Thompson in his opinion, and must ask to be allowed to state in the clearest possible terms that not only is there no reason to believe that attempts at isolation have taken any share whatever in the diminution of Norwegian leprosy, but much to the contrary. That the disease has declined, and continues to decline, is happily true. The *propter hoc*, however, fails utterly when we recognise that there has been during this period of its decline no increase whatever in isolation. There has never been in Norway any isolation directed against contagion. The first large leper hospitals in Norway were built by those who did not believe the disease contagious (Dr. Danielsen and others), and who wished simply to prevent marriages and to provide comfortable homes. When the bacillus was discovered, the old theory of contagion was revived, and subsequently certain legal enactments were passed, but there was no increase in arrangements for isolation. Quite the contrary. From that day to this the number of those isolated has been progressively reduced. The lepers have been left at home with their relatives. Yet the disease has declined. It may be noted that it was declining before. It must be obvious that it has been dying out under some other influence, and that the asylums, which no one had thought it worth while to provide, could not possibly be the cause. Let me in passing just remark that during the same period a parallel effort for the extirpation of leprosy was being made in South Africa. There efficient isolation laws were passed, and plenty of accommodation provided. Without flinching, compulsory isolation was carried out. The result has shown a steady and alarming increase in the disease.

Compulsory isolation has never been attempted in Norway, and it has been rigidly enforced in South Africa. The results have been conspicuously opposite to what believers in contagion would expect. The true explanation in each case is, I believe, not difficult to give, but I must not intrude upon your space further than simply to assert that it has nothing to do with belief in contagion and attempts at isolation. Dr. Thompson is, I think, more than justified in the doubts which he has expressed, and it rests with those who in future quote the Norwegian facts to show that they really bear the interpretation which they give to them. JONATHAN HUTCHINSON.

SIR JONATHAN HUTCHINSON'S views on the etiology of leprosy are well known to be opposed to the generally accepted view that it is an infectious disease caused by Hansen's bacillus. They were again brought before the second International Conference at Bergen, August 16–19, 1909. Nevertheless, the conclusions carried by the delegates were opposed to them. The second International Scientific Conference for the suppression of the disease reaffirmed in all aspects the conclusions adopted by the first conference in Berlin, 1897, when the attitude of Dr. Ashburton Thompson towards the accepted etiology was before the delegates. Leprosy was affirmed to be a disease communicable from one person to another. No country, no matter what its geographical situation may be, is secure against infection, and the adoption of proper measures against this possibility was recommended:—"Having regard to the favourable results which have been obtained in Germany, Iceland, Norway, and Sweden, by isolating the patients, it is desirable that infected countries should adopt the same measures."

In Norway the law, as formulated again in 1885, gave the Sanitary Commission or Board of Health in each district the right to order a leper, if he will live at home, to have his own room—at least his own bed; his clothes ought to be washed separately; to have his own eating apparatus—spoon, fork, knife, &c. If he cannot, or will not, conform to this regimen, he is obliged to enter an asylum. There are those who hold that leprosy is less easily communicated from the sick than is consumption. Dr. Thompson apparently implies that "special precautions therefore seem to be unnecessary" in leprosy because in the past they have been ignored for tuberculosis; but, in the opinion of the writer, it would be of enormous advantage to the public weal if the regulations as applying only to lepers remaining at home could be enforced in regard to tuberculosis. As a matter of fact, the success of the leprosy laws in Norway has led, on the initiative of Dr. Claus Hansen, brother of the discoverer of the *Bacillus leprae*, to the enforcement of analogous regulations as prophylactic measures against tuberculosis in that country since 1900.

It alters nothing in the efficacy of segregation that it was applied in Norway by Danielsen before Hansen—Danielsen's pupil, I believe—had discovered the lepra bacillus. Nor will any useful purpose be served by discussing the efficacy in the application of the law of segregation in Norway as impugned by Sir Jonathan Hutchinson. Dr. Ashburton Thompson's criticisms had been carefully studied by the writer of the article and passed in silence as special pleading—moderate, able, even eloquent—but as unconvincing to him as they have been to the expert delegates at two successive international conferences, the second of which was held in Norway itself.

THE WRITER OF THE ARTICLE.

Auror I Display.

THERE was a very fine display here of the aurora between 8 and 9 p.m. The nature of the phenomenon was sufficiently clearly marked to deserve more than a passing notice.

The curtains and shafts of light all had their origin overhead, radiating from a point a few degrees to the north of Castor and Pollux. At times as many as five curtains of light could be seen close together near the radiant centre, some of them spreading over the southern and others over the northern sky. When viewed to the north or south the thin veils showed streaks of light all radiating from the point of origin overhead. When viewed towards the east or west, *i.e.* end on, the light was most brilliant, and the wavy nature of the hanging curtains of light most marked.

For at least an hour these curtains or hanging veils of light could be seen originating above and spreading in all directions, north, south, east, and west. The radiating effect was, of course, due to perspective. There was very little wind at the time, and the curtains of light seemed to travel with it. Another effect which was most marked was that the east and west end of a curtain descending to the north of the point of view curved towards the north, whilst the ends of those curtains which descended to the south of the point of view of the observer curved to the south. This curving only showed itself when the curtains were low down and losing their brilliancy. There could be no doubt but that the whole phenomena originated in a comparatively small area to the north of Castor and Pollux.

The day had been fine and bright, and the ground was free from snow. Towards half-past nine the sky became hazy. R. M. DEELEY.

North Battleford, Saskatchewan, Canada,
March 28.

THE FREE ATMOSPHERE.[1]

THE publication referred to below adds yet another to the series of memoirs issued by the Meteorological Office in the past few years. It furnishes an example, of comparatively rare occurrence in original scientific investigation, of the successful cooperation of private and official enterprise.

The introduction by Dr. Shaw contains a short historical account of the progress made in the investigation of the upper air and a summary of the more important results obtained. It includes a welcome bibliography of the chief English publications on the subject.

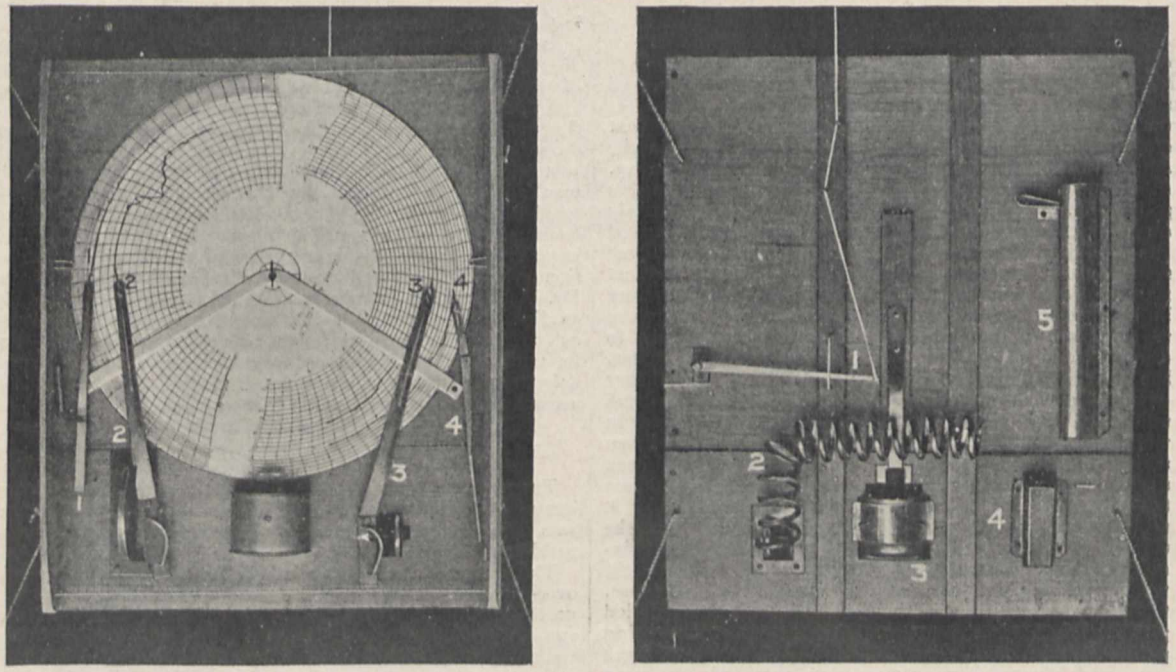
The work in this country was begun so long ago as 1749 by Wilson and Melville, of Glasgow, and the balloon ascents of Jeffries, and, later, of Welsh and Glaisher, maintained our position in the forefront of upper-air research. After a period of comparative inaction, the investigation was renewed at the instigation of Mr. Dines at the beginning of the present century. Dines began his work on the west coast of Scotland in 1902–4, and continued it, first at Oxshott, 15 miles south-west of London, and afterwards at Pyrton Hill, 40 miles west by north of London.

The report deals with kites, pilot balloons, and registering balloons, and contains a summary and brief discussion of the results obtained.

Three kinds of kites, all of the box pattern, are used at Pyrton Hill. No. 1 is 9 feet high, and has sails 3 feet wide and 18 feet long. It is used in light winds. No. 2, for standard use, is very similar, but the sails taper from 3 feet at the front and back sticks to 2 feet 4 inches at the sides. No. 3 is only 7 feet high, and the sail edges form arcs of circles, the width of the sails being 2 feet 6 inches at the sticks and 1 foot 6 inches midway between them. This kite is used if the wind aloft is likely to exceed 40 miles per hour. Steel piano wire, 1/32 inch in diameter, having a breaking strain of 250 lb., is used with all the kites.

If, when a kite is flying, it appears probable that putting on more kites, or letting out more wire, will increase the strain to more than 100 lb., the attempt is not made owing to the risk of breaking the wire, especially as records from greater heights can be obtained with registering balloons. It ought, however, to be borne in mind that the results for temperature and humidity obtained by balloons are less trustworthy than those obtained by kites, and this is of especial importance in connection with the daily variations. A kite can be kept for some time at a nearly constant level, and the kite and instruments remain exceptionally well ventilated without artificial means.

Dines's use of embroidery cambric at 9*d*. per yard, and black dress lining at 5*d*. per yard, for his sails recalls Stokes's marked preference of candles for his optical experiments. The art of using the simplest things to the best advantage runs some danger of being lost in the laboratories of ready-made apparatus and "arranged" experiments. It is refreshing to find instances of it in an official publication.



A FIG. 1. B

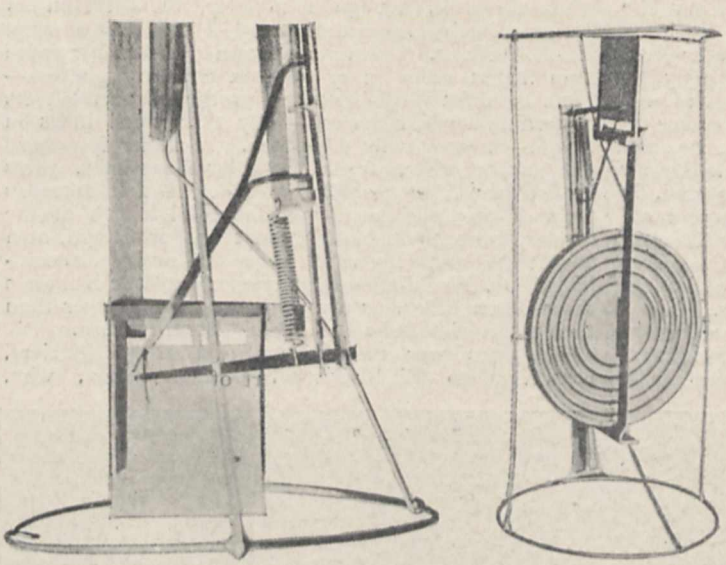
A good deal of trouble is taken to make clear, by diagrams and description, the method of letting-out and winding-in the kite wire. Mr. Dines having discovered, by long practical experience, the places where difficulties arise has taken the trouble to invent the necessary safeguards and to give to others the benefit of his labours.

The meteorograph used with kites is shown in Fig. 1, A, B.; Fig. 1, B, shows the exposed under-surface of the apparatus. The separate parts are (1) the lever and thread of the anemometer; (2) the thermometer, a spiral metal tube containing spirit; (3) the clock; (4) the cover of the aneroid barometer; (5) a metal cover protecting the hair of the hygrometer. In Fig. 1, A, the recording pens are (1) humidity, (2) atmospheric pressure, (3) temperature, (4) wind velocity. The surface shown in Fig. 1, A, is covered by waterproof cloth

[1] M.O. 202. "The Free Atmosphere in the Region of the British Isles." Contributions to the Investigation of the Upper Air, comprising a Report by W. H. Dines, F.R.S., on Apparatus and Methods in use at Pyrton Hill, with an introduction and a note on the Perturbations of the Stratosphere by Dr. W. N. Shaw, F.R.S., Director of the Meteorological Office. Pp. iv+56. (London: H.M. Stationery Office, 1909.) Price 2*s*. 6*d*.

when in use. The instrument is tied in the middle of the kite, partly for convenience, partly, presumably, to shelter it from direct sunshine.

The record is made on the cardboard disc shown in



A FIG. 2. B

Fig. 1, A. The difficulty of procuring cardboard which is not warped by varying humidity, and the occasional thickening of the trace through the running of the ink, suggest that it would be an improvement to use a smoked metal sheet.

The anemometer deserves special mention because it is simple and unique. It consists of a light celluloid ball of 3 inches diameter suspended by about 40 feet of fine cotton, and the velocity of the wind is deduced from the tension in the cotton. The effect of the wind on the cotton is neglected, but it appears doubtful if this is justifiable. With cotton 0·2 mm. in diameter, the area exposed to the wind is nearly one-third that of the ball used.

Pilot balloons are usually small balloons 2–3 feet in diameter, which are sent up to determine the wind at different altitudes. Observations are made by theodolites at the end of a base line, or at times by one theodolite, the rate of ascent in that case being calculated from the free lift and diameter of the balloon.

It is assumed that the rate of ascent is given by

$$L = k\rho v^2 r^2 = \mu v^2 r^2,$$

where L is the free lift, r the radius of the balloon, v the upward velocity, ρ the density of the air, and k a constant. The values of μ, calculated from ten sets of observations given in the report, show great irregularity, varying between $5{\cdot}5 \times 10^{-4}$ and $15{\cdot}6 \times 10^{-4}$ in C.G.S. units, or between 1/480 and 1/170 in the units used in this part of the report (grains, feet, minutes). Unfortunately, no information is given, and no reasons are put forward, to account for the variations, beyond a vague suggestion of convection currents. It would be interesting to know how much of the variation could be attributed to (1) the deposition of dew on the balloons, (2) the effect of solar radiation on the balloon's temperature, (3) differences in the wind, (4) errors in the observations. As they stand, the results indicate that observations made with one theodolite may give very erroneous values for the wind.

An interesting table gives the values of μ^{-1} obtained by six different methods. From his experiments with a whirling machine, Dines found 240. Observation of a small 3-inch ball, falling through 200 feet, gave 280. Dines's theodolite observations give 290, those of C. H. Ley 330, and twelve ascents of registering balloons 322. Stanton found a still higher value, 354, from laboratory experiments on a 1½-inch ball. It is of interest to note the close approximation to the corresponding value, 380, deduced from the value of k given by Allen's experiments with steel balls in water.

Registering balloons of about 1 metre diameter, having a free lift of 200 to 300 grammes, are used to carry a meteorograph, which weighs, with its case, 60 grammes only (28 grammes without the case). About 60 per cent. of the balloons sent up are recovered, and it seems remarkable that the proportion is higher in winter, the season of high winds, than it is in summer. The explanation given is that when the meteorographs fall in standing crops they frequently come into contact with mowing machines, and as the instrument case resembles an old tin can it is not surprising that Hodge neglects to gather up and return the fragments. The difficulty might be overcome by attaching a partially filled small, cheap balloon, which would act as a signal for some time after the instrument reached the earth. An addition of 5 per cent. to the number recovered would compensate for the extra cost.

The meteorograph is shown in Fig. 2, and diagrammatically in Fig. 3. The aneroid box A expands under decreasing pressure and opens the frame in which it is fixed, so that E, L move across the plate beneath them. If the temperature is constant they make two parallel traces; if the temperature falls, the German silver strip M contracts more than the invar strip HC, and rotates DE about C. Thus, the abscissæ of the trace give the pressures, and the distance between the traces the corresponding temperatures. The instrument furnishes no information as to the rate of ascent.

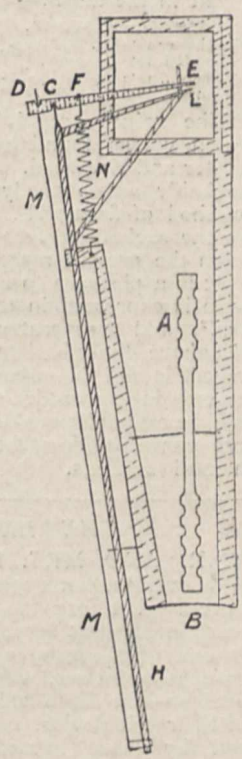


FIG. 3.

It is a great advantage that the calibration of the instrument is made on the actual plate, which is fitted ready for the ascent, and that the pressure and temperature are varied together. It ought, however, to be explained why the instrument is tested down to −40° C. and to 100 mm. only, when it is to be exposed to temperatures of −60° C. and pressures of 50 mm. or less.

The heights have been obtained from the recorded pressures by the use of diagrams, and more recently by means of semi-logarithmic squared paper. The need for great care in dealing with this problem is illustrated by the errors in the table on p. 7. On July 29 the difference of pressure

between 11 and 12 km. is 20 mm. at Manchester and 28 mm. at Pyrton Hill, which has a higher temperature at that height. Similar differences occur between 13 and 14 km., and between 5 and 6 km.

Great difficulty is experienced in reconciling the temperature observations with the observed and expected decrease in wind velocity in the advective region. The obvious errors noted above may be partly responsible for the extraordinary velocity of 150 m.p.s., found from the horizontal gradient of pressure at 16 km. But apart from errors of calculation, an error of only 1° C. in the mean temperature of the air column would produce an error of nearly 3 mm. in the pressure at 16 km. It must also be remembered that where convection is prevented the condition of steady motion may never be reached, and the differences of pressure may be equalised by translation of air across the isobars with moderate velocity.

Dr. Shaw finds that if the lower surface of the advective region is depressed owing to a disturbance in the lower atmosphere, there will be an increase of temperature of 9° C. per km. of depression. Such a depression would presumably be propagated with the same velocity as the disturbance, but the obstacles to convection in the advective region may make the upper portion of the atmosphere act as a damping agent by which the disturbance would be annulled.

The mean, maximum, and minimum values of H_c and T_c, the height and temperature at which the advective region begins, are given in the table :—

	Mean H_c	Mean T_c		H_c	T_c
Manchester	11·6 km.	219° A	Max.	15·2 km.	241° A
Pyrton Hill	12·0 ,,	217° ,,			
Dicham ...	12·2 ,,	221° ,,	Min.	7·8 ,,	204° ,,
Crinan ...	11·0 ,,	226° ,,			

The values are higher than the mean values found by the present writer and Harwood. The difference probably arises partly through the method of fixing H_c, partly owing to the exclusion of the 1909 results from the present report.

It is a pleasure to note that pressure is expressed in megadynes per cm.^{2}, and temperature in degrees C. above the absolute zero. The report is full of interest to all engaged in upper-air research, and will be especially useful to those who are contemplating the establishment of new experimental stations.

E. GOLD.

THE HISPAR GLACIER.[1]

DR. AND MRS. BULLOCK WORKMAN, the well-known explorers of the higher Himalayas, have read before the Royal Geographical Society a most interesting account of the Hispar Glacier. This is one of a group of four of the world's greatest mountain-glaciers, which, together with two others of them—the Biafo and the Chogo Lungma—and some of their tributaries, have been explored from end to end by these indomitable climbers. The Hispar Glacier, one of the many feeders of the Indus, occupies a long and nearly straight valley, running roughly parallel with the crest of the Karakoram—one of the watersheds of Asia. Here that is gashed by rather short and steep transverse valleys, altogether nine in number, and attains an elevation often exceeding 20,000 feet above sea-level. On the southern side is another mountain wall, not quite so lofty, though even its lowest point is quite a thousand feet above the summit of Mont Blanc. From its western part—rather more than fifteen miles in extent—six tributary glaciers—three of them large—descend to the Hispar, but its eastern and upper portion—fully twenty-one miles in length—is practically unbroken. A rather long and flat snow saddle, 17,500 feet above sea-level, parts the Hispar from the Biafo Glacier, which descends towards the south-east, and the total length of the former, from its termination near Hispar village, at a height of about 11,000 feet above sea-level, is, according to Dr. Workman's measurement, a little less than thirty-seven miles, or a mile and a half greater than that assigned to it by Drs. Calciati and Koncza.

The pass over the Hispar and Biafo glaciers, according to Lieut.-Colonel Godwin-Austen, who, about half a century ago, explored these ice-clad fastnesses, was in former times occasionally used by natives, especially marauders, but when Sir Martin Conway traversed it in 1892[1] he found the traditions were very vague. The only serious difficulties are those due to the length of the journey at such a considerable height above sea-level. These, however, did not prevent Dr. and Mrs. Workman from spending several weeks on their way over the pass from Hispar village to Askole, and carefully studying this ice-clad region.

FIG. 1.—A glacier-table of unusual size met with on the lowest third of the Biafo Glacier at an altitude of about 3660 metres (12,000 feet). The rock-boulder was 5 metres (16·4 feet) long, the ice-pedestal 3·8 metres (12·46 feet) high, and the height of the whole 5·5 metres (18 feet). A table with much lower pedestal seen in distance at left. (From the *Geographical Journal*.)

The Hispar Glacier has a low gradient—on the whole about one in thirty—and its average width is a little less than two miles. It receives, as has been said, six large tributaries from the northern side, and three, also large, on the lower part of its southern side. All, and especially the former, are laden with débris to an unusual extent. The effect of this is

[1] The Hispar Glacier. I. Its Tributaries and Mountains. By Fanny Bullock Workman. II. Prominent Features of its Structure. By William Hunter Workman. (*Geographical Journal*, vol. xxxv., pp. 105-31, February, 1910.)

[1] See "Climbing and Exploration in the Karakoram-Himalayas," by W. M. Conway, chapters xvi-xix. (1894.)

plainly visible on the trunk stream. Here, for a distance of nearly fifteen miles above its end, the whole surface "is broken into ice hillocks, separated by deep depressions and heavily coated with débris of every size from mud and sand to granite blocks 20 to 50 feet in diameter," such as may be seen in the gigantic glacier-table, for the picture of which (Fig. 1) we are indebted to the Royal Geographical Society. From slightly below the entrance of the Haigatum tributary a band of white ice appears among these hillocks, which broadens out as it rises until it occupies all the southern side of the glacier. On the northern side the hillocks persist for eleven and a half miles farther up. They vary in height from about 50 to 230 feet, or even more, and sometimes recall drumlins in their linear arrangement and form. Beyond these hillocks the ice, as would be expected, is fairly free from débris. In the other parts, while the lateral moraines are large, medial moraines are practically absent.

The surface exhibits some other peculiarities. Over two-thirds of its area lakelets, occupying ice-basins, are unusually common. Thus, as might be anticipated, it is but little crevassed. In fact, the only ice-fall is at the beginning of the descent from the actual pass, where the subglacial valley floor naturally steepens. In these circumstances the "hummocky" surface appears at first sight anomalous, but of this Dr. Workman offers a satisfactory explanation. The trunk stream of the Hispar receives at least a dozen tributary glaciers, most of them large. The valley, however, is a trench of only moderate breadth, bounded by steep, rocky walls. As the side streams are too strong to be ponded back by the main one, they force their way downwards side by side with it. Thus the pressure becomes greater than the resisting power of the ice, and this is squeezed upwards into ridges and protuberances. These are favourable to the formation of lakelets, which extend up to an elevation of about 16,000 feet, surface streams being correspondingly rare. Other lakelets, formed by dams of ice or moraine, occur at the side of the Hispar and its tributaries, as may be seen in Fig. 2. Intra-glacial moraines, due to the excretion of débris which has been engulfed in large crevasses, may also be observed, as well as the usual structures of *névé* and glacier-ice.

FIG. 2.—A border-lake near the junction of the Jutmaru with the Hispar Glacier. It is enclosed by a lateral moraine and the mountain-wall on the right, and the high side of the Jutmaru Glacier on the left, from which the ice-fragments floating on the water are derived. The stratification of the blackened glacial ice is well seen. Behind are the high snow-peaks walling in the Jutmaru. (From the *Geographical Journal*)

The scenery of this region of snowy peaks and giant glaciers has a general resemblance, though on a grander scale, to that of the Alps and the Caucasus, and its dominant outlines are indicative of the action of fluviatile rather than of glacial erosion. It is also worth noting that, notwithstanding the trough-like shape of the valley occupied by the Hispar ice-stream, neither the map nor the photographs suggest any marked truncation of the spurs past which it moves. Yet here, where several ice-streams are crowded into a comparatively narrow corridor, we might expect to find its rocky wall even undercut by their struggle to force a passage. The Hispar Glacier was one of several on which in 1906 the Geological Survey of India fixed marks in order to study their advance and retreat. It then appeared to be practically stationary, and had thus continued to the time of Dr. Workman's visit. So, too, had the Yengutsa Glacier, which reaches the valley-floor a little below the end of the Hispar. Yet, about five years prior to 1906, it had rapidly advanced for a distance of nearly two miles. One minor point of interest may be mentioned. Grouped spires or pyramids of snow or ice were not seldom observed, resembling the *niéves penitentes* of the Andes, to which Dr. Workman, though not without protest from Sir Martin Conway, extends the name.

T. G. BONNEY.

HALLEY'S COMET.

SINCE its conjunction with the sun Halley's comet has been seen from several observatories, and on April 16 was seen with the naked-eye by the observers at Cape Town. Thus there is some reason for hoping that, given clear morning skies, the comet may become easily observable in England, although its low altitude at sunrise, until after it has transitted the sun on May 19, is not favourable.

The following is part of the ephemeris calculated for April and May by Dr. Smart, and communicated by Mr. Crommelin to the *Astronomische Nachrichten* (No. 4379):—

Ephemeris for Greenwich Noon.

1910	R.A. h. m.	Decl. ° ′	1910	R.A. h. m.	Decl. ° ′
April 24 ...	23 50·3 ...	+ 7 47	May 20 ...	5 3·4 ...	+19 8
28 ...	23 50·9 ...	+ 7 56	21 ...	6 9·9 ...	+17 40
May 2 ...	23 54·5 ...	+ 8 18	22 ...	7 3·1 ...	+15 14
6 ...	0 3·1 ...	+ 9 5	23 ...	7 44·8 ...	+12 40
10 ...	0 21·6 ...	+10 30	24 ...	8 18·3 ...	+10 24
12 ...	0 38·5 ...	+11 41	25 ...	8 40·1 ...	+ 8 31
14 ...	1 5·8 ...	+13 27	26 ...	8 58·9 ...	+ 6 59
16 ...	1 49·9 ...	+15 59	27 ...	9 13·1 ...	+ 5 45
17 ...	2 23·1 ...	+17 29	28 ...	9 24·6 ...	+ 4 45
18 ...	3 7·3 ...	+18 51	29 ...	9 33·8 ...	+ 3 50
19 ...	4 3·2 ...	+19 43	30 ...	9 41·4 ...	+ 3 15

As will be seen from the ephemeris, the comet, when near the sun, will travel very quickly across our line of vision, traversing Aries, Taurus, Orion, and part of Gemini between May 16 and 22.

On May 20 the distance of the comet from the earth will be about fourteen million miles, but by May 30 this distance will have increased to more than forty million miles.

The two diagrams here given show, roughly, the conditions of observation, Fig. 1 for the eastern apparition, Fig. 2 for the western. In Fig. 1 the stars are shown approximately as they appear to an observer in London looking due E. one hour before sunrise (*i.e.* 3.30 a.m.) on May 1; the dated circles represent

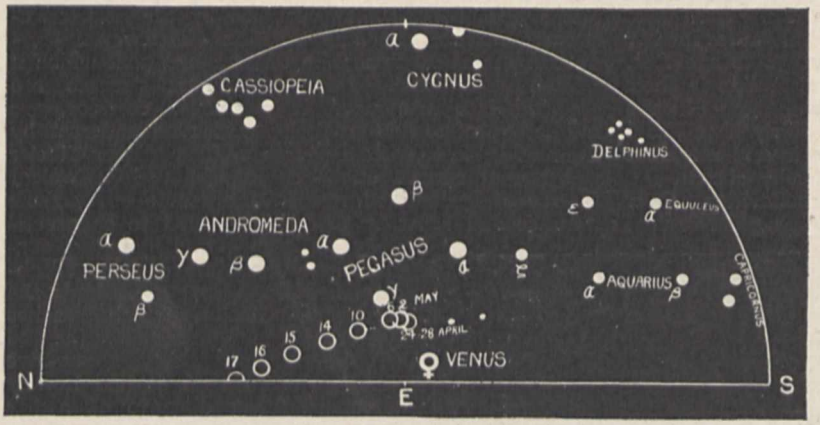


FIG. 1.

the approximate positions of the comet for the date given. Unless the eastern sky is fairly clear it is questionable whether Venus will be seen. It is obvious that to see the comet during its period as a "morning star" one must get away from the smoke-laden horizon found near large towns, and ascend to as great an altitude as possible. The observation will probably not be a simple one, for at this time of the year the sky, an hour or so before sunrise, is never dark unless cloudy; the dawn comes quite early. For this morning apparition, the Great Square of Pegasus should act as a splendid "warner" and landmark, just as it did in the evening apparition of comet 1910*a*. This mutual association of the two comets with Pegasus affords a good example of one of the chief difficulties experienced by those astronomers who have endeavoured to trace Halley's comet amid the mass of brief and very general records of comets in ancient chronicles. Fig. 2 illustrates the conditions after May 20, when the comet will be an evening star; the observer is supposed to be looking due W. at one hour after sunset on May 25 (about 9 p.m.); with a clear horizon, Procyon may serve as the indicator, but in any case Gemini and Leo will afford ready landmarks. It is now the general opinion, and hope, that no chart will be necessary during the last week or so in May, for the comet gives indications that it will probably be bright enough to be seen without difficulty. One favourable point is, of course, that during the morning apparitions the tail will rise before the comet, whilst under the conditions shown in Fig. 2 it will set later.

That the comet has developed a tail of some size is shown by photographs taken at Juvisy on February 12 and at Ottawa on February 10. The former shows a thin, feeble tail 1° 30′ long, the latter, which is reproduced in Fig. 3, a tail ½° long. From M. Baldet's drawing, made at the Juvisy equatorial on March 5, it would appear that the southern branch shown by him, Fig. 4, was probably too faint to impress itself on the Juvisy photograph. It is interesting to recall, here, that in the 1835 apparition the comet, for some time after passing perihelion (November 16), showed no trace of the tail, which on October 15 had extended to a distance of 20°. According to Sir John Herschel in his "Outlines of Astronomy," the comet was not picked up, after perihelion, until January 24, 1836, and then presented a small, round, well-defined disc, rather more than 2′ in diameter.

According to a correspondent of the *Morning Post*, the comet was seen at Greenwich Observatory, as a nebulous disc, some 30″ in diameter, in the 10-inch telescope, on the morning of April 18. A nucleus, from 3″ to 5″ in diameter, was recognised, but no definite tail could be seen, probably on account of the approaching daylight; there was, however, a lack of definition, on the western side of the head, probably denoting the presence of the tail. With the 13-inch telescope the comet was followed until 4.25 a.m., and was estimated to be as bright as a second or third magnitude star.

While the chance of capturing a sample of the comet, as suggested by Dr. Allen, is perhaps very small, it is a pity that apparently no action is being taken. The passage of the earth through a comet's tail is so rare an occurrence that even a small opportunity ought not to be missed. In the April number

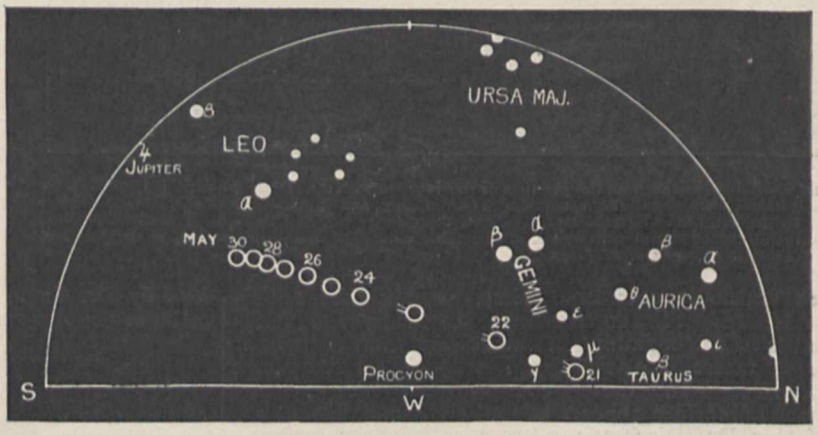


FIG. 2.

of the *Bulletin de la Société Astronomique de France*, M. C. E. Guillaume suggests the liquefaction of a large quantity of air which could afterwards be treated by fractional distillation, and possibly some cometary matter recognised. He points out that very minute quantities of the rare gases, *e.g.* krypton, are thus secured from immense volumes of air, and that it is now possible to liquefy 1000 cubic metres of air per hour; as he remarks, it is just possible that by this means the chemical study of the comet

might become a by-product of an industrial operation.

M. Flammarion suggests that if there is any palpable material at so great a distance from the head, it might be possible to measure the minute rise of temperature produced by the earth rushing through it at the rate of 77 kms. (forty-eight miles) per second.

FIG. 3.—Halley's Comet, 1910, February 10. Photographed at Ottawa.

The possibility of detecting the nucleus of the comet when it is crossing the sun's disc appears to be very remote. As pointed out by Prof. W. H. Pickering, a solid dark mass would need to have a diameter of at least seventy miles in order to be detected under these conditions, and, from the fact that Herr Archenhold saw a twelfth-magnitude star transitted by the comet, on December 5, without changing either in colour or brilliancy, it is extremely unlikely that masses of this order of size are contained in the comet's head; but the Kodaikanal spectroheliograph, in the hands of Mr. Evershed, may be able to disclose the cometary vapours during the transit.

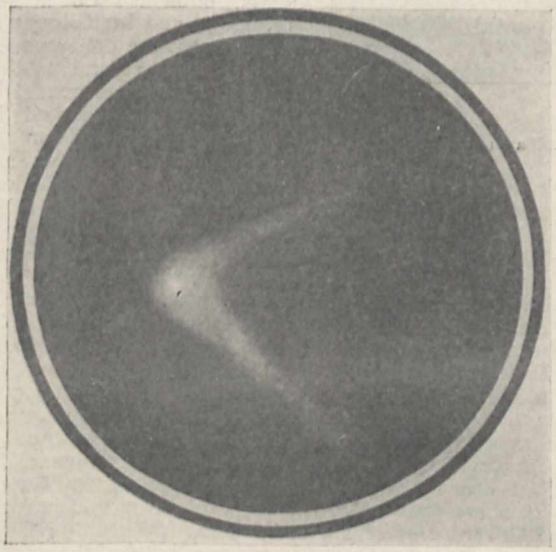


FIG. 4.—Halley's Comet, 1910, March 5. From a drawing by M. Baldet.

There have been many surmises as to what will be the effect on the earth and atmosphere. Some of these are notable only for their extravagance, but it does seem probable that an exceptional display of aurora may be generated, and also that we may experience the mistiness of the atmosphere which was generally noted in 1861, before it was known that we had passed through the tail of the great comet of that year. It has been suggested, too, that we may see the extension of the tail as a series of diverging streamers, as was also noted in 1861.

Reports from China state that the comet is being used as an omen to inflame the rioters in the disaffected districts, and that the authorities are exhibiting pictures of the comet, with accounts of its previous apparition without ill-effects, in order to reassure the inhabitants. While there is, of course, no possible likelihood of serious misapprehension in this country, it is obvious that there yet lingers a certain amount of superstition concerning the baneful effects of comets. We would suggest to all teachers that the May apparition will afford an excellent opportunity for giving real, "live" nature-study lessons, which should effectively eradicate such superstitious fancies from the minds of the rising generation.

ROMAN BRITAIN.[1]

THE first of the two volumes referred to below contains a fully illustrated account of the excavations carried out early in 1907 by the Manchester and District Branch of the Classical Association on the site of the Roman fort at Castlefield, Manchester. The second volume is a supplementary volume by the same association, describing excavations of an earthwork at Toothill, Cheshire, and at the Roman Fort Melandra.

The first volume is something more than a mere dry-as-dust description of excavations. It contains a number of very interesting and informing essays dealing with different departments of the subject, and written by experts, so that the general reader will have no difficulty in understanding the nature and value of the work that has been so efficiently carried out. Both volumes are ably edited by Mr. F. A. Bruton, of the Manchester Grammar School.

An interesting article on the name of the fort, by Prof. James Tait, shows how difficult it is to suggest an etymology of an ancient place-name which will withstand the assault of destructive criticism. The name Mancunium, which is usually associated with the Roman fort at Manchester, has been derived by various authorities from the Welsh, *main*, "a stone"; from the Welsh *man*, "a place," and *cenion*, "skins"; from the Welsh *meini cochion*, "redstones"; and from the Old Celtic *mammion*, suggesting a derivation from *mamma*, "mother." The last derivation applies to the form *Mamcunio*, one of the half-dozen different readings found in various ancient manuscripts.

Among the inscriptions found in the course of the excavations are several on altars dedicating them to the goddess "Fortune, the Preserver." The inscriptions, however, give very little information as to the details of the Roman occupation, though one inscription appears to imply that at one time soldiers from Rætia (Tyrol) and from Noricum formed part of the Manchester garrison.

Among the objects were a considerable number of coins and articles of bronze, silver, iron, and glass.

1 "The Roman Fort at Manchester." Edited by F. A. Bruton. (Manchester: University Press; London: Sherratt and Hughes, 1909.) Price 5s. net.

"Excavations at Toothill and Melandra." Edited by F. A. Bruton. (Manchester: University Press; London: Sherratt and Hughes, 1909.)

Among the pottery are some beautiful examples of "Samian" ware, some fine drawings of typical pieces by Mr. Phelps being reproduced.

An illuminating chapter on Mithras-worship in Roman Manchester, written by the Rev. E. L. Hicks, advances the theory that Mithras-worship was encouraged by the Emperors among the Roman soldiers, as an antidote to Christianity.

At the end of the volume is an elaborate catalogue of the coins of Roman Manchester, prepared by Dr. R. S. Conway, assisted by Mr. McInnes and Mr. Brooke.

The supplemental volume describes some excavations made by the association on an earthwork at Toothill, in Macclesfield Forest. This earthwork has long puzzled antiquaries, and was generally believed before these excavations were made to be a Roman camp or fort. But not a single trace of Roman occupation was found, nor of pre-Roman; the work may have been mediæval, but no positive evidence of its age has yet been found. The rest of the volume describes the continuation of the work at the Roman Fort Melandra.

These volumes are well and clearly written, and very fully illustrated, and will be of the greatest value to students of Roman Britain.

Photo. by J. J. Phelps.

Samian Bowl found in Manchester in 1907. From "The Roman Fort at Manchester."

ADMINISTRATION AND DISEASE.

THE report of the advisory committee for the Tropical Diseases Research Fund for 1909[1] contains so much original work that it should rank as a scientific publication. In it are to be found reports from all parts of the world in which the results of scientific investigations are communicated by those engaged in studies bearing directly or indirectly upon tropical diseases of all kinds. Some of these reports are even illustrated by figures, plain or coloured, which, however, for the most part, give the impression of either having been very badly drawn in the first place or very inadequately reproduced in this report. It is to be hoped that many of the important and interesting researches described here will find their way ultimately into recognised scientific or medical journals with fuller exposition and better illustrations.

The actual report of the committee occupies three pages out of a total of 134, the remainder being taken up by appendices. In the report the committee gives an account of its revenue, amounting to 3470*l.*, and the expenditure, totalling 3333*l.* 6*s.* 8*d.* The revenue is made up of contributions from the Imperial Government (1000*l.*), the Government of India (500*l.*), the Rhodes' Trustees (200*l.*), and Colonial Governments (1770*l.*); and, with regard to the last item, it is very satisfactory to learn that the Colonial Governments have one and all agreed to renew their grants for a further period of five years from 1909. The expenditure consisted of grants to the London School of Tropical Medicine (1383*l.* 6*s.* 8*d.*), the Liverpool School of Tropical Medicine (1000*l.*), the University of London (750*l.*), and the University of Cambridge (200*l.*). No grant was made to the Royal Society during the year, because the funds required for the continuation of the researches into sleeping sickness, carried on under the supervision of the society, were provided by the Uganda Protectorate.

The first appendix contains reports on measures taken for the prevention of malarial fever. A circular letter was dispatched by the Colonial Secretary to the Colonial Governors, enclosing (1) a letter from Sir William Osler, published in the *Times* of March 15, 1909, entitled "Malaria in Italy; a Lesson in Practical Hygiene," and (2) a report of the Bombay Medical Congress, published on March 16, 1909; and inquiring "to what extent the policy which Dr. Osler represents as having been so successful in Italy could be adopted in the territory under your administration." Replies are printed from Ceylon, Mauritius, East Africa, Nyasaland, Somaliland, Uganda, Gambia, Gold Coast, Sierra Leone, Northern and Southern Nigeria, South Africa, Bahamas, British Guiana, British Honduras, Jamaica, Leeward Islands, Trinidad, Windward Islands, Australia, and Cyprus. These various replies furnish much interesting reading. In general the defence of dwellings and individuals against mosquitoes, the destruction, so far as possible, of the breeding-grounds of the mosquitoes, and the free distribution of quinine, are the measures most commonly adopted. The Acting Governor of the Leeward Islands reports favourably on the efficacy of the small fish known as "millions" (*Girardinus poeciloides*) in keeping down mosquitoes. The Governor of Nyasaland reports favourably on the success of anti-malarial measures in the townships and other European settlements, but is less hopeful with regard to the scattered native villages.

The remaining appendices consist of a report from Dr. H. G. Plimmer on his work on the experimental treatment of trypanosomiasis; reports from the professor of protozoology in the University of London, the Quick Laboratory, Cambridge, the London School of

[1] Printed for His Majesty's Stationery Office, 1910. Cd. 4999. Price 2*s.* 8*d.*

Tropical Medicine, the Liverpool School of Tropical Medicine, and the various colonial laboratories; and, lastly, the circular letter sent by the Colonial Secretary to the Colonial Governors with regard to the renewal of contributions to the Tropical Diseases Research Fund. Many of these reports contain matter of much interest. From British Guiana come reports by the Government bacteriologist, Dr. K. S. Wise, and Prof. Deycke on the results of Prof. Deycke's treatment of leprosy during the first six months' trial. In the report of Dr. Castellani from Ceylon, peculiar parasites are described from the blood of man and other vertebrates in Ceylon, with illustrations of a relatively high standard. These parasites are found free in the blood-plasma and resemble the free "vermicules" of hæmogregarines, but do not appear to have any intracorpuscular stage. Dr. Castellani considers them to be Protozoa of a genus distinct from hæmogregarines, and compares them with bodies found in human blood in Algeria by the brothers Sergent, whose name is translated into Sergeant, in our opinion somewhat unnecessarily.

From East Africa the Government bacteriologist, Dr. P. H. Ross, gives an account of a number of experiments on the transmission of trypanosomes by *Glossina fusca* and *G. longipennis*. Amongst these special interest attaches to one in which a monkey was successfully infected with *Trypanosoma gambiense* by means of *Glossina fusca*, by the method of interrupted feeding. Two flies were used in this way on October 5, being first fed on an infected monkey and then transferred immediately to a healthy monkey; the experiment was repeated with three more flies on October 8; trypanosomes were first found in the blood of the second monkey on October 31. These experiments tend to show that tsetse-flies of species other than *G. palpalis* can transmit sleeping sickness by the direct or purely mechanical method.

The report shows the value and importance of the researches on tropical diseases that are being carried on in all parts of the world under the auspices of the Colonial Office and the Colonial Governments. Not only is the report encouraging for the future, but it is most interesting and instructive reading, and well worth the modest sum for which it is sold.

NOTES.

SIR ARCHIBALD GEIKIE, K.C.B., P.R.S., has been elected a foreign member of the Royal Danish Society of Sciences, Copenhagen.

THE death is announced, at eighty-four years of age, of Prof. Julius Kuehn, for many years professor of agriculture in Halle University.

THE annual meeting of the Iron and Steel Institute will be held on Wednesday and Thursday, May 4 and 5. On May 4 the retiring president (Sir Hugh Bell, Bart.) will induct into the chair the president-elect (the Duke of Devonshire). The Bessemer gold medal for 1910 will be presented to Mr. E. H. Saniter, and the president will deliver his inaugural address. A number of important papers will be read and discussed during both days of the meeting.

THE Geneva correspondent of the *Daily Chronicle* states that a monument in memory of Prof. Tyndall will be erected on the summit of the Bel Alp, 6735 feet high, a little above the place where for many years Tyndall resided during the summer months. Mrs. Tyndall has engaged M. F. Correvon, of Geneva, to design the monument, which is a large conical block of granite. It will be erected by the Swiss Alpine Club in July on Bel Alp, overlooking the Aletsch Glacier.

THE executive committee of the National Physical Laboratory has appointed Mr. J. E. Sears to take charge of the work of the metrology division of the laboratory in the place of Mr. H. Homan Jeffcott, who has been nominated recently to the professorship of engineering in the Royal College of Science, Dublin. Mr. Sears, who was formerly at St. John's College, Cambridge, graduated with first-class honours in mathematics and engineering, and is an associate member of the Institution of Civil Engineers.

UNDER the title of the *Journal of Genetics*, it is proposed to publish a periodical for original research in heredity, variation, and allied subjects. The journal will also, from time to time, contain articles summarising the existing state of knowledge in the various branches of genetics, but reviews and abstracts of work published elsewhere will, as a rule, not be included. Adequate illustrations will be provided, and, where the subject-matter demands it, free use will be made of coloured plates. The journal will be edited by Prof. W. Bateson, F.R.S., director of the John Innes Agricultural Institution, and Prof. R. C. Punnett, professor of biology in the University of Cambridge, and it will be published by the Cambridge University Press. It is hoped that the first number will be ready in August.

ON Tuesday next, April 26, Prof. F. W. Mott will begin a course of three lectures at the Royal Institution on "The Mechanism of the Human Voice"; on Thursday, April 28, Mr. W. McClintock will deliver the first of three lectures on "Blackfeet Indians in North America"; and on Saturday, April 30, Dr. D. H. Scott will commence a course of three lectures on "The World of Plants before the Appearance of Flowers." The Friday evening discourse on April 29 will be delivered by Dr. Tempest Anderson on "Matavanu: a New Volcano in Savaii (German Samoa)"; on May 6 by Sir Almroth Wright, on "Autoinoculation"; and on May 13 by Prof. W. H. Bragg, on "Radio-activity as a Kinetic Theory of a Fourth State of Matter."

AN interesting light has just been shed upon a controversy which excited some attention in 1907 (see NATURE of that year, September 26, p. 545, and October 17, p. 615) by the publication of the official report on "The Tomb of Queen Tiyi" (Constable and Co., Ltd., 1910). Two years ago archæologists maintained that the bones found in the tomb were the remains of the mummy of the queen herself, and seemed to regard as a matter of little importance the anatomical fact that the skeleton was that of a young man. Sir Gaston Maspero now states (*op. cit.*, p. i) that "when we came to examine the mosaic coffin and the sheets of gold in which the mummy was wrapped, we found that their legends asserted the mummy to be no other than Khuniatonu himself" (Queen Tiyi's son).

THE Seismological Society of America at a recent meeting passed a series of resolutions expressing its views on the establishment of a National Bureau of Seismology, and decided that copies of the resolutions should be transmitted to the President, President of the Senate, the Speaker of the House of Representatives, and the secretary of the Smithsonian Institution. After enumerating the chief earthquake disasters in the United States, and summarising what has been done in other countries for the encouragement of the study of seismology, the resolutions state that the Seismological Society of America strongly favours the establishment of a National Bureau of Seismology with power (*a*) to collect seismological data; (*b*) to establish observing stations; (*c*) to study and

investigate special earthquake regions within the national domain; (*d*) to cooperate with other scientific bodies and organisations and individual men of science in forwarding the development and dissemination of seismological knowledge. The society also favours the organisation of this bureau under the Smithsonian Institution, with the active cooperation of other scientific departments of the Government.

IN the death of Sir Walter Palmer, Bart., on April 16, at fifty-two years of age, the cause of higher education has suffered a heavy loss. Nowhere will that loss be felt more grievously than at Reading, for to Sir Walter Palmer more than perhaps to any other individual the University College of that town owes its origin and rapid development. Largely to his initiative was due the merging, some twenty years ago, of the University Extension Centre and the School of Science and Art into one institution, which has become the flourishing University College of to-day. The number of the benefactors of higher education in this country is not large. The institutions which they aid make heavy claims upon them, claims, not only on their wealth, but also on their time. That these claims are met unfailingly by men like Sir Walter must rejoice the hearts of those who believe that, "after bread, education is the first need of a people." From 1897 to 1903 Sir Walter was chairman of council, and in that capacity received the Prince of Wales on the occasion of the opening of the new college buildings in 1898. After his resignation of the chairmanship he remained a member of council and of the academic board. His deep and abiding interest in education was not confined to Reading; and the work done by him in London—he was a member of the Senate of the University of London—is widely known and appreciated.

THE Liverpool Marine Biological Station at Port Erin has been very fully occupied with workers during the present spring vacation. In the month from the middle of March more than forty senior students and professional biologists, representing six or seven universities, have occupied work-places. Amongst these may be mentioned Mr. Walter Tattersall (development of Littorina), Dr. Henderson (development of plaice), and two senior students, all from the University of Manchester; Dr. Stuart Thomson (Alcyonaria), from Bristol University; Mr. W. J. Dakin (memoir on Buccinum), from Belfast University; Mr. W. Riddell (plankton), Dr. J. Pearson (memoir on skate), Mr. Douglas Laurie, Prof. Herdman (plankton), and about twenty-five senior students from the biological departments of Liverpool University; Prof. Cole and three senior students from Reading; two from Cambridge, one from Birmingham, and a few others. Every work-place is now occupied, and an extension of the laboratory accommodation is urgently required. Work at sea, from the S.Y. *Ladybird*, is being carried on actively. The plankton on the surface of the Irish Sea is at present very abundant, and all the nets are giving large hauls. The vernal increase in phyto-plankton (such as diatoms) made its appearance this year between March 22 and 26, an unusually early date. Last year the phyto-plankton was not present in quantity (more than a million per fifteen minutes' haul of standard net) until April 19; in 1908 it began about the middle of April (from April 13 onwards), and in 1907 the maximum covered the last week of March and first fortnight of April—apparently the present season is more like 1907 in this respect than the two intermediate years. In the fish-hatchery the present season has been a late one, but in other respects is satisfactory. The spawning of the parent plaice (about 400 adult fish) in the pond began on February 14, but the numbers of fertilised eggs produced remained low until March 7, since when they have been spawned in abundance, the maximum on one day being 634,000, on April 12. The total number of eggs skimmed from the pond, to April 16 inclusive, is above 8½ millions, and the number of larval plaice set free in the open sea, to April 15, is 3,365,000. The spawning is still in progress, and will probably continue for several weeks.

DR. KNUT STJERNA, a promising anthropologist of Upsala, whose death, we regret to learn, occurred at an early age in November last, contributed to the January-February number of *L'Anthropologie* an elaborate paper entitled "Les Groups de Civilisation en Scandinavie a l'Epoque des Sépultures à Galerie." He recognises the remains of three races in this region:—first, the east and north were occupied by a race of fishermen and hunters, who retained much of the Palæolithic culture, and were connected across the Aland Archipelago with the people of east and south-east Europe; secondly, the Danish islands and the adjoining mainland were colonised by a people skilled in bee-culture, who possessed a regular type of weapons, and traded in the North Sea; lastly, there was on the west a foreign race, emigrants from Central Europe, possessing a civilisation which at the close of the period of the gallery tombs had begun to assert its influence on the adjoining Scandinavian races.

THE question of the origin and distribution of the cross-bow in India presents an interesting problem. Mr. G. Forrest, in the *National Geographic Magazine* for February, under the title of "The Land of the Cross-bow," describes its use by a people whom he calls the "Lissoos" in the Upper Salwin valley in Burma. The bow is made of wild mulberry, with a span of 5 feet and a pull of 35 lb.; the stock is of wild plum wood, the string of plaited hemp, and the trigger of bone; the arrows are made of split bamboo, 16 or 18 inches long, and poisoned with aconite. Sir J. G. Scott describes a similar weapon in use among the Lashis or Yawyins and the Kachins. It is not mentioned by Messrs. Skeat and Blagden as in use among the Pagan races of the Malay Peninsula. Mr. Thurston, in his recent work on the "Castes and Tribes of South India," says that he found a weapon of this type in use among the Ulládans, a wild tribe of Travancore, for shooting fish, and a specimen of the weapon, now in the Pitt Rivers Museum, Oxford, was picked up among the Korwas, a wild tribe in Central India, south of the river Son. The Ulládans seem to speak of it as the Firingi (Frank or European) weapon, but it is difficult to suggest any route by which it could have reached the Burmese tribes. Being an obvious development of the common bow, it may have been independently invented by them.

AT the end of an account of the birds obtained during the Alexander expedition to Alaska in 1908, Dr. J. Grinnell, in vol. v., No. 12, of the University of California Zoological Publications, directs attention to the tendency to melanism among the avifauna of the district. In this respect Alaskan birds resemble those from other regions with a heavy rainfall and damp climate. The melanism, there and elsewhere, cannot be directly attributed to the heavy precipitation, nor, in the author's opinion, to the humidity and paucity of light, but the true cause of the phenomenon is not at present apparent.

WE have to acknowledge the receipt of the volume of the *Sitzungsberichte der k. Bohm. Ges. der Wissenschaften* for 1909, and among the contents we may refer

to an account by Dr. Anton Fritsch of the discovery in the granitic area of Skuč of a superjacent deposit of altered sandstone containing Rudistæ and a number of other Upper Cretaceous molluscs. Another remarkable geological discovery recorded, by Mr. A. Hofmann, in the same volume relates to the occurrence of rounded pebbles of quartzite and other rocks in the brown coal formation. The author figures specimens of these pebbles *in situ*, but reserves an explanation of their mode of occurrence.

ZOOLOGICAL serials, both English and American, are flooded with descriptions of new forms of mammals from British East Africa, the American descriptions being based on specimens obtained during the Roosevelt expedition, which appears to have induced English naturalists to overhaul the collections in this country. The chief American contributors are Messrs. Heller, Miller, and Osgood; and among a batch of papers recently received we may refer to one by Mr. Heller on a sable antelope from the Shimba Hills, which is described as a new species, although, as it differs from the typical *Hippotragus niger* mainly by the non-assumption of the full sable livery, it is better regarded as a race of that species. A similar remark is applicable in the case of several of the other new forms, which are mostly rodents, and to the Angolan hippopotamus described by Mr. Miller as *Hippopotamus constrictus*.

IN the *Zoologischer Anzeiger* of March 1 (vol. xxxv., pp. 500–8) Dr. Max Schlosser announces the discovery in the Fayum Oligocene of remains of Primates which are referred to three new genera, viz. Mœripithecus, Parapithecus, and Propliopithecus. The last, as represented by *P. haeckeli*, is a small ape intermediate in size between Chrysothrix and Cebus, with the normal simian lower dental formula, the canine and premolars being vertical, and the two branches of the lower jaw running nearly parallel and forming a firm symphysis. Phylogenetically, this genus is regarded by its describer as of high importance, since, in his opinion, it is the ancestor, not only of the Simiidæ, but also of the Hominidæ. *Parapithecus fraasi* is a small species of the size of a squirrel-monkey, with the lower dental formula *i*.1, *c*.1, *p*.3, *m*.3. It is regarded as connecting the Eocene Anaptomorphidæ with the Simiidæ, and perhaps also with the Cercopithecidæ. *Moeripithecus markgrafi* is too imperfectly known to admit of its systematic position being determined; it was about the size of a spider-monkey. Dr. Schlosser also describes a number of new types of hyracoids from the Fayum, among which Bunohyrax is based on some of the species included by Dr. Andrews in Geniohyus, both genera being regarded as bunodont hyracoids. In this connection it may be mentioned that Dr. Marcellin Boule (*Comptes rendus*, vol. cl., p. 812) has just described remains of a species of the Siwalik genus Merycopotamus from Upper Tertiary strata in southern Tunisia. This *M. africanus*, as it is named, affords further evidence in favour of Dr. Arldt's theory as to the migration of the Siwalik fauna through a forest-tract to Africa.

THE association of particular species of insects with particular flowers has always been a matter of interest to those who concern themselves with the question of the natural means of cross-fertilisation by insect agency. With respect to our native orchid, *O. maculata*, previous records have generally credited insects other than Lepidoptera as being the fertilising agents. In the *Entomologist* for November, 1909 (vol. xlii., p. 281), Prof. Meldola recorded the capture in August at Onich, Inverness-shire, of a specimen of the common "shark," *Cucullia umbratica*, with one of the pollinia of *O. maculata* attached to its head, thus proving that this moth visits the flower in question. Prof. Meldola's observation has been followed up by Mr. A. M. Stewart, of Paisley, who in the current number of the *Entomologist* (April, vol. xliii., p. 106) records *Plusia festucae* as a fertiliser of the same orchid. In view of the large numbers of moth collectors now at work in this country, it is remarkable that such few observations of this kind have been placed upon record. Photographic reproductions of the heads of both species showing the pollinium *in situ* are given in the *Entomologist* for this month.

WE have received the Year-book for 1909 of the Dairy Students' Union, a body founded four years ago to assist its members with advice on various difficulties that arise and information of vacancies occurring in different branches of dairying, and "to create and stimulate interest in scientific research and new inventions in the dairy world." The book contains several short articles by Messrs. Blackshaw, D. A. Gilchrist, T. R. Robinson, C. W. Walker-Tisdale, and other dairy writers, and there is an interesting set of replies to queries that have been sent in by members during the year and dealt with by the advisory board.

THE direct determination of the total solids in milk presents certain practical difficulties which would be of serious disadvantage to the ordinary analyst who has to make a large number of determinations. It is found, however, that a simple formula expresses with sufficient accuracy the relation between the total solids, the fat (as determined by Gerber's or similar methods), and the specific gravity determined by the lactometer. Mr. Collins has recently issued an account of a slide rule that he has invented, and is now on the market, by which the necessary calculation, including the temperature correction, may be made at one setting. Such a rule will be of great benefit to the busy milk analyst, who has hitherto had to work out the calculation in the ordinary way. The paper is published in the University of Durham Philosophical Society's Proceedings.

PRINCE GALITZIN has recently published an interesting study of the records of the great earthquake of January 22 (*Bull. de l'Acad. Imp. des Sci. de St. Pétersbourg*, 1910, pp. 211–6). He estimates the distance of the epicentre from Pulkowa at 2400 km., and its azimuth N.W. −49·4°. From these data he assigns the following position for the epicentre, lat. 68° N., long. 17° W., that is, a little to the north of Iceland. This agrees somewhat closely with the position calculated by Dr. Tams from the epicentral distances from Jugenheim, Strassburg, Vienna, and Hamburg, namely, lat. 70·3° ± 1·7° N., long. 14·3° ± 2·2° W. According to intelligence received from Iceland, a violent earthquake took place in the neighbourhood of that island about the time mentioned.

THROUGH the courtesy of Dr. Reusch, director of the Geological Survey of Norway, we have received an abstract of the history and proceedings of the Norsk Geologisk Forening, founded in 1905, and of its predecessor, the Geologisk Klub of Christiania. This history is reprinted from the journal of the society, the *Norsk Geologisk Tidsskrift* (Bind i., 1909), and forms a complete record of investigations and discussions since 1893. Like the old Geological Club in London, the Norwegian club consisted mainly of men engaged in active geological research, and this character is maintained by its successor, the forty members of which resemble an academy rather than a general geological society. In the first volume of the *Tidsskrift* some of the papers are in German, while

others have summaries in English. Scandinavian geology, as is well recognised, has a special interest for workers on our pre-Devonian rocks and for all interested in recent modifications of our shore-lines.

THE first part has appeared of the comprehensive work entitled "Handbuch der Regionalen Geologie," edited by Profs. Steinmann and Wilckens, of Bonn (Heidelberg: Carl Winter, 1910). This includes the whole of Denmark, by Dr. N. V. Ussing, of Copenhagen, and is published at the moderate price of 1.60 marks, or 1.20 marks to subscribers. The scheme of the editors is already in full operation, and some sixty contributors of various nationalities are at work on the subdivisions of the eight royal octavo volumes. Landscape illustrations are excluded, but sketch-maps and sections are given in the text. The references to original memoirs are likely to be especially useful. The present part of 38 pages, so convenient to carry in the hand-bag, will form a companion for all scientific visitors to Denmark. One of the maps shows how the post-Glacial uplift of Scandinavia has affected a large part of the Danish peninsula and the islands. Bornholm falls into the Scandinavian region, and contains rocks from the pre-Cambrian up to the Liassic systems, unknown otherwise in Denmark. Attention is directed to the Middle and Upper Jurassic and Lower Cretaceous strata of Jutland, represented only by boulders in the drift. The various oscillatory movements that have given the kingdom its present outlines are well stated on p. 26.

A PRELIMINARY report on the mineral production of Canada during the year 1909 has been prepared by Mr. John McLeish, chief of the Division of Mineral Resources and Statistics, and published by the Mines branch of the Canada Department of Mines. The total value of the mineral production during the year was upwards of 18,000,000*l.*, an increase of 5 per cent. over 1908. Of this total, 49·9 per cent. represents metals, 49·7 per cent. non-metallic products, the remaining 0·4 per cent. being mineral products not reported. Coal is still the most important Canadian mineral, and constitutes 27 per cent. of the total. Silver occupies second place with 15·9 per cent., gold and nickel come next with 10·8 and 10·5 per cent. respectively, and copper contributes 7·8 per cent. The metals nearly all showed an increased output compared with 1908, while in the non-metallic class there is a larger number of products showing increases than those showing decreases. The increases were very noticeable in the cases of corundum, gypsum, natural gas, salt, and in the structural materials, cement, clay products, lime, and stone.

IN a paper published in Petermann's *Mitteilungen* Dr. Marquardsen, of Göttingen, reviews the present state of our knowledge of the topography and hydrography of the inland drainage area of the Sudan and Sahara. The total area of this region is estimated at 2,139,000 square kilometres. Dr. Marquardsen states some interesting results with regard to Lake Chad; the variations in size and level do not, in his opinion, indicate a progressive change in climate since its discovery by Denham in 1823; the lake appears to be shifting northward and gradually filling up. The question of the ultimate filling up of the whole basin, and breaking through of the streams which now supply Lake Chad, is discussed; and in this connection special significance is attached to the Logone-Tuburi bifurcation and the activity of the source streams of the Benue.

THE climatology of 1909, as recorded at the Juvisy Observatory, is reviewed by MM. Flammarion and J. Loisel in No. 2 (1910) of the *Bulletin de la Société astronomique de France*. The form of the discussion and of the comprehensive set of curves follows that of previous years, each element in the climatological record being discussed separately and compared with the same element in former seasons and years. Thus we see that 1909 was one of the coldest years since 1885, the mean temperature for the year (9·5° C.) being the lowest since 1891; in the matter of mean summer (June, July, August) temperature the value (16° C.) was the lowest since 1886, when the records were commenced. Similarly interesting comparisons are made for the other elements.

MESSRS. GEO. PHILIP AND SON have sent us a cardboard model, designed by Mr. Rupert Hicks, to show the relative positions of Halley's comet, the sun, and the earth during the present apparition. The model consists of a piece of stout cardboard 12 inches by 10 inches, near the centre of which is fixed a gilded disc representing the sun. Attached by an arm to the latter is a circle representing the earth, the revolution being provided for by the sun being pivoted at the centre. Then on a longer arm is affixed a model comet, which may describe an arc representing that part of the comet's path lying within the orbit of the earth. Thus one gets the comet's path, relative to earth and sun, from March 10 to May 30, and, by swinging the discs into their appropriate positions on the dated arcs, it is possible to see at a glance the conditions governing the visibility of the comet and its tail on any specified date; the tail is made long enough to illustrate the probable passage of the earth through it on May 19. The price of the model is 1*s.* net, post free 1*s.* 1*d.*, and as a method of illustrating to non-astronomical people the various conditions under which the comet appears and disappears the model should prove instructive and interesting.

THE February number of the Journal of the Institution of Electrical Engineers contains a communication made to the Manchester section of the institution by Mr. J. W. Warr on the electric ignition of internal-combustion engines. Descriptions of the principal methods of electric ignition at present in use are given, but the author expresses a decided preference for the high-tension method both for stationary engines and for motor-cars. The simplicity of the means of production of the current for low-tension methods is more than compensated by the trouble introduced by the mechanical contact breakers which are then necessary to produce the spark. Of the various high-tension methods, Mr. Warr considers that depending directly on a magneto machine to be the most trustworthy.

ACCORDING to an article in the February number of *Le Radium*, M. T. Bialobjeski has commenced at the Collège de France an examination of the effects of the β and γ rays of radium on the conductivity of solid dielectrics. His method is to use the dielectric in a condenser the plates of which are horizontal, the lower one being connected through an electrometer to earth, while the upper one consists of a thin sheet of aluminium foil kept in contact with the dielectric by means of a ring of lead. The rays from 1 milligram of radium bromide contained in a platinum capsule closed by a mica window fall on the upper plate of the condenser and pass through it to the dielectric beneath. The potential difference between the plates is maintained by storage cells, and can be increased to 1800 volts. The current produced is measured by the rate of motion of the electrometer needle. Sulphur, paraffin, wax, and amber have up to the present been examined. For discs more than 1 millimetre thick the current was proportional to the electromotive force used.

For smaller thicknesses the behaviour varied greatly with the material, but the author hopes to explain the whole of the phenomena observed by means of the ionisation theory.

THE launch of H.M.S. *Colossus* was carried out successfully on Saturday, April 9. This vessel has been constructed by Scott's Shipbuilding and Engineering Company, of Greenock. That the work has been carried out expeditiously will be evident from the fact that the keel was laid less than nine months ago. The ship will have a displacement of 20,250 tons, and has a length of 510 feet, beam 86 feet, and a designed speed of 21 knots. Parsons turbines and Babcock boilers of 25,000 horse-power will be fitted, and good progress has been made with these also. The launching weight was 7500 tons, and the vessel was completely afloat 58½ seconds after the first movement, which occurred without the vessel hanging on the ways for any appreciable time.

AN interesting article on the development of the hydraulic reaction turbine in America, by H. Birchard Taylor, appears in the *Engineering Magazine* for March. American makers have advanced greatly since 1890, and have abandoned the methods of "trial and error" in vogue prior to that date, methods which caused the Niagara Falls Power Company to go abroad for the designs of their first machines. To-day, American designers are in a position to design and construct machinery to meet the most severe requirements, and have to their credit the largest turbines in the world, among which may be mentioned the four 13,000-horse-power Francis turbines, now operating in the plant of the Toronto Power Company at Niagara Falls. The author of the article has given special attention to erosion, and brings forward evidence which indicates that trouble owing to this cause may be eliminated by correct design. Thus a bronze wheel under a head of 266 feet was so eroded at the end of a few months that it was necessary to replace it. A new wheel, of slightly different design, but of precisely the same material, ran five years without showing any signs of wear. Electrolysis and chemical action are considered by Mr. Taylor, who believes that both can be eliminated by properly designing the wheel blades.

THE issues of *Engineering* for April 8 and 15 contain a detailed account of some experiments upon the flow of water over triangular notches, carried out by Mr. James Barr at the James Watt Engineering Laboratories at Glasgow University, under the supervision of Prof. Archibald Barr. The late Prof. James Thomson first investigated this form of notch in 1860 and 1861 with rather crude apparatus. It speaks well for his skill as an experimenter that the present series, with elaborate and finely constructed apparatus, show no divergence from Thomson's conclusions. Thomson's law, that the quantity flowing is, in almost all cases, proportional to the 5/2 power of the head, has been verified. Further investigation shows that the prevention of the inward flow of the water at the sides of the notch, whether caused by the narrowness of the channel of approach or by the roughness of the up-stream surface of the notch, produces an increase in the quantity flowing over the notch. Various notches were experimented upon, the value of the coefficient in Thomson's formula for a narrow surface, right-angled notch being found to vary from 0·3104 at a head of 2 inches to 0·2995 at a head of 10 inches. Thomson's average value of 0·305 for heads from 2 to 7 inches must have been very near the truth. The articles are well illustrated, and give full tables and curves of results.

MESSRS. CONSTABLE AND CO. are publishing immediately a little book of pocket size, being a "Guide to the Preservation of Health in West Africa," by Mr. Henry Strachan, principal medical officer in southern Nigeria. They announce also the forthcoming publication of a series of essays dealing with the consideration of the introduction of an international language into science. Such a language has been constructed by an international commission, and the English edition of the essays in which it is presented is by Prof. F. G. Donnan.

MESSRS. W. WESLEY AND SON, Essex Street, Strand, London, W.C., have just issued a classified catalogue of manuscripts, books, and pamphlets on astronomy, including the libraries of the late Miss A. M. Clerke, Dr. A. A. Common, Mr. E. Crossley, and Captain W. Noble. The catalogue includes the titles of about 3700 works, arranged in alphabetical order, according to authors' names, in groups relating to the various branches of theoretical and practical astronomy and astronomical physics. The classification renders it easy to find the works which Messrs. Wesley have available upon any particular subject of astronomical study or research, and all who are desirous of filling up gaps in their libraries should see this catalogue.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF COMETS.—In No. 4402 of the *Astronomische Nachrichten* Dr. Wolf directs attention to a peculiarity in the form of comet 1910*a*. Besides the main and subsidiary tails, Dr. Wolf's photographs show a conical faint mass of material extending from the base of the coma towards the sun, quite different from anything he has seen in previous comets, and having the appearance of a miniature zodiacal light. The point of the cone was in position-angle 215°, 180° from the direction of the axis of the tail, and was at a distance of 13′ from the nucleus.

Comet 1909*e* (Daniel) was photographed at Heidelberg on February 28, and Dr. Wolf also publishes the latest-determined position of comet 1909*a*, determined from a photograph secured on August 19, 1909, when the comet was fainter than the sixteenth magnitude.

Observations published by Dr. Graff in the same journal show that during January comet 1909*e* was a large nebulous mass, 3′ in diameter, with a nucleus of magnitude 12·5.

OBJECTIVE-PRISM DETERMINATIONS OF RADIAL VELOCITIES.—An ingenious method of determining, approximately, the approach or recession of faint stars is proposed by Prof. Pickering in Circular 154 of the Harvard College Observatory. Various methods have been proposed before, but have not proved remarkably successful. In one of these it was proposed to introduce a standard artificial absorption band in the spectrum of each star, but the didymium and hyponitric acid filter then employed produced bands which were far too wide and hazy for precise measurement.

This difficulty has now been largely removed by Prof. R. W. Wood, who has devised a filter giving an absorption band at λ 4272 which is distinctly more definite than the hydrogen lines in first-type stars. The filter is a weak solution of neodymium chloride, and further experiments are in progress to reduce the thickness of the absorption band by the addition of lanthanum and phosphoric acid. Trial exposures have shown that for ninth-magnitude first-type stars the probable error, at present, is about 10 km., and for eighth-magnitude second-type stars somewhat less; a number of reproductions of the photographs obtained accompany the circular.

Prof. Pickering also enumerates the available objective-prism equipment at Harvard, and states that they are ready to take such photographs as may be desired; further, he invites cooperation from astronomers experienced in radial-velocity work.

ENCKE'S COMET, 1895–1908.—The Monthly Notices for March (vol. lxx., No. 5, p. 429) contains a discussion by Dr. Backlund of the motion, brightness, &c., of Encke's comet during the period 1895–1908. In the first place, he deduces elements fitting the observations of 1895, 1901, and 1904, and shows that the acceleration of the mean motion was not constant during the period under discussion. This leads to a discussion of the various causes which might produce the diminution observed, and of the probable time at which such causes, or cause, were, or was, effective. Excluding solar electrical forces, it seems probable that the resistance encountered is a meteoric swarm in the neighbourhood of perihelion, and the decrease of the acceleration must be attributed rather to the diminution of the density of the resisting medium than to changes in the comet itself. If, however, the variation of the acceleration is held to be actually connected with the maxima of solar activity, tangential electrical forces are admissible in explaining it, and the problem becomes indeterminate.

Various causes of the comet's fluctuations in brightness, *e.g.* an alteration in shape, and therefore in surface presented, produced by the solar tidal action, are discussed, but no explanation is entirely satisfactory, and the question is left open.

Dr. Backlund then investigates the relation between Wolf's comet of 1907 and Encke's comet, and the possibility of capture by Jupiter. Whilst not proving that the comet was captured, he shows the possibility of such capture having taken place within the past 5700 years.

THE SPECTRA OF THE MAJOR PLANETS.—In Bulletin No. 42 of the Lowell Observatory Dr. V. M. Slipher publishes further descriptions and reproductions of the spectra of the major planets. The photographs were taken with plates especially sensitised for the red end of the spectrum, and show a wealth of detail between D and A. Comparative exposures on the south equatorial dark belt and the bright equatorial region of Jupiter indicate no reason for supposing that the darker portions of the planet are those lying the deeper. The spectrum of Saturn is generally similar to that of Jupiter, but there is a strong band in the latter at λ 646 which is absent, or nearly so, in the former; as the others are of the same intensity, this points to the existence of a constituent in Jupiter's atmosphere which is absent in that of Saturn. No trace of the planetary bands is found in the spectra of Saturn's rings, and there is no indication of any atmosphere about the rings.

A comparison of the spectra of the four major planets shows that in Neptune all the bands seen in the other three are intensified, except that at λ 646, which appears to be peculiar to Jupiter. The evidence for hydrogen absorption in the atmospheres of Uranus and Neptune is very slight, and the intensification of C and F is not copied by the hydrogen bands at λλ 4341 and 4102, so far as an ordinary eye examination can determine, so that, at the best, the identity can only be considered probable. Of the other bands photographed scarcely anything is known, but it is shown that the very strong band at λ 619 is not identical with one in the spectra of red stars, as is sometimes stated.

THE INTRINSIC BRILLIANCY OF THE SUN.—In a previous paper Dr. Nordmann estimated that the intrinsic brilliancy of the sun was 319,000 decimal candles per sq. cm. (NATURE, March 3, p. 29), but he now finds that one of his data, owing to an ambiguity in Müller's text, is incorrect. He has, therefore, re-calculated his value, and gives, in No. 13 of the *Comptes rendus* (March 29), 100,500 decimal candles per sq. cm.

THE CARNEGIE INSTITUTION OF WASHINGTON.

THE eighth annual report of the Carnegie Institution of Washington, describing the work of the institution during the year 1909, has now been published. It is a well-illustrated volume of 259 pages, dealing with the work of administration, the investigations carried out under the auspices of the institution, the various publications, the expenditure recommended for 1910, and additional suggestions. Subjoined are extracts from the report of the president of the institution upon the progress of the different scientific departments.

Among the more important events of the year are the completion of the administration building in Washington, the establishment and active operation of the observatory of the department of meridian astrometry in Argentina, the construction and putting into commission of the non-magnetic ship *Carnegie* of the department of terrestrial magnetism, and the inauguration of the project for the publication of an edition of the master-works on international law. Attention is directed to the fact that with these, and with the previously established larger enterprises under way, the accumulated income of the institution has been exhausted, and that there will be no room for further expansion under current income in the immediate future.

In the last annual report a summary statement of the work of the institution up to October 31, 1908, was given. A more detailed study of the scope and geographical range of this work shows that investigations have been carried on under the auspices of the institution in more than thirty different fields of research, and that these investigations have extended to more than forty different countries. The total number of volumes of publications issued directly by the institution is 141, with an aggregate of about 35,000 pages of printed matter. For the larger departments of investigation there are now provided two astronomical observatories, five laboratories, and one ship. A complete list of the equipments of these establishments includes fifty-eight buildings and eight smaller craft in addition to the ship *Carnegie*. The total amount of funds granted for expenditure is 864,000*l*. The total amount expended is 825,900*l*.

At the date of the preceding annual report the department of meridian astrometry was engaged in the construction of a temporary observatory at San Luis, Argentina. The instrumental equipment for this was shipped from the Dudley Observatory, Albany, N.Y., in December, 1908. After safe transportation to San Luis, the constants of the meridian transit, the principal instrument used, were carefully re-determined, proving to the highest order of precision that this instrument suffered no injury in transshipment. With this indispensable preliminary investigation completed, the work of stellar observation was begun in April, 1909, and is now going on at a rapid rate.

The following list shows the departments of investigation to which the larger grants were made by the trustees and the amounts allotted from those grants by the executive committee during the year:—

	£
Department of Botanical Research	6,400
Department of Economics and Sociology ...	3,500
Department of Experimental Evolution... ...	5,800
Department of Historical Research	4,100
Department of Marine Biology	3,000
Department of Meridian Astrometry	6,000
Department of Terrestrial Magnetism	12,000
Department of Terrestrial Magnetism, vessel...	15,000
Geophysical Laboratory	9,000
Horticultural work of Luther Burbank ...	2,000
Nutrition Laboratory	5,000
Solar Observatory	20,800
Division of Publications	900

The various investigations of the botanical research department have been successfully continued during the past year. Among these, the experiments of the director in the production of mutants in plants seem destined to play a fundamental *rôle* in the determination of the absorbing biological question of the derivation of species. Equally important in this same line are the experiments with beetles of Prof. Tower, for which vivaria are now maintained at the Desert Laboratory at Tucson and at the Marine Biological Laboratory at Dry Tortugas, Florida.

The work of the department of experimental evolution presents a double interest in furnishing evidences at once of the evolution of organic forms and of the evolution of a science. The history of biological science, like the history of most sciences in their earlier stages, has been, and still is, marred to some extent by heated controversy. But all this is destined to disappear with the rise of biology

to the plane of quantitative determination. It is on this plane that the department in question is seeking, with capital initial success, to carry on its investigations. The publications of the department already issued are reckoned among the most important of recent contributions in this large field of research.

The work of the geophysical laboratory proceeds by means of some of the most recent methods and appliances of research, and hence its aims and lines of investigation, like those of all new sciences, present to the public more or less of obscurities of interpretation and obstacles to ready appreciation. The researches of the laboratory afford another instance of the normal evolution of a science from the observational and descriptive stage to the higher level of measurement and calculation. That geology and mineralogy will be much advanced by such researches is now recognised and attested by eminent specialists. Indeed, the definitive results already attained by members of the laboratory staff are now finding their way into the elementary as well as into the more technical literature of those sciences. The equipment of the laboratory has received an important addition during the year in apparatus for subjecting materials under observation to high pressures and temperatures, either simultaneously or separately. This apparatus, developed by Dr. A. Ludwig, research associate of the department for the year, will give pressures up to 17,000 atmospheres, or 250,000 lb. per square inch.

The Tortugas laboratory of the department of marine biology is proving highly effective as a centre for research by a wide range of specialists. Eight associate investigators have availed themselves of the opportunities afforded by the department during the past season, and the results of their studies are now in preparation for publication as contributions to science from the laboratory. It is of interest to note the advent of quantitative investigations here as well as elsewhere in the advancing biological sciences.

The apparatus of the nutrition laboratory proves highly effective, and the experiments already made, on pathological as well as normal subjects, fully justify the confident expectations hitherto entertained with respect to this line of research. Many additions have been made during the year to the equipment of the laboratory. Among these are a bed-calorimeter into which a recumbent patient may enter with ease and safety; a portable respiration apparatus which may be applied readily to a patient reclining on a cot while his respiratory action is accurately determined; and an automatic temperature register, which will give a continuous record of temperature changes in the calorimeters to which it is applied.

The achievements already attained in the development of novel methods and effective apparatus for studies of the sun, and the additions to our knowledge of solar physics already made at the solar observatory, not only justify the predictions of its founders, but warrant the anticipation of still more important contributions to astrophysics in the near future. Work of investigation and work of construction have proceeded simultaneously during the year, both at the observatory site on Mount Wilson and at the shops and physical laboratory in Pasadena. The 60-inch equatorial reflecting telescope, the installation of which was completed a year ago, has been tested during the past year and proved to be of unequalled excellence, whether used as a visual or as a photographic instrument. Its optical perfection and its wide range of applicability make it a noteworthy contribution to progress in observational astronomy. The 150-foot tower telescope, authorised by the budget of the current year, is in a forward state of construction, and will soon become one of the most effective units in the telescope battery of the observatory. The discovery of the existence of the Zeeman effect in the sun, announced by the director a year and a half ago, has been confirmed and extended in its application to further interpretation of the nature of sun-spots, as well as to researches into the more recondite electromagnetic properties shown by the sun. Closely connected, apparently, with these properties are the major and minor "magnetic storms" to which the earth's magnetism is subject, now of special interest alike to the staff of the solar observatory and to the staff of the department of terrestrial magnetism. It may suffice here to record only one other item of interest, namely, the failure, thus far, of the manufacturers of glass at St. Gobain, France, to furnish a satisfactory disc for the 100-inch Hooker telescope. The disc reported as *en route* for delivery a year ago proved so defective that it had to be rejected. The manufacturers are still confident, however, that they can meet the requirements, and it is hoped that through the collaboration of Prof. Ritchey, of the observatory staff, who has spent some months at St. Gobain during the year, a satisfactory disc may be ultimately secured.

The field-work of the terrestrial magnetism department has gone forward with dispatch. Surveys have been carried on in fifteen different countries distributed over four different continents. The routes traversed by the observers will give a large aggregate of data from hitherto little-known or unexplored regions. Thus Mr. Sowers has obtained observations at intervals along a route extending from eastern China west across China and Chinese Turkestan, and thence south to Bombay, India; Prof. Beattie, research associate of the department, has completed a survey from Cape Town to Cairo; Mr. Pearson has secured measurements in Persia, Beluchistan, Arabia, Turkey, and Russia; while other observers have been equally active in South America, Central America, and British America.

The publication of sixteen volumes of researches has been authorised by the executive committee during the year at an aggregate estimated cost of 5840*l*.

RECENT WORK OF GEOLOGICAL SURVEYS.[1]

III.—CANADA.

THE Geological Survey Branch of the Canadian Department of Mines continues to issue colour-printed geological maps at an extremely moderate price, as well as numerous mining plans on a large scale. We note that "individual maps or reports will be furnished free to *bona fide* Canadian applicants."

The Mines branch deals in its reports with technical matters relating to ore-deposits, the occurrence of which means so much to the Dominion; but its memoirs cannot be neglected by the geologist. Mr. Fritz Cirkel's report on the chrome iron ore deposits in eastern Quebec (1909) thus contains an interesting account of the serpentines of Canada (p. 12); the chromite occurs in those of Cambrian age, while the earlier serpentines appear, so far, unproductive. The Cambrian serpentines are associated with diorite, and are regarded (p. 18) as alteration-products of an olivine-gabbro. Their non-aluminous character, as shown in the typical analysis given, would lead one to assume that considerable differentiation had gone on in the basic series, and that the serpentine was at one time an olivine rock rather than a gabbro. This is probably the author's view, as stated on p. 87. The chromite is irregularly distributed in pockets, a provoking arrangement for the miner, and reminding one of the occurrences in the Dun Mountain district of New Zealand. This report, with its review of chromite ores in the world at large, is of far more than local value, and the deposits in the Transvaal, so recently described, are well referred to and illustrated. Mr. F. Hille's report, on some iron-ore deposits in Thunder Bay and Rainy River districts, Ontario, dwells on the possibility of using peat-coke, manufactured by the Ziegler process, as a fuel for smelting. Many provinces of Canada are rich in peat, poor in wood, and destitute of coal. The ores dealt with in the report are magnetite and hæmatite, and a magnetic survey has been used in the detection of the former.

The recent reports of the Canadian Geological Survey Branch include one by Mr. W. H. Collins on Gowganda Mining Division, Ontario (1909), with a very large geological map on the scale of one inch to one mile. The district described lies along the Montreal River, west of the Quebec border, and is being invaded by a rush of prospectors, owing to the discovery of silver cobalt ores similar to those that have made the reputation of Cobalt. The valuable veins occupy large fissures in quartz-diabase, which is intrusive in Huronian sediments. The author traces a magmatic gradation from the diabase into an aplite intimately associated with it (p. 33). The illustra-

[1] The second article appeared in NATURE of February 10.

tions show well the physical characters of this forest-clad region, which, with its lakes, rivers, and low hills, is, indeed, typical of the pre-Cambrian lands of North America.

Mr. Collins also reports on the "Region lying North of Lake Superior between the Pic and Nipigon Rivers, Ontario" (1909), where he was again on the great Archæan peneplain. The soils, still so deficient on this recently glaciated surface, fill the river-valleys and depressions, and "form a thin, discontinuous blanket that ineffectually covers the underlying Archæan floor." Mr. W. J. Wilson's report on parts of Algoma and Thunder Bay districts, Ontario, is bound up with that by Mr. Collins, and covers the river-courses of the country to the north and east. The large map illustrating both papers, on the scale of eight miles to one inch, together with the photographic illustrations, shows how exploration must for a long time be confined to the natural channels through the woodlands. Fossiliferous beds of Silurian age have been found on the tributaries running from the south and west into the Albany River. Their fauna is described by Mr. Whiteaves in an appendix (p. 34), and the report, with characteristic Canadian foresight, also illustrates the modern fauna in the form of speckled trout and store-clad Indians.

Mr. O. E. Leroy writes on the "Main Coast of British Columbia and Adjacent Islands in New Westminster and Nanaimo Districts" (1908), where he has a fascinating field among the fjords north-west of Vancouver. The drainage-grooves now entered by the sea are believed to have originated in early Cretaceous times, when great erosion prevailed. The country has been modified by local glaciation and by the passage of the lobe of an ice-sheet down the Strait of Georgia, inside Vancouver Island. A great batholite, varying in composition from a granite to a gabbro, invaded the Palæozoic sediments and igneous series, probably in the Upper Jurassic epoch, and has left conspicuous traces of its gradual advance by "stoping" (p. 17). This mass is responsible for a large part of the steep and rocky scenery along the fjords. The country appears rich in lead and copper ores, and magnetite awaits further development on Texada Island. The coal on Vancouver Island and the limestone on Texada Island are suggested as local means of smelting.

Mr. D. D. Cairnes's report on part of the Conrad and Whitehorse mining districts (1908) gives impressive illustrations of the grim scenery of Yukon. Aërial tramways now bring up fuel and food to claims on Alpine ridges, and the telephone prevents the feeling of isolation which tends to grow on pioneers. Conrad City is so young that it does not appear on the contoured map constructed in 1906, but we understand it to be at the foot of the Montana tramway. A photograph of it, facing the huge mountain-wall across the lake, assures us of its reality. As usual, the best is made of everything, and we are told that the long summer days may be delightful, although the lake waters remain so cold as to threaten death to those immersed in them. The gold-mining is in vein-quartz traversing Palæozoic schists, as in the Klondike fields. The granite that is so conspicuous on the coast of British Columbia cuts these schists, and is overlain by porphyrites and the Lower Cretaceous Tutshi series. A post-glacial eruption (p. 37) of considerable magnitude has formed a layer of volcanic ash 3 to 6 inches thick over a wide area in the valley-floors.

The Canadian Survey is not entirely absorbed by the excitements of mining enterprise. Dr. D. P. Penhallow, in a handsome quarto, reports on the Tertiary plants of British Columbia. This includes a review of all the known species, conveniently arranged alphabetically under genera, which are also in alphabetical order. The basis of the present work is an extensive series of plant-remains collected by Mr. L. M. Lambe for the Survey in 1906. East of the Rocky Mountains, the Canadian lignites are of "Laramie" (Eocene) age, though they have been referred by Heer, as was his general practice, to the Miocene. Similarly, the "Miocene" lignites of British Columbia are shown, by Dr. Penhallow's analysis of species, to be partly of Laramie and largely of Oligocene age. Sir William Dawson's views have thus been verified in detail. The table on p. 152 will be useful to stratigraphers.

Part iv. of the third volume of "Contributions to Canadian Palæontology" is by Mr. Lambe, on the Vertebrata of the Oligocene of the Cypress Hills, Saskatchewan. This is a continuation and revision of a previous work by Cope, and describes several new species, including *Amia exilis* and *Lepidosteus longus* among fishes, represented by fragmental remains, a probable anthracotherian tooth, and the well-preserved lower jaw of a Titanothere, *Megacerops primitivus*. Eight excellent plates, from the author's drawings, accompany the memoir. G. A. J. C.

PAPERS ON AMERICAN INVERTEBRATES.

NOS. 1706, 1710, 1712, and 1713 of the Proceedings of the U.S. National Museum are devoted to the descriptions of various groups of invertebrates from American territory. In No. 1713 Mr. S. S. Berry deals with a series of new cephalopods from the Hawaiian Islands, among which special interest attaches to the new genus and species *Stephanoteuthis hawaiiensis*, an apparent member of the Sepiolidæ, characterised by the peculiar shape of the body and the ventral anterior extension of the mantle to cover the funnel. In other respects the genus is, however, related to Heteroteuthis. A remarkable globular form, described as *Cranchia globula*, is related to *C. reinhardti*, in which globularity appears to be a feature of immaturity, but whether the same holds good for the new form—if, indeed, it be really distinct—remains for future determination.

Cœlenterates from Labrador and Newfoundland form the subject of No. 1706. These have been investigated by Mr. H. B. Bigelow, who finds that all of them belong to previously described species, so that their interest is largely geographical. Several of them have been hitherto known only from Greenland and northern Europe. The species *Catablema vesicaria* and *Æginopsis laurentii* have, however, proved of interest from an anatomical point of view, and are important in regard to the classification of the Narcomedusæ.

In No. 1710 Mr. E. B. Williamson revises the arrangement of the North American dragon-flies of the genus Macromia, from which he finds those described as Epopthalmia to be inseparable. Didymops, as regards venation, appears to come very close to Macromia, but may seemingly be distinguished by other characters. Two new species of the genus under review are named and described.

No. 1712 is devoted to the second part of Dr. N. Annandale's account of the fresh-water sponges in the collection of the U.S. National Museum, none of the few forms referred to being new to science.

EDUCATION IN ENGLAND AND ABROAD.[1]

FROM the eighth century to the time of the Reformation the history of education in England, France, and Germany was in many respects similar. The one champion of learning was the Church; and in the religious houses we find an organised and established system of education, of which not only the lower rank of people, who could not pay for their learning, but noblemen and gentlemen's sons might take advantage. In England the system was particularly successful; as early as the year 1201 there are said to have been more than 3000 scholars at the University of Oxford, and Roger Bacon tells us that there never had been so great an appearance of learning and so great an application to study as at that time, when schools were erected in every city, town, and borough. The learning of Englishmen compared favourably at this early date with that of scholars on the Continent. We are told that in 1169 there was a "colony" of English students at the University of Paris, belonging to the faculty of arts, of which it is said that they "in particular were so numerous that they occupied several schools or colleges, and made so distinguished a figure by their genius and learning, as well as by their generous manner of living, that they attracted the notice of all strangers."

Against the Church, in this matter of education, were arrayed both the general opinion of the aristocratic classes and also the power of the law. Not all the sons of gentle-

[1] From a paper read at the North of England Education Conference, Leeds, on January 8, by Otto Siepmann.

men were left in utter ignorance. Younger sons gave themselves with increasing frequency to the studies of good learning, though those who inherited their fathers' estates were usually of the familiar type. The daughters of the upper classes were not infrequently educated by the Church, but the fact remains that the provision made for education in religious houses, and in the grammar schools that were founded in the twelfth century, was in the main intended for the poor citizen's and ploughman's children. Winchester (founded in 1373) was probably the only school that did anything before 1450 for the education of the gentry. Even there the number of poor to paying scholars was as seven to one.

Yet England was, so far as education is concerned, the leading nation of Europe at this time. Progress was steady, and the respect for learning, starting among the lower classes, gradually forced its way upwards. The revival of learning in Italy, and in Europe generally, facilitated the progress of education in England, and disposed of the contempt originally felt for scholarship by the aristocracy; but while the introduction of the study of Greek enhanced the value of education, the recognition of literary culture by the upper classes of society began to make it the privilege of the rich, to the exclusion of the poorer scholars, whose monopoly it had originally been. The great principle upon which the Church had built up its system was abandoned. Rich men's sons were turning poor men out of the endowments meant only for the poor. "*Les gros poissons mangent les menus.*" "Poore men are supplanted by the rich, the weake by the strong, the meane by the mighty."

But the fatal event was the dissolution of the monasteries, and the final destruction of the Church's system of education, which had raised Englishmen to a height of culture to which the other nations of Europe could not attain. The effects were immediate and disastrous; by one blow the whole English educational system was crippled and almost destroyed; until the end of the nineteenth century the effects of that fatal step were still felt, and it is only recently that efforts have been made to reorganise and restore what at that time was destroyed.

The Reformation, which was the ultimate cause of the downfall of the English system of education, was in Germany the decisive influence which led to the establishing of education upon a broad and stable basis. Up to that time education had been dominated by the Church, and had existed, in the first place, for the Church, and the results had not been so satisfactory as in England. Since then the State, the municipal authorities, and, above all, the parents, have taken an ever-increasing interest in the education of children.

The leader of this great movement was Martin Luther. In his "Epistle to the Burgomasters and Councillors of Sundry Cities in German Lands," written in 1524, he declared it to be the duty of cities, and of secular authorities in general, to provide good schools and to encourage attendance; and, at a later date (1530), in his "discourse on the duty of keeping children at school," he urged the authorities, even, if necessary, at the public expense and with the aid of compulsory measures, to draw clever boys to the pursuit of learning in order to provide competent men to fill the public offices.

The outcome of this movement in favour of general education for all, and the pursuit of advanced studies by gifted scholars, is to be seen in the foundation of a large number of grammar schools, in the reform of the universities, and in the establishment of elementary schools in which reading, writing, catechism, and singing were taught.

In spite of various set-backs, such as the thirty years' war, this system of education survived in its main outlines until the end of the eighteenth century. In the nineteenth century it was developed by the introduction of modern sciences, modern languages, and their literatures, as compulsory subjects in secondary schools, and by their admission into the curriculum of the universities; but the present system in Germany has evolved, under the combined influences of Humanism and the Reformation, from that which was established as a result of Martin Luther's movement.

The importance of France in the history of education is mainly confined to its influence upon higher education. The failure of the Reformation left the educational system of the Church very much as it was; but in university education France took a leading position in the Middle Ages. The University of Paris, which attracted, even in the twelfth century, many students from all countries in Europe, became the prototype of German universities founded in the following century; but elementary education in that country has remained in a deplorable condition. In 1866 24 per cent. of the recruits could neither read nor write, and twenty years later a similar percentage of those who were married were unable to sign the register.

The new era in the political, economic, and educational history of the world may be said to begin with the year 1870. The history of education in the three countries since that date is so familiar to you that I may proceed at once to the present state of affairs, first of all in Germany. In elementary education Germany had a start of more than a century as compared with England. For rich and poor alike attendance at the elementary school had been compulsory in every German State for more than a hundred years before the Forster Act became law. The system is of long standing, and experience has shown that the organisation and working of the arrangement are practically perfect.

The curriculum in German elementary schools is of the simplest. Originally the three R's, religious knowledge, and singing were the only subjects taught; to these have been added at various times the elements of geography and history to stimulate interest and encourage patriotism, and, for pupils of the upper standards, a certain amount of natural history. The compulsory school age is from six to fourteen, and although there is some diversity in the excellence of the school buildings, they are, for the most part, airy and good.

In Germany the State does not exist for the individual; the individual exists for the State, and the State considers that it is to its own advantage to have, above all things, a high average level of knowledge and ability. This the Germans have certainly succeeded in attaining in elementary education, and it is in this high average that their great superiority in elementary education consists.

Let us now turn to the German secondary schools. The organisation is as complete as in the case of elementary schools, and the principle is again the same. Individual prominence must be sacrificed to raise the common average; and to this must be added another principle, equally important and similar in its effects, that all subjects are taught in form; this applies to every school and to every boy from the first to the last day of his career.

The education of a boy in secondary schools may proceed upon any one of three lines. It may be classical, semi-classical, or modern. For centuries Germany clung to a belief in the classical system for higher schools, but the force of circumstances eventually necessitated the formation of two new types of school, each designed to give a liberal education of a different kind. Yet the classical Gymnasium still holds its own (although there is no longer any very close attention paid to composition in Latin and Greek), for in 1908, of the freshmen who matriculated at Prussian universities, 77 per cent. came from Gymnasien, or classical schools.

The Realgymnasium, or semi-classical school, is differentiated from the Gymnasium by the fact that, while Greek is not taught at all, modern languages, mathematics, and science receive greater attention. The Oberrealschule is purely modern in its curriculum, and excludes both Latin and Greek. All three types have a nine years' course, usually begun at the age of ten, preceded by three or four years at an elementary or preparatory school, which is often attached to the college. All these schools are established by the State or by the State in conjunction with the municipality; their fees range between 5*l.* and 6*l.* per annum.

There are some to whom the principle upon which these schools are founded will appear to be radically false, however good may be the discipline and the organisation in its execution. As the main intention is to make it possible for a high percentage of the pupils to pass the leaving examination, practically the whole form has to be pro-

moted from one stage to the next, and the amount of work set for the form to master has to be small enough to be done by some of the more stupid boys in the given time. The inevitable result is that the ablest boys mark time from first to last throughout their school career. They have a year to do work which they could do in half the time, so that their powers are never developed by sustained or strenuous effort.

Individual excellence is sacrificed in yet another way, according to the second guiding principle of secondary education stated above. Since all subjects are done in form, a particular aptitude for a special subject is never developed at school. Our best boys in any given subject attain a far higher standard before they leave school than is possible in Germany. Yet by preventing the possibility of specialisation at school the German system ensures for every boy a sound general education. Every boy is compelled to take all subjects prescribed by the syllabus of his school. Only recently, and in isolated cases, has this rule been remitted in the highest forms by way of experiment.

At the university all this is changed. There is no prescribed course of studies of any kind, and no compulsory attendance. The German student enjoys almost complete liberty, both as regards his studies and his behaviour. Yet in the majority of cases he makes good use of his time, partly because his allowance will not admit of any vast extravagance, partly because his position in life frequently depends upon his passing the final examination, but chiefly, I think, because those Germans who go to the universities do so, for the most part, because they have pronounced and genuine intellectual interests. The freedom which they are allowed in the choice of their subjects, and the general lack of supervision and of interim examinations, react favourably upon the results of their work. They carry into life an active interest in some branch of knowledge, which they frequently pursue as long as they live.

The German Government is convinced that education will be the determining factor in the future of the nation. In 1908 the Prussian Minister of Education framed a whole new scheme of regulations intended to prevent mechanical learning and routine work, to foster self-reliance and personal initiative in the pupils of the elementary schools. Observation is to be encouraged in open-air lessons and expeditions, and the children are to learn something of the working of commerce in modern times, of the means of transport, and of Germany's colonial activity; and in continuation schools commercial education is being put within the reach of an ever-increasing number of students. In 1907 there were, moreover, 1600 industrial continuation schools for boys, and 50,000 students were working at rural continuation schools as compared with 8000 twenty years before. The State contribution for industrial continuation schools has been increased 100 per cent. since 1901.

Besides all this there has been a remarkable increase in Realschulen and Höhere Bürgerschulen with a six years' course, of which Prof. Sadler has given such a flattering account in special reports. In the technical colleges of university rank the increase in the number of students is almost as striking. Mention should also be made of the National Chemical Laboratory, for which a fund of a million marks is to be raised. The Prussian Government has offered a site for the building free of cost, and the results of its erection should be of world-wide importance. New academies of commerce have sprung up at Cologne, Frankfort, and elsewhere, and the Hamburg Colonial Institute is to be made into an establishment of university standard for those who intend to give their lives to colonial enterprise.

On turning to France we find, in a minor degree, two of the prominent characteristics which we noted in German education, first, a profound sense of the unique importance of education, and a serious effort in recent years to improve the existing system; secondly, that genuine intellectual interest which is imparted to pupils in the secondary schools.

As in pre-Reformation days, France is chiefly distinguished for its secondary and university education. *Primary education* is still in a lamentable condition, for the law of 1882, which made it compulsory, is practically a dead letter. Of four and a half million pupils, nearly one million were recently found not to be in attendance on a given day. The percentage of illiterates is even now increasing. M. Steeg, the chairman of the Budget Committee, in submitting the estimates for 1909, said:—"While in Germany and Switzerland there is not one illiterate in 200 inhabitants, in France, out of every hundred young men, four or five cannot read, and out of every hundred young women six or seven are absolutely illiterate." As a matter of fact (according to the Handwörterbuch für Staatswissenschaften of 1908), the number of illiterates in Germany was two in every ten thousand recruits, in France 400, while in England 300 out of every 10,000 people married were unable to sign the register. The alarm caused by the increasing illiteracy in France has led to severe criticism of the methods and scope of the instruction in primary schools. The main fault found with the official course of instruction is that it is too ambitious. *The higher primary schools*, intended for children between the ages of twelve and fifteen, are more satisfactory in their results, but they are few in number. There are also practical schools of commerce and industry, of which there were sixty in 1907, but they interfere with the general education of the children by taking them for practical training at the early age of twelve. Private enterprise has in recent years provided continuation schools, at which there were in 1907 half a million adult attendants, and these are at the present moment under the consideration of the French Government. The so-called *universités populaires*, for the spread of political and social theories, are on the decline.

Secondary education comprises the Lycées established by the State in conjunction with the municipalities, and the Collèges established by the *communities*. Following a preparatory course of two years, the Lycée course proper is divided into two cycles; the lower cycle covers four years, and comprises a classical course and a non-classical course; the upper cycle comprises three years. The programme for the first two of the three years is arranged in four parallel courses, as follows:—(*a*) classical course; (*b*) Latin and modern languages; (*c*) Latin and sciences; (*d*) sciences and modern languages. Following these two years is the class of philosophy and mathematics, each side comprising a classical and a non-classical section. The bachelor's diploma is awarded to students who complete either of the full secondary courses of instruction and pass the degree examination.

As regards universities in France, that of Paris stands out with great prominence. It is richly endowed, and receives from the State nearly five million francs per annum. It is a vast and excellent institution for teaching and research. Its library consists of about 580,000 volumes, and the most eminent scholars of the country are among its professors. In January of last year there were 16,935 students attending this great University, while the fourteen provincial universities were attended by only 18,000 students, and their income proper amounted to not more than two and a half million francs, besides two million francs from loans; but it is to be expected that the provincial universities in France will have a prosperous future before them, since the energy displayed in them and the work done by professors and students are of a high order.

Besides the universities, France possesses several special schools of university rank, all of which enjoy a great reputation, among them the Collège de France, the École Pratique des Hautes Études, the École Nationale de Chartes, and the School for Oriental Languages.

Impartial judgment of the French system of education reveals a great deal that is excellent, especially in secondary schools and at the universities. The progress made since 1872 is very considerable, though much yet remains to be done.

If the study of educational systems prevailing abroad is of special interest to us at the present time, it is because England's attention has been attracted by the commercial and industrial success of other nations which have long since held the conviction expressed by Signor Luzzatti at the scientific congress at Padua in September last in these words:—"The fate of nations is nowadays decided in their secondary schools." The belief that there may be some

truth in this bold assertion has rapidly gained ground among Englishmen who have the welfare of the nation at heart, and those who are directly interested in the severe competition in trade and commerce that has come with the enormous advances made by Germany and the United States in industrial and commercial enterprise. Although there are probably still a large number of Englishmen who have their doubts about this magic power of education, the experience of the last forty years and the revelations that have been made about other countries, together with the fact that foreign competition is felt to become a little uncomfortable, have made this educational question sufficiently urgent for the Government to take the matter in hand, and as a result we have a large department of the Government with a responsible Minister of Education at its head, and a most active Permanent Secretary, all hard at work to set our house in order.

The schools we require are (1) an elementary school with a modest and simple curriculum; (2) a municipal or county secondary school of the type of the German Realschule with leaving age sixteen, in which French, German, and English, elementary mathematics, and elementary science form the staple of education; (3) a modern school with leaving age nineteen, in which the same subjects are taught, but carried further, and in which Latin should be an alternative to one of the foreign languages; (4) a classical school, in which Greek, Latin, and English form the backbone of the teaching, and mathematics, science, French, and German hold a subordinate place. This type of school would naturally be one for the abler boys, for they alone can reap the full benefit of such a wide course, but I am convinced that they can cope with it successfully; those who cannot do so should be rigidly kept out of it. Boys of the modern and the classical school should be admitted to the universities after having passed through the top form and after passing a leaving certificate examination in the subjects of their curriculum. Scholars from the elementary school should pass on to the municipal or county or modern school at the age of ten, and there should be attached to the elementary school a technical or industrial department for boys who are apprenticed to a trade, which they should attend for two years—from fourteen to sixteen—as part of their period of apprenticeship. Such a school has recently been opened by the London County Council as a day technical school for boys in book production (printing, book-binding, &c.). A similar department might be attached to municipal or county schools for boys from sixteen to eighteen, in which, according to the locality, agricultural, commercial, or industrial subjects of a practical nature should be taught.

You may think that these ideas are Utopian; I do not; in fact, I am convinced that if the nation has the will the authorities will find the way, and, though it be a costly enterprise, I venture to say that England never made a better investment, not even in Dreadnoughts.

"Caveant consules ne quid detrimenti capiat res publica."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—The ordinary course of instruction given by Captain Lyons, F.R.S., lecturer in geography, has proved so successful that a higher or second-year course has been instituted in addition, with the approval of the Senate and Court of the University.

The annual meeting of the Institute of Metals will be held in Glasgow on September 21 and 22 in the natural philosophy building, which has been granted for the purpose by the University Court.

The principal has received intimation of a gift of 5000*l.* for the general fund of the University from the trustees of the late Alexander Fleming; and of a grant of 2000*l.* for the provision of additional lecturers and assistants in the faculty of arts from the committee for the better equipment of the University.

The first sod on the site of the buildings in Kelvingrove Park for the Scottish Exhibition of National History, Art, and Industry, 1911, was cut by Lord Tullibardine on April 22. The promoters of the exhibition have promised to present to the University a sum of 15,000*l.* from the profits for the foundation of a chair of Scottish history and literature. Meanwhile, Sir Herbert Maxwell, F.R.S., and Dr. William Wallace have been appointed university lecturers in Scottish history and Scottish literature respectively.

At the graduation on April 18 six graduates received the degree of D.Sc. for original research. One was a lady and one a Japanese naval architect. Thirty-one candidates were admitted to the degree of B.Sc.

Sir William MacGregor, who is a medical graduate of Glasgow, has been requested to represent the Senate at the semi-jubilee of the foundation of the Royal Geographical Society of Australasia, to be celebrated at Brisbane in June.

MR. J. A. SMITH has been elected to the Waynflete chair of moral and metaphysical philosophy in the University of Oxford, in succession to Prof. T. Case, who resigned last term.

THE committee of the Central Bureau for the International Interchange of Students (of which Lord Strathcona is the president and Lord Brassey the treasurer) has opened an office in Caxton House, Westminster, to facilitate educational travel for all university men, graduates or otherwise, with the view of assisting them to gain a first-hand knowledge of the life, needs, progress, and potentialities of other English-speaking countries. Travelling scholarships for undergraduates are being raised at nearly all the universities. They will be tenable this summer, and will provide a valuable educational tour of a practical character through Canada and the United States for students whose return to their own universities will allow for the dissemination of their widened outlook and inspiration among their contemporaries. Already a few of the scholarships are completed. The scholarship tours are intended to be of great educational interest, and to illustrate the more important spheres of activity—administration, the scheme of education, industry, social work, &c. The places at which stops will be made are chosen accordingly. Private persons who are prepared to conform to the rules made to govern the tours, and to defray their own expenses, will be allowed to join these tours. A number of university men, both staff and students, as well as non-resident graduates, are arranging to travel independently under the auspices of the bureau, which freely provides them with introductions, information relating to places offering the best facilities for the study of a given subject, and special rates of travel. The bureau aims at being a clearing house of information on education of a practical kind for students throughout the world; and among its more immediate objects are the promotion of a standardisation of work among the universities which would enable a student to take a part of his course in another university than his first Alma Mater. It desires to encourage a greater exchange for post-graduate work. The expenses of organising and conducting the scholarship tours are not inconsiderable, and further donations are needed. They should be sent to Lord Brassey. A sum of 1000*l.* has been offered conditionally on a further 6000*l.* being forthcoming. The various sums raised for scholarships will count towards this total, but donations to the central fund are necessary to enable the work to be effectually carried on. Further information will be readily given on application to the honorary secretary, Mr. H. W. Crees, at Caxton House.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 14.—Sir Archibald Geikie, K.C.B., president, in the chair.—E. N. da C. **Andrade**: The viscous flow in metals, and allied phenomena. These experiments on the flow of metals were carried out on wires, which were subjected to a continued constant stress. The increase of stress which takes place owing to thinning if the wire is stretched by a constant load was avoided by having the stretching weights made in the form of hyperbolæ of revolution, and letting them sink into water as the wire lengthened; the size of such a weight can be chosen so as to keep the load per unit area of cross-

section constant. The metals treated were lead and a lead-tin alloy; the general nature of the results was the same in both cases. When suitably loaded there is a rapid initial flow which gradually settles down to a steady flow, for which the rate per unit length of wire flowing is constant right up to breaking. Throughout the experimental range the extension can be represented closely by the formula

$$l = l_0(1 + \beta t^{\frac{1}{3}})e^{\kappa t}.$$

β is taken as a measure of the more rapid initial flow, which we call the β flow; κ as a measure of the coefficient of viscous traction. The curves κ/(stress) against stress are hyperbolæ with one asymptote parallel to, one steeply inclined to, the axis of stress. β tends to become constant as stress increases; for a series of experiments on lead done at 160° C. β tends to the same constant value as for the series done at room temperature. This supports the suggestion that β measures a definite physical effect, dependent on some geometrical structure. For the alloy the β flow is relatively very small.—Clive **Cuthbertson** and Maude **Cuthbertson**: The refraction and dispersion of argon, and re-determinations of the dispersion of helium, neon, krypton, and xenon. The refractive index of argon has been determined for seven points in the spectrum with improved apparatus, and careful re-determinations have been made of the dispersion of the other four inert gases in order to bring them all up to the same level of accuracy. The refractivities are expressed in the form

$$\mu - 1 = C/(n_0^2 - n^2),$$

and the constants of these equations, calculated from the observations by the method of least squares, are shown in the following table:—

Element	$C \times 10^{-27}$	$n_0^2 \times 10^{-27}$
Helium	2·42476 ...	34991·7
Neon	5·18652 ...	38916·2
Argon	9·43264 ...	17008·9
Krypton	10·6893 ...	12767·9
Xenon	12·2418 ...	8977·9

The values of the refractivities derived from these equations generally agree with those found experimentally to one or two points in the fifth significant figure. It is satisfactory to find that the values of n_0^2 now obtained by these more accurate measurements do not differ by more than 2 per cent. from those published by the authors last September. —Dr. J. O. Wakelin **Barratt**: The action of the radiation from radium bromide upon the skin of the ear of the rabbit. The ear of the rabbit was exposed to the action of the radiation from 1 mg. of radium bromide spread over a circular area of 7 mm. diameter, and the resulting pigmentation of the skin was studied. It was found that pigment was deposited most abundantly opposite the edge of the disc of radium salt. The deposit, when viewed under a low magnification, presented a characteristic reticular appearance. The larger spaces enclosed by the pigment, which were more or less polygonal, contained hair follicle groups, but the smaller spaces were free from hair follicles. A certain amount of pigment was also deposited in a diffuse manner, chiefly opposite, or a little outside, the edge of the disc. This, when marked, caused the reticular pattern to be somewhat obscured. The deposit of pigment was not quite uniform, but tended to take on a punctate character. Opposite the centre of the disc of radium salt a varying degree of depigmentation occurred, though at the same time here and there a small amount of pigment, arranged in an imperfect reticular pattern, could sometimes be recognised. The pigmentation was chiefly in the epidermis, the cutis vera being less affected. The depigmentation also affected both epidermis and cutis vera, but was, however, more striking in the latter than in the former. No change in the pigmentation of the hair shafts was observed. In a white rabbit the pupils of which presented a red reflex, prolonged exposure to the action of radium bromide caused the appearance of an exceedingly slight reticular deposit opposite the applicator. With this exception, all the rabbits employed had black or mixed black and white coats. Attempts were made to obtain pigmentation by the action of radium upon human skin, but were not successful.—Prof. Silvanus P. **Thompson**: A physiological effect of an alternating magnetic field. If in a darkened room, or with eyes closed, the head is placed in an alternating magnetic field of sufficient intensity, there is perceived over the whole region of vision a faint flickering illumination, colourless or of a slightly blue tint. The period of the flicker is not well defined. It does not seem to be the same over the whole field of vision at the same time, nor is it equally bright over the whole field of vision. Even in daylight, with the eyes open, one is conscious of a sensation of flicker superposed on the ordinary vision. It has not yet been definitely ascertained whether there is any relation between the direction of the axis of the field with respect to the position of the skull. No after-effects of any kind have been observed. The alternating magnetic field, the intensity of which (quadratic mean) was about 1000 C.G.S. units, was produced by sending a current of about 180 amperes through a coil of thirty-two turns formed into cylindrical form about 9 inches in internal diameter, the current having a frequency of fifty periods per second. No effect on the senses of smell, taste, or hearing has been observed. (Added April 14, 1910.—Several of the observers have noticed a sensation of taste after two or three minutes in the alternating magnetic field.)

Faraday Society, April 5.—Dr. J. C. Cain in the chair.—W. P. **Dreaper**: Nature of the action of dyeing. The abnormal reactions obtaining in the case of "ingrain" colours when the dye was produced *in situ*, as compared with the same dyeing effect when the same dyes are applied as direct dyes in relation to their subsequent resistance to resolution into solvents; the variations in the rate of fading of picric acid on different fibres under the influence of dehydrating reagents acting through a vacuum as compared with the equivalent action on the acid itself; the abnormal reactions obtained when the dyes of the indicator class (*e.g.* methyl orange) are subjected to the action of acids in the presence of fibre substances; the variations in resolution of the dyes from the fibres brought about by differences in temperature of dyeing; all these were, it was claimed, proof as to the important influence of certain factors in determining the fixing power of the fibres for dyes, this varying as the conditions of dyeing. It was also pointed out that the dyes were definitely fixed in some way on animal fibres, so that they might even resist the subsequent action of acids, as proved by these colour changes.—Prof. W. W. Haldane **Gee** and W. **Harrison**: The electrical theory of dyeing. The literature relating to the causes of dyeing reveals great differences of opinion as to the physical and chemical phenomena involved. The basis of the electrical theory is that when any two bodies are placed in contact they are oppositely electrified. In the case of tinctorial chemistry, one of the bodies is a non-conducting solid and the other a liquid. There does not seem to be any direct method of obtaining the value of the potential difference between such bodies. The authors avail themselves of the classic theory of von Helmholtz, which enables the potential difference between a liquid and a porous diaphragm to be deduced. They have determined the nature of the charge on the particles in suspension and in colloidal solution, and find that in water all basic substances are positive, the hydrochlorides of basic dyes positive, all acid substances negative, and most neutral substances negative. They find the speed of the particles under electrical stress to be of the order 20×10^{-5} cm. per second, per volt, per cm. Negatively charged particles attain their maximum speed at about 40° C. By measuring the difference of electrical pressure between the two sides of a diaphragm when the liquid is filtered under mechanical pressure, the authors find the approximate value of the contact difference between fibres and water to be:—cotton, 0·06 volt; silk, 0·22 volt; wool, 0·90 volt. The influence of temperature shows a maximum charge at about 40° C., and a minimum at about 80° C.

Linnean Society, April 7.—Dr. D. H. Scott, F.R.S., president, in the chair, succeeded by Mr. H. W. Monckton, treasurer and vice-president.—A. **Henry**: Elm seedlings showing Mendelian results. There are but two species of elm in Britain, *Ulmus montana*, With., and *U. glabra*, Mill.; both are known in the east of England as "Wych-elm." There are, in addition, many so-called varieties, the most remarkable being the "English elm" of British botanists and foresters, confined to the south of England,

and styled *U. campestris*; this tree is unknown on the Continent. The "Huntingdon elm" he regarded as a hybrid, the first cross between the two species cited. The previous year had been noteworthy for the profuse fruiting of every kind of elm in England, due to the fine autumn of 1908 and the abnormal amount of sunshine during the spring of 1909. The author had procured abundance of seeds of numerous varieties and forms, and from many localities. These had been sown, and their progeny analysed. It was shown that the plants thus arising conformed very closely to the Mendelian formula of 9 : 3 : 3 : 1. The author gave, in confirmation of his views, the experience he had with regard to the black Italian poplar, *Populus nigra*×*deltoidea*, the cricket-bat willow, *Salix alba*×*fragilis*, and the Luccombe oak, *Quercus Cerris*×*Suber*, namely, that the offspring of a first cross invariably produced a crop of the most diverse character, and this induced the author to formulate his view, that when botanists were unable to agree about the forms of a given plant, it was due to a mixture of at least two species, but where there was practical unanimity, as with varieties of beech and ash, there was only one species concerned, and the varieties were due to individual peculiarities. He finally insisted upon the importance of planting trees of a first cross, on account of their abnormal luxuriance and rapid growth, and their producing timber far more quickly than either parent.—F. **Chapman**: The Foraminifera and Ostracoda from soundings, chiefly deep water, collected round Funafuti by H.M.S. *Penguin*.

Physical Society, April 8.—Prof. H. L. Callendar F.R.S., president, in the chair.—B. S. **Cohen**: Demonstration of telephone currents in loaded and unloaded lines. The demonstration showed the relationship between the sent and received currents in telephone lines under the various conditions which occur in practice. By the aid of Prof. Kennelly's formulæ it is possible to calculate the relationship between the sent and received currents under any conditions met with in practice, and for some of the conditions used in the demonstration the calculated results had been obtained. Four essentials were necessary for the experiments shown:—(1) A current comparable to the actual telephonic speech current. This was obtained from a vibrating wire interrupter giving a wave with a fundamental of about 100 ~ per second with a damped oscillation of about 800 ~ per second superimposed. (2) A telephone line with or without its load in the shape of inductance coils. (3) Terminal apparatus. The lines were terminated by receivers and induction coils as used in practice for what is known as local battery working. (4) Current measurers. For this purpose barretters arranged as alternating-current ammeters were used. The first experiment showed the relationship between the received and sent current for various lengths of standard cable unloaded. The second experiment illustrated the variation in the current sent when the receiving end was open or closed circuited and the length of cable was varied. The third experiment showed the current distribution along the loaded cable by inserting a barretter at different points along the cable. The author gave explanations of the various phenomena illustrated in the experiments. He pointed out that it is now possible to make both calculations and quantitative telephonic tests which give mutual confirmation.

PARIS.

Academy of Sciences, April 11.—M. Émile Picard in the chair.—G. **Bratu**: Certain non-linear integral equations.—Paul **Lévy**: Non-linear integral equations.—B. **Galitzine**: The vibration of buildings. Gas engines, not perfectly balanced, and running at a high velocity, have been found to set up vibrations in the surrounding buildings which were not only unpleasant to the inhabitants, but gave rise to dangerous cracks in the masonry. The ordinary seismograph is not suitable for studying this class of vibration, so that an instrument has been specially designed for this purpose. A description of the instrument is given, and the theory of its working.—M. **Dussaud**: Sources of light with reduced surfaces employed normally or obliquely. Movable sources of light. Practical applications.—F. **Charron**: The lubricating action of air in the friction of solids. Friction in a vacuum. An apparatus is described capable of measuring the critical speed at which the friction of two surfaces is a minimum. By placing the apparatus in a vacuum it was shown that, as the pressure of the air was reduced, the friction varied less and less with the speed. At a pressure of 1 mm. the friction was nearly independent of the speed.—E. **Haudié**: The general law relating to a generator or a receiver with a derived branch: the case of dynamos.—C. E. **Guye** and A. **Tscherniavski**: The measurement of very high potentials by means of an electrometer under pressure. By placing the electrometer in air under a pressure of four to nine atmospheres, the errors due to the silent or brush discharge and electric breeze were suppressed. The constant of the apparatus was nearly independent of the pressure of the gas, and the damping was easily under control. A potential of 80,000 volts from a Wimshurst machine was readily measured with this arrangement.—G. **Urbain**: The magneto-chemical analysis of the rare earths. The magnetisation coefficients vary more rapidly than the atomic weights in the rare earths, and the measurements are much more easily made. The results of the application of the method to the separation of a mixture of dysprosium and yttrium are given.—W. **Louguinine**: The determination of the quantities of heat disengaged during the addition of bromine to some unsaturated substances. Data are given for the heat of combination of bromine with caprylene, styrolene, cyclohexane, ethyl phenylpropiolate, and pulegone.—E. **Kohn-Abrest**: The nitrides and oxides extracted from aluminium heated in air.—L. **Grenet**: The cementation of silicon steels. Silicon steels which do not undergo cementation in wood charcoal can be readily cemented by the use of prussiate of potash.—M. **Vournasos**: The reducing action of alkaline formates on certain mineral compounds. Boron nitride heated with an alkaline formate gives off a mixture of hydrogen, ammonia, and boron hydride. The proportion of the latter compound may amount to 1·5 per cent.—Léo **Vignon**: The phenomena of electric transport in solutions of certain colouring materials. Transportation phenomena are very clearly produced with the colloidal solution of several dyestuffs, proving the presence of undissolved granules carrying appreciable electric charges. With colouring matters in true solution these effects are not produced.—E. **Darmois**: Artificial camphor. It is possible to prepare both the dextro and lævo optically active forms of synthetical camphor.—F. **Couturier**: The condensation of pinacoline with its esters.—Jacques **de Lapparent**: The basic rocks of Saint-Quay-Portrieux (Côtes-du-Nord) and their relations with the pegmatite lodes which traverse them.—Victor **Henri**, André **Helbronner**, and Max **de Recklinghausen**: The sterilisation of large quantities of water by the ultra-violet rays. The arrangement of lamps described is capable of sterilising water on the large scale with an expenditure of 36 watt-hours per cubic metre of water treated.—Ch. **Dhéré** and M. **Gorgolewski**: The preparation of demineralised gelatin and some of its chemico-physical properties. Two methods of purification have been used, dialysis and freezing. The gelatin thus obtained is practically free from ash. It forms jellies, but less well than when electrolytes are present. Between certain limits of concentration solutions of this highly purified gelatin are opalescent, this opalescence disappearing on adding traces of alkali.—H. **Stassano** and A. **Daumas**: The double *rôle* of calcium in the coagulation of blood and lymph.—M. **Weinberg**: The influence of feeding on the production of spontaneous atheroma.—Ph. **Glangeaud**: Archæn formations in the Forez mountains.—Wilfrid **von Seidlitz**: The crushed granites (mylonites) of the Grisons, the Vorarlberg, and the Allgäu.—J. **Thoulet**: Marine sediments of atmospheric origin.

CAPE TOWN.

Royal Society of South Africa, March 16.—Mr. S. S. Hough, F.R.S., president, in the chair.—Dr. R. **Marloth**: Some new South African succulents. Among the new species are some of special biological interest. *Mesembrianthemum mitratum* was discovered in the desert belt east of Port Nolloth by Mr. Garwood Alston. The shrub bears at the end of the apparently dead branches a fleshy knob. This consists of two closely joined leaves, between

which the flower appears. Flower and fruit are then fed by the sap of the knob until fully developed, when nothing is left of the sheltering knob except its skin. Another species of Mesembrianthemum takes the same care of its flower and fruit, nursing them within its own body; but it is even more cautious than its big brother, for it buries itself entirely in the ground and shows only the apex of its few leaves. As the ends of the leaves are flat, flush with the ground, and coloured exactly like the rusty gravel, it is practically impossible to detect them when they are not in flower. *Euphorbia elastica* is the species from which some sort of rubber has been manufactured in Little Namaqualand, and, although the quality was not good, it is not impossible that, with the present boom in rubber, even those barren deserts may see a flourishing industry.—R. A. **Lehfeldt**: Variation of gravity. There have been differences of opinion as to the way in which the value of gravity is affected by height above sea-level, and special interest attaches to measurements on a really large tableland. The result of observations taken at Johannesburg and Vereeniging is that the variation per metre is 0·000236, considerably less than that given by Helmert.—W. T. **Saxton**: The ovule of the Bruniaceæ. The main point brought out in this paper is that the ovule in the Bruniaceæ is pendulous and anatropous, with a dorsal raphe. There is a simple massive integument with a long slender micropyle.—R. **Brown**: *Chrysochloris namaquensis*, Brown. *Chrysochloris namaquensis* was named from skulls found at Garies in the disgorged pellets of owls. A description is now given of the skin. A remarkable feature of the species is that the third molar is about as frequently absent as present.

DIARY OF SOCIETIES.

THURSDAY, APRIL 21.

ROYAL SOCIETY, at 4.30.—The Incidence of Light upon a Transparent Sphere of Dimensions comparable with the Wave-length: Lord Rayleigh, O.M., F.R.S.—On the Improbability of a Random Distribution of the Stars in Space: Prof. Karl Pearson, F.R.S.—The Total Ionisation produced in Different Gases by the Kathode Rays ejected by X-Rays: Dr. R. D. Kleeman.—Tone Perception in *Gammarus pulex*: Prof. F. J. Cole.

ROYAL INSTITUTION, at 3.—The Himalayan Region: Dr. Tom G. Longstaff.

CONCRETE INSTITUTE, at 8.—The Effect of Sewage and Sewage Gases on Portland Cement Concrete: S. H. Chambers.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Hydro-electric Installations of Sweden: A. V. Clayton.

ROYAL SOCIETY OF ARTS, at 4.30.—The Arts and Crafts of Tibet, and the Eastern Himalayas: J. Claude White.

ROYAL GEOGRAPHICAL SOCIETY, at 4.30.—Dewponds: E. A. Martin.

LINNEAN SOCIETY, at 8.—The Seedling and Adult Anatomy of *Welwitschia mirabilis*: Miss M. G. Sykes.—Anthomyidæ auf den Seychellen gesammelt: Prof. P. Stein.—The Dermaptera of the Seychelles: Dr. Malcolm Burr.—The Pteropoda and Heteropoda collected by the Percy Sladen Trust Expedition in the Indian Ocean: Dr. J. J. Tesch.—Die Pilzmücken Fauna der Seychellen: Dr. G. Enderlein.

OPTICAL SOCIETY, at 8.—Historical Exhibit of Spectacles: E. C. Bull.—Abrasives and Polishing Materials: Dr. W. Rosenhain.

FRIDAY, APRIL 22.

ROYAL INSTITUTION, at 9.—The Telegraphy of Photographs, Wireless and by Wire: T. Thorne Baker.

PHYSICAL SOCIETY, at 5.—Further Tests of Brittle Materials under Combined Stress: W. A. Scoble.—The Magnetic Balance of Curie and Cheneveau: C. Cheneveau with A. C. Jolley.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The History and Present Method of Quay-wall Construction at the Port of Rotterdam: H. C. A. Thieme.

SATURDAY, APRIL 23.

ROYAL INSTITUTION, at 3.—Bells, Carillons and Chimes: W. W. Starmer.

MONDAY, APRIL 25.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Aldabra and Neighbouring Islands in the South-west Indian Ocean: J. C. F. Fryer.

ROYAL SOCIETY OF ARTS, at 8.—Modern Methods of Brick-making: Dr. A. B. Searle.

INSTITUTE OF ACTUARIES, at 5.—Analysis and Apportionment of the Expenses of Management of a Life Office with a view to ascertaining the Office Premium Loadings: H. J. Rietschel.

TUESDAY, APRIL 26.

ROYAL INSTITUTION, at 3.—The Mechanism of the Human Voice: Prof. F. W. Mott, F.R.S.

FARADAY SOCIETY, at 8.—Is Water an Electrolyte? Prof. P. Walden.—On the Nature of Molecular Association in the Special Case of Water: Prof. Ph. Guye.—Liquid Water a Ternary Mixture. Solution-volumes in Aqueous Solutions: W. R. Bousfield and Dr. T. M. Lowry.—The Specific Heat of Gaseous, Solid, and Fluid Water: Communications from William Sutherland and Prof. W. Nernst.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Mythology and Superstitions of the Lengua Indians of the Paraguayan Chaco: Rev. H. T. Morrey Jones.

INSTITUTION OF CIVIL ENGINEERS, at 8.

WEDNESDAY, APRIL 27.

GEOLOGICAL SOCIETY, at 8.

ROYAL SOCIETY OF ARTS, at 8.—Irish Linen and some Features of its Production: Sir William Crawford.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, APRIL 28.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Rotatory Character of some Terrestrial Magnetic Disturbances at Greenwich and on their Diurnal Distribution: R. B. Sangster.—The Chromophil Tissues and the Adrenal Medulla: Prof. Swale Vincent.—The Liberation of Helium from Minerals by the Action of Heat: D. O. Wood.

ROYAL INSTITUTION, at 3.—Blackfeet Indians in North America: Walter McClintock.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Earthed *versus* Insulated Neutrals in Colliery Installations: W. W. Wood.

MATHEMATICAL SOCIETY, at 5.30.—The Accuracy of Interpolation by Finite Differences: Dr. W. F. Sheppard.—Note on Maclaurin's Test for the Convergence of Series: G. H. Hardy.

FRIDAY, APRIL 29.

ROYAL INSTITUTION, at 9.—Matavanu: a New Volcano in Savaii (German Samoa): Dr. Tempest Anderson.

SATURDAY, APRIL 30.

ROYAL INSTITUTION, at 3.—The World of Plants before the Appearance of Flowers: Dr. D. H. Scott, F.R.S.

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