THURSDAY, NOVEMBER 22, 1900.

THE CORRESPONDENCE OF BERZELIUS AND SCHÖNBEIN.

The Letters of Jöns Jacob Berzelius and Christian Friedrich Schönbein, 1836–1847. Edited by Georg W. A. Kahlbaum. Translated by Francis V. Darbishire, Ph.D., and N. V. Sidgwick. Pp. 112. (London, Edinburgh and Oxford, Williams and Norgate, 1900.)

IN collecting materials for the life of Schönbein, the first instalment of which has already been noticed in these columns, Dr. Kahlbaum has had placed at his disposal all the correspondence, covering nearly fifty years, left behind him by the illustrious discoverer of ozone and gun-cotton. The letters of Faraday and Liebig have thus been made public, and we have now an English edition of the letters which passed between Berzelius and Schönbein, the original edition in German having been prepared by the editor as a tribute to the memory of Berzelius on the occasion of the commemoration at Stockholm, on October 9, 1898, of the fiftieth anniversary of the death of the great Swedish chemist. The translators have added two of Schönbein's letters written in 1847, and a paper by that author which was not included in the German edition. Of the twenty-two letters published in this little volume eight are by Berzelius.

Berzelius was senior to Schönbein by twenty years, and it appears that the latter had about 1827 resolved to go to Stockholm to complete his studies under the "consummate master of chemical science." In order to raise the necessary funds he offered a London bookseller (Koller) a translation of Berzelius' "Lärbok i Kemien," and about the same time he proposed to a German acquaintance (Perthes, of Gotha) to supply a German translation of Gay-Lussac's lectures on physics, which he was then attending at the Sorbonne. Neither of these schemes came to anything, and Schönbein was, as already recorded in his life, invited to Bâle as temporary professor in 1828. The Swabian chemist thus never came under the personal influence of his Swedish contemporary as a pupil, and the acquaintance was commenced in 1836 by a letter, in which Schönbein submitted the results of his experiments on the passivity of iron. In this letter, which is the first of the present series, he describes himself to Berzelius as "a perfect stranger." The reply, dated May 4, 1837, is interesting, not only because it is the first communication from Berzelius, but also because it at once emphasises the difference of opinion which at that time separated the two schools of "contact" and "chemical" electricians. Having suggested that the iron by contact becomes charged with opposite electricity, he goes on to say:

"But of course you cannot admit the latter assumption, since you accept De la Rive's view that electricity of an opposite character cannot be produced by contact. In this, however, I do not agree with you; I am firmly convinced that when we understand the cause of this remarkable property of iron, we shall find in it one more proof that Volta's conception was more profound and nearer the truth than that of his opponents, who, by admitting that electricity and chemical affinity are different manifestations of the same force, acknowledge, though without being conscious of so doing, that Volta was right."

In subsequent letters the prevailing note of the correspondence is still the origin of the electric current and the cause of polarisation. In his letter of October 14, 1838, Schönbein describes the polarisation of liquid electrodes (hydrochloric acid) in a U-tube, and suggests in explanation that the first step in the decomposition of a molecule by electricity is, as it were, a preliminary loosening of the affinities of the atoms:—"Between the complete separation of two elements and their most intimate chemical union there exist intermediate conditions of combination, of which as yet we know nothing; unless indeed isomerism points to some such relation." Berzelius (November 13, 1838) opposes this view, and refers his correspondent to a theory of the galvanic cell which he had advanced thirty-six years previously. The reference to this theory has apparently given the editor, Dr. Kahlbaum, some trouble, but he appears to have identified it and appends a valuable bibliographical footnote. Schönbein's reply (March 28, 1839) contains further arguments against what he calls the "electrochemical theory," meaning, of course, the form of that theory promulgated by Berzelius. He sums up in the statement that "the act of chemical combination of the elements is not due to the play of electrical forces, or, in other words, that affinity and electricity are not the same thing, though they are mutually dependent."

The first reference to ozone in the present correspondence is contained in a letter from Schönbein to Berzelius dated September 11, 1840, in which he refers to the "odoriferous principle" as having already been discovered but not isolated in sufficient quantity to determine its chemical characters. The reply to this communication, of which a copy by Schönbein has been found, was kept by the Crown Prince, subsequently King Maximilian II. of Bavaria, under somewhat interesting circumstances. It appears that the first paper on ozone had been sent by Schönbein to Prof. Schelling, who was then at Munich, and the latter in his reply says:

"In the person of our Crown Prince we possess a distinguished patron of research, especially on scientific lines. Should you ever be unable from want of pecuniary resources to begin a lengthy research, from which you have grounds for expecting good results, let me know, and it will give me great pleasure to awaken the interest of our generous Prince on your behalf."

On the strength of this recommendation Schönbein applied for a grant in order to purchase a battery; but unfortunately the application was received by the Prince just as he was leaving for Greece, and he took the correspondence, including the letter from Berzelius referred to above, away with him, so that nothing resulted from the application.

Passing on to the year 1844, there is a very long letter addressed to Berzelius and containing a fairly complete *résumé* of Schönbein's work on ozone down to that period. It is of interest to read that he sends his correspondent the bleached strip of paper which first "proved the bleaching power of the electrical odour" on April 7, 1844. In this letter also we find the view that nitrogen is a hydride of ozone, and, in curious antithesis to existing

notions, that "certain diseases might be due to ozone." The reply from Berzelius is chiefly remarkable for the cogency of the reasons which he urges against the view that nitrogen is a constituent of ozone, and the friendly spirit in which he urges Schönbein to follow up his investigation "with true Bunsen perseverance."

The letter from Schönbein dated January 15, 1845, contains an account of the production of an "electro-negative oxidising substance" by the slow combustion of ether vapour and phosphorus, by a hydrogen flame and by a candle flame. This was read to the Academy at Stockholm, and Berzelius in his reply considers his correspondent to have proved that ozone is always formed during combustions in atmospheric air. He then goes on to criticise most frankly some of Schönbein's conclusions in a detailed paper published in 1844, he makes excellent suggestions for testing certain points experimentally, and winds up with the remark :—

"It would, therefore, be better to put on one side all theoretical conjectures as to the constitution of ozone and nitrogen, and to study the properties of ozone itself. When once you have caught it, it will be easier to theorise about it."

In his reply Schönbein explains that much of his correspondent's criticism had arisen from the misrepresentation of his views owing to the bad rendering of his paper into French, but he candidly and gratefully accepts the remainder. He still clings, however, to the possibility of nitrogen being a compound, and adds a remark to the effect that even if this hypothesis were baseless, it had guided him in all his experiments and had led him to many discoveries.

A letter of Schönbein's dated March 22, 1845, is of particular interest from several points of view. It was communicated by Berzelius to the Stockholm Academy, together with another letter from Plantamour, of Geneva, which contained a description of Marignac's first experiments and conclusions respecting ozone. Schönbein in his letter refers also to the work of his friend Marignac, and describes the results to Berzelius. He considered that his and Marignac's experiments confirm one another, and he adds :—

"I think we may fairly conclude from them that oxygen and hydrogen are the constituents of ozone."

Thus he had by that time abandoned the view that nitrogen had anything to do with ozone, and it is quite exciting, even at the present time, to read in this letter how near he was to the explanation of the true nature of ozone, and yet how he missed the path. He gives convincing reasons for believing that ozone and Thénard's hydrogen peroxide were distinct, and he proves by experiment that ozone is destroyed by passing through a hot tube. Yet it seems to have been first suggested by Plantamour, in a letter to Berzelius dated April 20, 1845, that ozone was not a compound, but only a form of oxygen, although in the paper printed as an appendix to the present volume Schönbein speaks of this view as having been originated by De la Rive.

The subsequent letters teem with interest especially when, as in that dated June 20, 1846, the practical applications of gun-cotton begin to figure in the correspondence. The King of Sweden, at the instigation of Berzelius, sent Schönbein the Vasa Medal in February, 1847. On March 12 of that year Berzelius addressed a long letter to Schönbein full of the most friendly and candid criticism of his views on the chemical nature of nitric acid and ozone. From this it appears that Schönbein still believed that ozone contained hydrogen, for his correspondent says :—

"But does ozone really contain hydrogen? This question we can answer most emphatically in the negative. If oxygen gas collected during the last third of its evolution from potassium chlorate be exposed to a series of short electric sparks, ozone is formed just as readily and to precisely the same extent as during the first third of the operation. In this case, however, it is physically impossible for water to be present. This constitutes the most indisputable proof that ozone does not contain hydrogen. Hence it follows that ozone is an allotropic modification of oxygen itself, &c."

The criticisms in this letter are altogether very vigorous, and Berzelius lays down a principle at the outset of his attack which it would have been well to have kept in view in many "modern instances" of theorising :—

"The test of the truth of a theory is that it should harmonise the particular instance with the whole system of science ; for the laws of nature are always consistent with one another. Now if you advance a principle which makes an exception of what was before consistent with scientific ideas, logic pronounces against you."

He concludes by begging his correspondent to excuse his preaching, and hopes he will not refuse to learn. It is, no doubt, only a coincidence, but this, the last letter from Berzelius, is the only one in which the Swedish chemist winds up with the subscription, "Farewell, yours sincerely." The reply by Schönbein, dated March 29, 1847, contains a further defence of his views concerning the nature of ozone and nitric acid, and begs in conclusion for a letter from Berzelius stating that he (Schönbein) was the first discoverer of gun-cotton. He had patented this explosive in England, and says that his patent "will undoubtedly be contested."

Berzelius died August 7, 1848, and the editor has discovered a short sketch of an obituary notice by Schönbein which was apparently never published, but which had been hastily written on a sheet of paper partly covered by the draft of a letter to Faraday. The position occupied in the world of science by the illustrious Swede needs no further definition at the present day, but this short estimate of his achievements by his contemporary Schönbein will still be read with interest.

We have once again to express our obligations to Dr. Kahlbaum and his colleagues for a remarkably interesting little contribution to the history of chemistry.

R. MELDOLA.

SOME OBSERVATIONS ON ANIMAL HYPNOTISM.

Beiträge zur Physiologie des Centralnervensystems. Von Max Verworn, a.o. Professor an der Universität Jena. Erster Theil. Die sogenannte Hypnose der Thiere. Pp. iv + 92 ; and 18 figures. (Jena : J. Fischer, 1898.)

THIS volume by Prof. Verworn, on the phenomenon of so-called hypnotism in the lower animals, is a clear and exhaustive account of the subject. Paucity

of knowledge renders the theme one very limited for scientific treatment. During the past two and a half centuries, various inquirers into nature, from Daniel Schwenter and the Jesuit Father Kircher onwards, noted that by handling animals it is possible to impose upon them postures. Though strained, these are for a time maintained after release from the hands of the "operator." This "animal plasticity" recalls the plasticity of the human subject in the cataleptic phase of hypnosis. In human hypnosis, however, the cataleptic rigidity is only one, and not the most striking, of a set of concurrent symptoms contributing to make up the hypnotic state. Abeyance of will, ultra-sensitivity of the senses, contraction of the field of attention with substitution of passivity for activity, appropriate response to complex sensorial stimuli of the organs of vision and hearing, execution of acts resembling those of volition, paralysis of memory, all these characters of hypnotism predicate a mental organisation much higher than can be attributed to the majority of creatures in which the so-called "animal hypnotism" can be induced. These remain, therefore, almost without counterpart in "animal hypnotism." If it is permissible to speak of "will" in dealing with neural types so far removed from human as those of the crayfish and the amphibian, there does occur in animal hypnotism what resembles suspension of "willed" action. The animal remains motionless for long periods in postures which it has been constrained to assume. The guinea-pig is, as regards neural organisation, the highest type in which the phenomenon has been at all systematically studied. Both cat and dog are reported "refractory." It is true a condition characterised by cataleptoid plasticity has been observed in the monkey subsequent to extirpation of its cerebral hemispheres. The animal then enters a peculiar state known as "decerebrate rigidity," of which a spastic contraction of the extensor muscles of the limbs and trunk is characteristic. That this condition in the monkey is allied to that termed "animal hypnotism" is strongly suggested by the fact that, as Heubel first showed, the induction of so-called hypnotism in the lower types is favoured by decerebration, and the plasticity is more pronounced in decerebrate than in intact animals.

Prof. Verworn has succeeded in obtaining graphic records of the contraction of the implicated muscles during their condition of tonic rigidity. He notes that the constrained postures in which the rigid animal remains are all of them attitudes assumed in attempt at recovery of the normal from an abnormal posture, *e.g.* in attempt to right itself after being placed over on its back. When the creature breaks from the spell its escape is usually sudden. Those muscles, then, that have been in tonic contraction do not relax, but by contracting further complete the execution of the movement toward which the posture was an approach.

The long continuance of the hypnotic tonic contraction leads Prof. Verworn to conclude that there must, during its course, become established in the nerve-cells and muscle-cells an equilibrium between assimilation and dissimilation. This instance induces him to sketch the theory of the chemical exchanges involved in cell-life. The cell must, as a chemical machine, be able to live and work at various rates all equally without exhaustion. A faster rate of liberation of energy by decomposition of the molecules is met by faster replenishment of energy by the synthesis of new molecules. The author speaks of the functional activity of the cell in relation to its metabolism as "biotonus," *e.g.* the biotonus of the nerve-cell. The Jena school of physiology is so closely associated with the teaching of the elder Hering, to whom we owe the theory of assimilation and dissimilation as colligate functions of protoplasm, that no doubt the sketch given by Verworn is not intended to challenge comparison with Hering's essays. It is probably intended to fall into place as an item toward the general promulgation of Hering's fundamental doctrine; this it does, though the exact application of the theory to the as yet insufficiently analysed phenomenon of animal hypnotism is not so definite as that of some other examples that could more easily have been found.

The volume is altogether an interesting one. It is considerably enhanced in value by thirteen excellent figure photographs from nature of animals in the condition of the so-called "hypnosis." C. S. S.

OUR BOOK SHELF.

Memoranda of the Origin, Plan and Results of the Experiments conducted at Rothamsted; Fifty-seventh Year of the Experiments, 1900. (Issued by the Committee.)

THE history of this publication is worth noting. It first appeared in 1855, the year of the opening of the new laboratory at Rothamsted, and was issued for the use of the numerous visitors to the experiments; it then consisted of four pages, giving the last year's produce on some of the experimental fields, and the scheme of cropping and manuring of the other fields on the farm. The next issue was in 1862, when the average produce on each plot was given. For some years it was not published annually, but supplements were from time to time issued. Annual publication commenced in 1872. In 1878, a preface giving an account of the origin and scope of the Rothamsted experiments was added, with a list of the papers already published. But little alteration in its character has since taken place, though the additions have been considerable. The present volume contains 120 pages, and supplies plans of the experimental fields.

The "Memoranda" do not furnish a report of the work done at Rothamsted by Messrs. Lawes and Gilbert, except so far as this is shown by the preface reprinted each year, and the lists of papers. The pages are mostly occupied by a mass of figures, showing the manuring, and the average produce on each experimental plot with the produce of the last year. There are also tables giving some particulars of the chemical composition of the sugar beet, mangel wurzel, and potatoes grown by various manures. There is little or no discussion of the numerical results recorded, but most of the sections begin with some remarks elucidating the general character of the experiment next described.

As the produce yielded by nearly every experimental plot is annually published in these "Memoranda," the record is one of great value to the student, especially if he has at his disposal a complete series of the earlier issues. When thus furnished he is able to study the results of the experiments in a very thorough way, having a complete up-to-date record to work on. Unfortunately, however, this is just the kind of publication which is seldom saved and bound for reference, and it is doubtful if many complete sets now exist.

The tables of the "Memoranda" are little suited for the use of the popular writer, and sad mistakes are

sometimes made by the agricultural press in their quotations from them. This is generally due to the alterations in the manures on some of the plots during the long course of the experiments, the average produce of the plot given in the table thus sometimes bears no relation to the manure which the plot is now receiving. In the summary tables now separately printed for the use of visitors to the fields these errors are avoided by calculating the average produce for those periods only to which the present manuring applies.

A melancholy interest attaches to the present issue of the "Memoranda" as being the last with which Sir J. B. Lawes, the founder of experiments, will be personally connected. R. W.

The Scenery and Geology of the Peak of Derbyshire. By Elizabeth Dale. Pp. viii + 176. (Buxton: C. F. Wardley. London: Sampson Low and Co., Ltd., 1900.)

THE main object of the author, who is Pfeiffer student of Girton College, Cambridge, "has been to give a simple account of the geology of this most interesting district, treating this limited subject in such a way as will make it possible for the book to serve as an introduction to the study of the science." That this purpose has been carried out in a thorough and praiseworthy manner will not be questioned. Miss Dale is well acquainted with the district; she has herself contributed to our stock of knowledge, and has gathered other information from the best authorities. The country of the Peak is attractive to lovers of scenery as well as geological students; and a handy volume which tells as this does of the numerous fine sections, of good localities for fossils, of the origin of the physical features and of the caverns and their varied contents, is sure to be appreciated. We doubt, however, the wisdom of introducing so much general geology in what is essentially a local guide. It would have been enough to point out the lessons to be derived from the rocks in the district without dealing with other matters, such as the nebular theory, or the growth of geology and its relation to modern thought. Those who reside in Derbyshire, and have no other geological books, may be glad to have such full information; but those who want only the local facts, and explanations of them, will not be so pleased. The work throughout bears evidence of painstaking research, and we notice very few errata. The book has a somewhat provincial aspect in its "get up;" some groups of illustrations, when they occupy a whole page in the text, are notified as plates, while, curiously enough, Plate vii. is placed before Plate vi. There is a well-printed and clear geological map of Buxton and neighbourhood; but it ends off in the middle of Kinderscout, which is marked on the map as "The Peak." The pictorial illustrations are fairly good; they would have been excellent if well printed.

Malaria. By Angelo Celli, Director of the Institute of Hygiene, University of Rome. Translated by John Joseph Eyre, with an introduction by Dr. Patrick Manson. Pp. xxiv + 275. (London: Longmans and Co., 1900.)

SINCE Laveran's great discovery of its parasitic nature, war has been waged with ever-increasing vigour against malaria, and Italy has always been in the forefront of the battle.

The fortunate combination of an ample supply of material and men capable of taking advantage of it has resulted in great and important additions being made to our knowledge of the fever and its etiology.

Among the Italian workers Prof. Celli is one of the most prominent, and the present volume, founded on a recent course of lectures delivered in Rome, gives us a cursory glance at much of the work on which his eminence is based.

By dealing, as he does here, only with the malaria fevers of the Roman Campagna, Prof. Celli loses nothing in interest, for though we agree with him when he says malaria is a local phenomenon which must be studied on the spot, and data gathered in a particular territory cannot be generalised, yet a book that will enable English readers to readily acquire a succinct and fairly complete knowledge of the recent progress towards the elucidation of the malaria mystery cannot fail to be gladly welcomed.

The lectures contain necessarily much that is true without being new, and the information, though sound on the whole, is on some points rather scanty. This is specially true of the description given of the various mosquitoes responsible for Roman malaria; the information on this point is slender and quite inadequate for the identification of species. The bionomics of the mosquitoes are also insufficiently detailed, and several important points are omitted. No mention is made of the peculiar attitude assumed by Anopheles when at rest, nor is the tendency of Culex to lay their eggs in artificial receptacles of water noticed.

It is, moreover, inaccurate to say that mosquitoes live only in low-lying places. In British Central Africa they have been found at an altitude of several thousand feet.

One of the best parts of the book is that which deals with the local or physical causes of predisposition or of immunity, and it will be seen how remarkably it agrees with the accounts of similar observations in other parts of the world. Readers who are aware of the efforts now being made to improve the conditions of European life in the tropics will appreciate the emphasis with which this part of the subject is treated.

Part ii. deals with Prophylaxis in its various aspects, and here the author is at his best. The advice he gives is excellent and practical, and if intelligently followed would greatly reduce the ravages of malaria. No mention is, however, made of either mosquito curtains or punkahs. It is satisfactory that justice is done to Ross's epoch-making work, an example which might well be followed by some other Italian writers.

The nomenclature differs somewhat from that now generally adopted in England; hæmosporidia being substituted for hæmamœbidæ, and sporozoites for blasts.

The translator has done his work well, though his choice of words is not always good. The illustrations are good throughout, but we think it a mistake to represent the mature zygote in Fig. 19 as possessing a double-walled capsule, and the unstained blasts on the same plate are not correctly depicted.

A Year with Nature. By W. P. Westell. Pp. xvi+276. Illustrated. 8vo. (London: H. J. Deane, 1900.)

WITH every desire to be charitable to an author who, so far as we are aware, has seen his work "within covers" for the first time during the present year, we are fain to confess ourselves at a loss to conjecture the class of readers for whom the volume before us is intended. Clearly it is not for the professional naturalist; and we doubt whether the average reader interested in natural history will find much entertainment in its pages.

Apparently the general plan of the work is intended to be a kind of naturalists' calendar, but intercalated in several of the chapters are essays on subjects which seem to have no connection with the one in hand. We fail, for instance, to see any connection between birds' tails and October, or between their beaks and September; neither do we realise the affinity between January and Mr. Rothschild's museum at Tring Park—certainly none such could have been suggested by the author's reception when he visited that admirable institution.

In his preface the author very candidly, although perhaps somewhat superfluously, informs his readers that he has "not tried to cultivate any literary style or artistic merit." He might have added that his mode of

framing a sentence is such as, at times, to convey to his readers a meaning totally different from the one he intended, and also that he is not always acquainted with the signification of the terms he employs. As an example of the former kind of error we may refer our readers to p. 17, where it is stated that antelopes and snow-leopards are "denizens of the deep"; while as a sample of the second we may adduce the misapplication of the term "antlers" to the cranial appendages of sheep (p. 26).

Admitting that Mr. Westell displays a strong love of nature, the best we can say of the text in general is that, for the most part, it consists of descriptions of what may be seen during a country walk at different seasons of the year, interspersed with platitudes and reflections, and extracts from poems. We have, however, failed to detect anything strikingly original either in the proper subject of the book or in the articles devoted to the discussion of the beaks, tails and feet of birds. The article on the Rothschild museum and menagerie seems chiefly intended to display the author's profound ignorance of natural history in general.

The one redeeming feature of the book is to be found in the illustrations, which are exquisite examples of photogravure; and if it consisted of these alone (which, by the way, have been photographed by friends of the author), it would certainly form a pretty picture-book for the drawing-room table. But, as the author is once again candid enough to admit, the illustrations, for the most part, have no sort of connection with the text, and are, so to speak, thrown in at haphazard.

A few of the articles, it seems, have previously appeared in magazines; while the majority or all of the rest were first published in the columns of certain local newspapers circulating in the home counties. In our own opinion, the author would have been better advised had he been content with the credit to be derived from such ephemeral publication. R. L.

The Geology of Sydney and the Blue Mountains: a Popular Introduction to the Study of Geology. By the Rev. J. Milne Curran. Second edition. Pp. 391. (Sydney: Angus and Robertson, 1899. London: Australian Book Co., 38, West Smithfield.)

THIS is, strictly speaking, an elementary manual of geology, written and illustrated with especial reference to the geology of Sydney. The general plan of the work is good; the book is well printed and illustrated with maps, photographic pictures of rock structure and scenery, figures of fossils and rock sections; and it is satisfactory to learn that the labours of the author have been appreciated, as the first edition, published in 1898, was sold out in a few months. This speaks well for the interest taken in the study of geology in New South Wales. The colony is fortunate in having representatives of all the great geological systems from the Silurian upwards, but it is sufficient for the Australian student to learn the forms of life which characterise these main divisions all the world over, while he supplements the knowledge with particulars of the strata and organic remains in his own country. To him information about the Hawkesbury-Wianamatta series or the Mount Lambie sandstones is more important than a description of the Wenlock Limestone, the Lower Greensand or the London Clay.

The author gives general accounts of fossils, minerals, and rocks, but he sometimes becomes too popular in style, as, for instance, when he remarks of the Labyrinthodon, that "This ungainly creature was a shovel-headed Salamander, which pottered about like Falstaff in his old age, 'with much belly and little legs.'" To be very popular and also exact is difficult, and in this respect the author is not wholly successful.

Information is tabulated and repeated almost to excess; there is a table of the stratified rocks of New South Wales, another of the principal Australian sedimentary formations, and a third of the general succession of Australasian strata, to say nothing of minor tables. The characteristic fossils of the Australian formations are enumerated (pp. 84, 85), but in so erratic a fashion that saurians, fishes, echinoderms and mollusca are hopelessly mixed.

The author observes in his preface (p. 8) that "some friendly critics have found fault with the disposition of the illustrations." These critics were quite right. There is no excuse for placing a figure of the Triassic *Trematonotus* in a page dealing with Pleistocene, nor a figure of remarkable weathering of sandstone in a page treating of basalt!

The sketch map which serves as frontispiece has no scale attached to it, while the coloured geological map of Mount Victoria, Blackheath and Hartley takes in a part of the Blue Mountains, though the fact is not made manifest. It is desirable that references be given in all cases where quotations on scientific subjects are made, and it would be well to add the initials of authors in the list of works given in the appendix.

The author concludes his work with a glossary. We doubt the utility of giving the derivations of many biological names; some of these appear ludicrous, as, for instance, *Agnostus* (I know not), *Athyris* (without a door), *Avicula* (a little bird), *Phanerogams* (visible marriage), &c. These, however, are trifling matters. The book is one on which further pains may advantageously be bestowed, as it is sure soon to reach a third edition.

Light Railways at Home and Abroad. By W. H. Cole, M.I.C.E. Pp. x + 339. (London: C. Griffin and Co., Ltd., 1899.)

WHILE it is too soon to say that the Light Railways Act of 1896 has in any degree failed in its object, it must be admitted that as yet there are no signs of that revolution in the transport service of country districts for which the more enthusiastic promoters of the Act had hoped. Of the many schemes that have been brought forward but few have emerged from the successive ordeals of the Light Railway Commissioners and the Board of Trade, and of these several have failed to secure the necessary support of capital. This is hardly to be wondered at, for the districts in which the need of improved facilities for transport is most urgent are precisely those in which the spirit of enterprise and the power of raising capital are weakest. The British agriculturist, too, whether landlord or tenant, has been so long unaccustomed to take joint action for a common end, that many hopeful schemes have failed to obtain the support of those who might be expected to reap the chief benefit from them. It may be that the provisions of the Act require modification, that the Board of Trade must become less exacting in its conditions, that greater encouragement must be given to local authorities, or easier access afforded to Treasury grants. These are questions which a few years working of the Act will answer.

Meantime, to all who are interested in the subject of light railways, whether as promoter, engineer, or possible user, Mr. Cole's book is indispensable. His object has been to collect all available information from many scattered sources, and to condense and present it in compact and accessible form, and he has succeeded in producing a very useful book of reference. Something more than a hundred pages are devoted to light railways abroad, special attention being given to their development in Belgium, France, Italy and India. In each case full details are given as to the provision of capital, whether by the State, by local authorities or by private enterprise; as to gauge, weight of rolling stock, use of highways and other details of construction; as to various economies of working, limits of speed and precautions

for safety; and, lastly, as to the financial return and the disposal of profits when such exist.

The second portion of the book is more directly concerned with light railway development in England. A useful chapter is concerned with an analysis of the Act of 1896, while the special chapters on "The Question of Gauge" and on "The Construction and Working of Light Railways" are perhaps the most valuable in the book. On the question of gauge it may be worth while to quote Mr. Cole's conclusion, which is that for railways making connection with main lines the standard gauge is imperative, and that for smaller independent lines the reduced gauge of thirty inches may be used. In this connection we notice no reference to the Duke of Westminster's narrow-gauge railway at Eaton Hall, though this is, perhaps, the most instructive example of a small and self-contained railway in the United Kingdom.

The book contains a number of folding plates, showing details of construction both of permanent way and of rolling stock; and a long appendix includes tables of returns for many railways, both of standard and of light construction, as well as the full text of the Act of 1896 and its schedules.

Les Plaques sensibles au Champ électrostatique. Par V. Schaffers, S.J. Pp. xxxix + 19. (Paris: A. Hermann, Librairie Scientifique, 1900.)

THE phenomena treated of in this pamphlet are those observed when an electric discharge from a powerful Whimshurst was passed over the film of a photographic plate between two metallic points which usually were both in contact with the film. A great variety of films, containing various metallic salts mixed with different emulsions, &c., besides those ordinarily used for photographic purposes, were tried.

The potential difference used was not enough to spark across between the poles, and the changes produced in the films are probably mainly due to the current through the film, and not to the discharges through the air above it. In some cases the marks produced on the plate were approximately parallel to the lines of electrostatic force or current stream lines through the film, and several plates are given showing the effects obtained in such cases. A considerable variety of peculiar and more or less interesting appearances are clearly described, and possible explanations of them discussed. Scarcely any variations in the method of submitting the material to the action of the discharge were tried, and the object of the experimenter seems to have been more to obtain a large variety of peculiar appearances than to really elucidate the nature of the actions taking place. The method of obtaining pictures of the lines of force or current stream lines between conductors on the plates is described in detail, and such pictures as the author points out may be useful for educational purposes in some cases.

H. A. W.

The Elements of Plane Trigonometry. By Prof. W. P. Durfee. Pp. vi+105. (Boston, U.S.A.: Ginn & Co., 1900.)

THERE are a few novel points in this book. Logarithms and their use in computations are dealt with in the first chapter, and most of the exercises are of a character which will lead the student to see that trigonometry has a practical value. The second chapter deals with trigonometrical ratios, and is followed by chapters on unlimited angles, reduction formulæ, the addition theorem, relations between the sides of a triangle and the trigonometrical functions of its angles, and solution of triangles. Logarithms are used in all the calculations. The course of work in the book is suitable for elementary students of trigonometry, and constitutes an introduction to the theory of functions as illustrated by trigonometrical ratios.

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.*]

Autotomic Curves.

MR. RICHMOND'S letter appears to be written under a misapprehension. My objection to such phrases as "non-singular cubic curve," "non-singular curve of the *n*th order," arises from the fact that a point of inflexion is just as much a singularity as a node, and that it is therefore inaccurate and misleading to describe such curves as non-singular. In fact, the only non-singular curves which exist are conic sections; all others are singular. On the other hand, the word autotomic exactly expresses the idea it is desired to convey; and I have been informed by several excellent Greek scholars that they do not consider the phrase "an anautotomic curve" open to objection, and that the alliteration may be frequently avoided by the use of the words every or any instead of an.

The terms *sesecting* and *non-sesecting* appear to be unobjectionable from a literary point of view; but with regard to *unautotomic* and *nodeless* there is a general consensus of opinion amongst writers who are careful about their style against the use of hybrid terms composed of words belonging to two different languages.

A. B. BASSET.

Fledborough Hall, Holyport, Berks, November 16.

A Remarkable Dolphin.

DR. WAY, the headmaster of Rossall School, has recently forwarded to the Natural History Museum (for determination) portions of a cetacean stranded at Rossall in September. These portions include the skull, the imperfect flippers, the tail (including the caudal vertebræ), and the back-fin.

The skull and other bones leave no doubt that the animal is the bottle-nosed dolphin (*Tursiops tursio*). In place, however, of the ordinary "flukes" of a dolphin, the tail terminates in two long, narrow lobes, of which one is very much longer than the other; and, were it not placed in a horizontal instead of a vertical plane, it might well be mistaken for the tail of a thresher shark. The larger lobe of the tail measures 5 feet 3 inches, while the total length of the remainder of the creature was 10 feet. A similar abnormal elongation is noticeable in the case of the back-fin, which is about twice as long as ordinary, and proportionately slender. Externally, both the tail and the back-fin are thickly coated with small sea-weeds and sertularians.

Judging from the teeth, the animal appears to be very aged, and the only conjecture I can make in regard to the tail and back-fin is that their abnormal form is due to pathological hypertrophy, perhaps induced by an injury. I should be glad to hear of any other instances of analogous malformation among cetaceans.

R. LYDEKKER.

British Museum (Natural History), Nov. 19.

The Optics of Acuteness of Sight.

OBSERVATIONS have been frequently made upon the remarkable eyesight of certain uncivilised tribes. Travellers have told us of guides who could see four of Jupiter's satellites with the unaided eye; and lately Sir Redvers Buller has declared that the average Boer can see at least two miles further than the British soldier. It is of some interest to consider whether this superiority is due to a real change in the optical properties of the eye, or merely to some special ability to interpret slight differences of impression, which might be acquired by practice. As we have as yet no data as to the constants of a Boer's eye, we may raise the question whether such feats are optically impossible for an Englishman's eye.

The minimum visual angle is determined by the transverse diameter (c) of a foveal retinal cone, and its distance ($F''K''$) from the second nodal point of the eye. We have—

$$\tan \frac{\alpha}{2} = \frac{\frac{1}{2}c}{F''K''}$$

and, where c = ·002 mm., $F'K''$ = 15·498 mm.

$$\alpha = 26{\cdot}618''$$

In order that two points may be distinguished as such by the

eye, their retinal images must be separated by at least one unexcited retinal cone. The distance between the two images must therefore be ·004 mm., or the intervening cone may be encroached upon. Therefore the minimum visual angle

$$\theta = 2\alpha = 53{\cdot}236''.$$

Now Jupiter's edge and his first satellite may subtend at the sun an angle of 1·33″, so that we may regard this as the average angle subtended at the earth. Hence we see that there is no optical reason why the four satellites should not be seen by the naked eye. If they were sufficiently bright they no doubt could be distinguished by the normal Englishman's eye. "It must be remembered, however," as Sir Michael Foster says, "that the fusion or distinction of sensations is ultimately determined by the brain. The retinal area must be carefully distinguished from the sensational unit, for the sensation is a process whose arena stretches from the retina to certain parts of the brain, and the circumscription of the sensational unit, though it must begin as a retinal area, must also be continued as a cerebral area, the latter corresponding to, and being, as it were, the projection of the former." No amount of education can make the sensational unit smaller than the minimum retinal area, though by practice the cerebral area may be made more sensitive to minute sensational impulses.

A. S. PERCIVAL.

26 Ellison Place, Newcastle-upon-Tyne.

ELECTRIC TRACTION TROUBLES.

THE English—the pioneers in the development of railways, steamships, the telegraph, and other inventions of the nineteenth century—are now running the risk of becoming a nation of imitators. Apart from the fact that the entire route, Shepherd's Bush to the Bank, was not sent bodily across the Atlantic to be tunnelled, the Central London Railway might almost as well have been constructed in Central America as in Central London.

For not merely did the steam-engines come from Milwaukee, the electric lifts from New York, the dynamos, locomotives, and other electric apparatus from Schenectady, but the curious practice of requiring a passenger to first purchase a ticket and then drop it immediately into a box, as well as the projection of information into each end of a car on quitting each station are Yankee notions, and one expects to hear that the "next station is Chippawa" or Winettea, and not commonplace Bond Street or Oxford Circus.

The characteristics of American traction are convenience, comfort, speed, low fares and a liberal scattering of the electric current over the district generally. Chinese like, we have faithfully adopted them all. To go from the City to the Albert Hall, up to this summer, one went, of course, from the Mansion House to the South Kensington railway stations. Now one saves time and money by being whisked electrically to Lancaster Gate and walking across Kensington Gardens. No wonder, then, on C.I.V. Monday 230,000 people used the Central London Railway, enough passengers, in fact, to fill every seat one and a quarter times in every train from early morn on Monday to the small hours of the following day.

No need to issue return tickets at reduced rates when every passenger who goes by this line can be relied upon to return by it. What matters it, then—may think the artisan, the clerk, the stockbroker, the investor, and even, perhaps, the engineers and directors of the Central London Railway itself—by what route the electric current returns? The electric current that starts from the Marble Arch, say, must, from the nature of things, go back there. Why, then, should advantages be offered it that are not thought necessary in the case of the general public to induce a return home inside the tube?

If one were a shareholder *only* of the Central London Railway, one might find it difficult to realise that any other interest was of any consequence. But, if a considerable portion of one's income happens to be derived from dividends on the shares in gas and water companies, one may prefer that these sources of income shall not be seriously interfered with. Hence, the clean white glazed brick walls, the brilliant arc lamps, the pleasant gliding lifts, the entire absence of those rolling clouds of smoky steam that greet a passenger as he descends into the Euston Road on a damp, cold November day, fail to cheer him on his swift modern progress under Oxford Street, should he make the following little elementary calculations:—Over 2000 electric horse-power which, at times, every day is already actually put into the Central London Railway at a single sub-station between Shepherd's Bush and the Bank means a current of over 3000 amperes; and this current, after passing through the electro-motors on the trains in the neighbourhood of that sub-station, has to come back there through the *uninsulated* rails on which the trains run. Suppose, in consequence of these rails being *un*insulated, 10 per cent. of this return current strays outside the iron tube and comes back by the iron gas and water pipes running parallel with the railway on the ground above it. This means about $\frac{3}{4}$lb. of iron removed from the gas and water pipes in an hour in the neighbourhood of a sub-station.

Such large currents, however, as 3000 amperes are at present probably only seldom reached, therefore, to avoid even an approach to exaggeration, let us assume that the average current which strays into the gas and water pipes on its way back to a sub-station is only, say, $\frac{1}{100}$th of the maximum value of the current leaving a sub-station each day. This seems a modest enough estimate. Then, since the line works some eighteen or more hours per day, this means about *a quarter of a ton of iron* removed per year from the gas and water pipes in the neighbourhood of *each* of the places at which the current is fed into the railway. Consequently, as there are several such places between Shepherd's Bush and the Bank, this would lead to more than *one ton of iron* being eaten out of the pipes each year.

Is this important? Well, as holders of gas and water companies shares we should say, very! But are the travelling facilities of the London public to be interfered with, is the development of electric traction to be hampered—just when our people are having their first taste of the immense advantages that accrue from propelling trains and tramcars by electricity—simply because several millions sterling happen to have been invested on pipes, retorts, gasometers, waterworks, &c., and because there are people so blind as to actually prefer the receipts of regular dividends to the slavish copy of American practice?

Luckily, no such terrible alternative need be flourished in the faces of our democratic governing bodies, who, while naturally anxious to defend the people from the supposed extortions of the gas and water companies, are no less anxious to shield from the incursions of the electric traction capitalist a large class of persons with small incomes who have placed their savings in what they rightly regarded as safe investments—viz., the shares of gas companies.

Another electric service has been inaugurated this year in which trains as large as, or larger than, those on the Central London Railway are driven electrically over a far more difficult route—viz., from Earl's Court to High Street, Kensington, among ordinary trains over points and crossings.

And yet, in spite of this greater difficulty, there is not merely an insulated conductor to take the electric current to the trains, as on the Central London Railway, but also an insulated conductor to bring it back by; and the rails on which the electric trains run between Earl's Court and High Street, Kensington, are used simply for

what they were originally put there—viz., to carry the weight of the train, and not to ineffectually carry an electric current also. Such a system enormously diminishes the electrolytic corrosion of gas and water pipes; and, since it is a system that has been designed by a celebrated firm of consulting electrical engineers and carried out by a no less celebrated firm of electrical contractors, surely nobody suggests that it is in any sense impracticable.

It will be urged, however, that on that vast network of tramways lying between Uxbridge Road and Acton, Hammersmith and Hounslow, Kew and Richmond, &c., which will shortly be worked electrically, two overhead insulated conductors are impossible,and we must adopt the American system. Yes, but what American system? The conduit system, for example, employed already for years in Washington, and of which some seventy miles now exist in New York, in which there are no overhead wires at all, but an insulated going and an insulated return conductor, both under the street? Or is all this too modern for England, and can we not project ourselves in advance of where America was several years ago, and must we resort to the old insulated trolley wire to take the current and the *un*insulated rails to bring it back?

Why, only recently there was suggested, in one of the technical papers, a proposal to overcome all this difficulty in the case of street electric tramways by taking the current to the cars by means of an overhead trolley wire as hitherto, but using instead of the rails as the return conductor an *insulated* cable which was connected automatically with a car as it passed along and which, differing in potential from the earth by only a few volts, could not give rise to appreciable leakage to the ground. Will an insuperable barrier to a trial of such an English system be found in the fact that its parent, called "surface contact," was itself born of English parents in 1881? Must it, like an opera singer of forty years ago, first adopt an Italian name before it will be accepted by a British public?

Already the Central London Railway Co. has given notice of an application to Parliament for powers to extend westward and eastward; every week now some new underground electric railway scheme blossoms forth for London, while in a few years electric tramways will doubtless be a common method of conveyance in this city. An urgent question, therefore, that London must ask itself *to-day* is—Does it want to preserve its gas and water pipes?

AGRICULTURAL DEMONSTRATION AND EXPERIMENT.

THE issue by the Board of Agriculture of the "Annual Report on the Distribution of Grants for Agricultural Education and Research in the year 1899-1900," directs attention to a department of educational activity which was practically non-existent in the beginning of the present decade. From this it need not be inferred that there was no education in agriculture—both in the class-room and on the field—before this date. The work of Rothamsted, of our leading agricultural societies, and of certain agricultural colleges, is conclusive evidence to the contrary. But it was not till some ten years ago that the aid of the State was given to the establishment and maintenance of agricultural departments in provincial colleges, and of independent teaching institutions, which should be in a position to supply education and advice to the agricultural community in their district.

The report before us summarises the courses of instruction, attendance, intra- and extra-mural work, and financial aspects of each of the eleven English and Welsh collegiate departments and teaching institutions that divide amongst them 7750*l.* of the Board's grants. The grants to Scotland have, since 1896, been paid through the Scotch Education Office, so that the work of North Britain does not come within the purview of the Board's report.

Within certain limits, each institution is allowed to administer its grant and organise its work on the lines that experience has shown to be most consistent with local requirements. As a result, we find considerable variety in the educational ramifications of the different centres, though this variety is less pronounced now than formerly. Practically all the colleges receiving the Board's grants have arranged courses of instruction, extending over two or three years, which lead up to a certificate, diploma or degree. In addition to these extended courses, most of the colleges are now holding short courses of six to ten weeks, which are specially designed to meet the wants of young farmers who cannot be spared from home for a longer period. Such classes have proved most useful in America and on the Continent, and they are also being well attended in this country.

A prominent feature of the work of all the colleges is the conduct of field demonstrations and experiments, of which a condensed account is given in the second section of the appendix of the Report under notice. This form of educational work was vigorously prosecuted by Young and Marshall in the latter half of last century, and, in the face of a mild undercurrent of opposition, it has been continued ever since. It is a form of educational activity that has been largely developed in the United States, in Canada and on the Continent, so that it may fairly be urged that, whatever its weaknesses, it has, on the whole, gained extensive adoption by reason of intrinsic merit. The objectors to this form of education, or means of agricultural improvement, base their opposition on the following grounds:—

(1) The difficulty of getting a series of plots on soil of equal quality.

(2) The danger of applying results obtained on one farm to the agricultural practice of another.

(3) The possible interference with results of extraneous causes, *e.g.*, birds, mammals, insects, diseases, weather.

(4) The misinterpretation of the value of purely quantitative results.

No doubt the usefulness of field trials may be marred, or worse, by failure under these heads, but the exercise of ordinary care in selecting the land, the rejection of results that have manifestly been unduly influenced by extraneous causes, and, above all, the frequent repetition, both as regards place and season, of the experiments, must in the end furnish a set of figures that cannot fail to prove a useful guide in agricultural practice. If one may not indulge in wide generalisation from even a considerable number of concrete cases, that is no valid argument against field trials. On the contrary, it is fair to say that if there are a large number of soils that require special treatment, it is the more necessary that farmers should be made familiar with the arrangements and method of field trials, in order that they may, by their aid, inquire into the manurial and other requirements of their own land. In point of fact it is probable that therein lies the main value of such work. No one, who has given careful heed to the experimental results of past years, will deny that, at least under certain conditions of soil, some very striking and unexpected results have been obtained. Farmers who see such results, recognise that they have made the acquaintance of facts that they would not have anticipated, and they naturally conclude, and rightly, that if the unexpected has

happened on the farm of a neighbour, it may be that their own practice is not all that could be desired. When once this spirit of inquiry has been roused, a long step forward has been made. But farmers will give attention to work that is going on in their own neighbourhood, under conditions with which they are familiar, when they would not concern themselves with results obtained on a station that they had never seen. For this reason, local experiments and demonstrations would be justified, even if they were no more than a repetition of work conducted elsewhere.

Some curious results have, from time to time, been got with potash, and at no place has this been more conspicuously the case than at the Northumberland Demonstration Farm of Cockle Park. Speaking generally, and taking the average of several seasons, one finds that, in the North of England, the addition of 3 or 4 cwt. of kainit per acre to a nitrogenous-phosphatic artificial dressing increases the turnip or swede crop by about 30 cwt. per acre. Such a return is moderately profitable, but not sufficiently so to make it a matter of the first importance, whether north-country farmers use potash for their turnips or not. But not so at Cockle Park, where the arable land is a light loam overlying millstone grit. At that station, potash has proved to be absolutely indispensable in the growth of root crops, so much so, in fact, that, without the support of potash, other manurial elements have practically no effect. The figures for turnips—in terms of an acre—for three years are as follows :—

Treatment of crop.	1896		1897		1898	
	Tons.	Cwt.	Tons.	Cwt.	Tons.	Cwt.
Unmanured	19	19	2	10	13	2
Nitrogen and phosphoric acid, no potash	16	17	4	17	8	3
Nitrogen and phosphoric acid, with potash	26	3	14	10	25	5

During two of the seasons the crop was actually injured by the use of nitrogen (in the form of sulphate of ammonia) and phosphoric acid (in the form of superphosphate of lime) unsupported by potash. Similar results have been got by at least one foreign investigator by means of water-cultures, and it would be interesting to have an explanation of this curious phenomenon. But, without any explanation, the many hundreds of farmers who have seen these demonstrations have at once perceived that, on land of this character, large expenditure on manures may be absolutely profitless ; and they have gone home with the determination to experiment on their own land, in order to ascertain whether their system of manuring is as rational as it might be.

To show how unsafe it is to apply, generally, results obtained with one class of plant, attention may be directed to some experiments begun in 1897 on a permanent meadow, situated within a few hundred yards of the three fields in which the turnip experiments were conducted. The soil of this meadow is somewhat more argillaceous than that of the arable land, but from the appearance of the soil, and in view of the results referred to above, one would not expect that the herbage growing upon it would be absolutely independent of artificial supplies of potash. And yet four years' results have shown that not only does potash fail to increase the yield, but that, when used unsupported by phosphate, it does positive harm. The figures are as follows, the sulphate of potash, which was applied each year, supplying 50 lbs. of potash per acre :—

Treatment.	1897	1898	1899	1900	Total
	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.
Unmanured	22½	27½	19½	20	89½
Potash only	20	25½	13¾	16¾	76
Sulphate of ammonia	33½	37¼	25	26½	122¼
,, ,, plus potash	29¾	35¼	19	22¾	106¾
Phosphate	25	32¼	23¼	27	107½
,, plus potash	26¼	36¼	20½	26½	109½
Ammonia and phosphate	35¼	41½	26¼	30½	133½
,, ,, plus potash	33½	41	24¼	30½	129¼

Without any exception, the potash has invariably reduced the yield (*a*) when used alone, and (*b*) when added to a nitrogenous manure. This depressing influence is more pronounced in the last two than in the first two years, a result doubtless due to the accumulation of potash in the soil. When used along with phosphate, the potash slightly increased the yield in the first two years, whereas it has reduced it in the last two. Finally, when added to both nitrogen and phosphate, the action of the potash has either been harmful, or, at the best, negative.

These results not only come out in weighing the crops, but they are precisely what one would anticipate from the general appearance of the plants. In the case of turnips, the plants that have received no potash are of an unhealthy green colour. The leaves are shrivelled and puckered, and covered by large yellow blotches. In the case of the meadow plots that have received potash, *without phosphates*, the herbage is pale, almost brownish-green in colour. In other parts of the country this poisonous influence of potash on the mixed herbage of meadows has been observed, Mr. Wood, for instance, having recorded several cases in the east of England. It is evidently a subject of some scientific interest, and worthy of further investigation.

In the past, the agricultural experiments and demonstrations conducted by the local colleges and other institutions subsidised by the Board of Agriculture have been chiefly concerned with the manuring of land, though a considerable amount of work has, in the aggregate, been done in the direction of (*a*) testing new varieties of plants ; (*b*) dealing with insect and fungoid injuries, and the eradication of weeds, notably charlock ; (*c*) the rearing and feeding of stock ; (*d*) dairying ; (*e*) cider manufacture. The initiation of such work has, with few exceptions, been left entirely in the hands of the staff at the various centres, and while much is to be said in favour of this system, there is a good deal to be urged against it. More particularly it is apparent that the lack of any central control, or, it may be, the want of opportunities for consultation among the workers, has engendered a certain amount of unnecessary confusion, which could easily have been avoided with advantage to every one. While one worker uses 50 lbs. of phosphoric acid, another, perhaps, uses 65 lbs., while a third may use 3 cwt. of some phosphate without regard to its contents of phosphoric acid. This means all-round waste of energy, and renders definite comparison of the results impossible.

By voluntary association, one special four-course rotation experiment is being carried out by the Durham College of Science, the Yorkshire College, Cambridge University, the South-Eastern Agricultural College and Nottingham University College. The present season will see the close of this experiment at three of the centres, and the results are likely to be much more valuable than if the work had been entirely uncoordinated. Major Craigie, in his report, directs special attention to this experiment, as also to the fact that the Board has

made arrangements for the repetition in the south and centre of England of the Northumberland "manuring for mutton" experiment. This work, started in the spring of 1897, took the form of determining the results of the manurial treatment of grass land, not in terms of hay, but in the terms of live-weight increase. Ten three-acre plots were fenced off on a large field of poor pasture, and nine of these plots were subjected to as many distinct forms of treatment. The plots have each year been grazed by sheep, each plot being stocked with as many animals as a committee of practical farmers considered it would carry. The individual weights of the animals are determined by monthly weighings. During the first season (1897) variations in the yield of animal increase were fairly pronounced; while in the second, third and fourth years the results have been extremely striking. Lime, used alone, has almost failed to act; while phosphates, especially basic slag, have, in some cases, enabled the land to carry twice as many sheep as the untreated area, and not only so, but the animals have given more than double the individual live-weight increase. The addition of sulphate of ammonia or potash to a phosphatic dressing has had extremely little influence, whereas the beneficial effects of a similar addition of pulverised lime have been very conspicuous. The yield of hay on separate sub-plots gave but a modified reflection of the mutton results, showing that the manures have had much more influence on the quality than on the quantity of the herbage. By a single expenditure of about twenty shillings per acre on manure, it has been shown that land worth five shillings per acre per annum has been—temporarily at least—raised in value to five or six times this sum. Whether such a result will be obtained in other parts of the country it would be hazardous to predict, but there can be no question of the desirability of putting the matter to the test, and it is satisfactory to find that the Board has made arrangements to do so.

The past ten years may be regarded as a period of adjustment in the history of the provincial agricultural colleges. They were called into being as a result of the sudden endowment of county councils with large funds, and practically no preparations had been made for their reception. They were placed in the receipt of grants from public bodies, and these bodies naturally wanted results for their money. If these results could be made to loom large in the eyes of the county council electorate, so much the better. The success of a local lecture was judged rather by the size of the audience than by any educational standard. The county councils vied with each other as to the number of field demonstrations they could show. But things are different now. Both colleges and county councils have elaborated educational schemes, and work will in the future be tested by its intrinsic quality. Now that the feverish incentive to the production of results has been replaced by a demand for thoroughness, it is to be hoped that the colleges will be allowed to settle down to do some first-class work. But, with the best intentions, county councils sometimes handicap the staff of the institutions that they support. It is quite impossible that a department of agriculture can develop in such a way as to do justice to its students, or to take its proper place amongst the other departments of a college or University if a large portion of the time of the members of its staff has to be spent away from headquarters. The local work that they are doing may be of the greatest importance, but the time occupied in its preparation and accomplishment makes a serious inroad on the efficiency of in-college work. It is to be hoped that county councils will give their support to central institutions without being too exacting in their local demands upon them, while the Board of Agriculture should be endowed with funds sufficient to enable the agricultural departments of the colleges to prosecute the highest forms of research. WM. SOMERVILLE.

HORTICULTURAL PRACTICE.

ONE method by which the gardener "improves" particular plants was well illustrated at the Hybridisation Conference held in the gardens of the Royal Horticultural Society last year. The proceedings of that meeting were amply recorded in these columns at the time, so that there is no need to do more than mention that branch of the subject. Another method of improvement consists in the continuous selection of the best and the cotemporaneous elimination of inferior varieties. This is the method followed by the great seed-firms, who devote large areas to their trial grounds and take the greatest pains to secure and maintain the purity of their stocks. A variation may arise from seed or from "sports," the latter term being applied to bud-variations which occur suddenly, no one knows why. If the variation be a desirable one, the cultivator preserves the seed, sows it, and in due time finds that a certain percentage of the seedlings reproduces the desired form. Further sowings take place, the percentage of the new variation being constantly increased till at length the seeds are said "to come true," and a new species, at any rate so far as gardens are concerned, is evolved by the constant practice of selection.

In the case of a sport, propagation is effected by cuttings or grafts.

The advent of the Chrysanthemum season reminds us of other practices which the gardener adopts with the view of securing "improvement." Those who visited the recent exhibitions at the Royal Horticultural Society and at the Westminster Aquarium must have been forcibly struck with the contrast between the wild Chinese Chrysanthemum and the Japanese varieties, which constituted the essential part of the exhibition. The wild plant, sent from the Royal Gardens, Kew, was discovered in central China. Horticulturally it was but a poor weed, with small yellow flower-heads about half an inch in diameter, by no means so attractive as our own corn-marigold. Yet from this plant, either alone or when crossed with another species, the Chinese and the Japanese have evolved flowers of every shade of colour except blue, and the gardener has produced flowers 15 and 18 inches in diameter.

The Japanese varieties, originally introduced by Fortune in 1862, at once attracted attention by their large size and fantastic form. It is these Japanese varieties that now constitute the staple of our exhibitions, and their size and colour offer, as we have said, the greatest possible contrast to the inconspicuous flowers of the wild plant. They are purely artificial productions, and nothing like them occurs in nature, although occasionally, in Composites, malformations occur in the ray-florets which give a clue to the origin of these strange productions.

It is mainly to the art of the gardener that we owe these monstrous blooms. That art consists essentially in "disbudding" or in removing certain buds and leaving others. As the history is interesting and not generally known in scientific circles, it may be well briefly to summarise the facts of the case. The "first break" or lateral bud of a Chrysanthemum makes its appearance from the middle of April to the middle of June, the precise period differing in the case of different varieties. The second or "crown" bud appears in August, and consists of a flower-bud surrounded by leafy shoots, which grow sympodially; these are removed, and the development of the central flower-bud allowed to proceed. The third or "terminal" bud is formed in September, and always consists of one central bud surrounded by other secondary flower-buds, but not by any leaf-shoots. The secondary flower-buds are removed, and all the energy of the plant concentrated in the central bud, which, in florists' language, is "taken," or, more correctly, which is reserved.

Lastly, in December, after the flowers are over, a quantity of leaf-buds are produced from the base of the stem. These are used as cuttings.

Dis-budding is a common enough procedure in roses and other flowers grown for exhibition; but the peculiarity in the Chrysanthemum is the difference in the position, time of formation, and nature of the buds. The practice varies in accordance with these differences. Different varieties demand different treatment. In some instances the bud must be "taken" at this time, in other cases at a different period. In some varieties the best blooms are produced by the "crown" buds; in others it is the terminal buds that produce the finest flowers. All this is determined by experiment, but in any case this variation in the position, form and time of development of the buds is sufficiently important to attract the attention of the physiologist.

Another practice now much followed is that of retarding the growing and flowering period of plants by means of cold. By this means flowers, say of lily of the valley, can be had at any season that may be desired.

The chief point of physiological interest appears to reside in the fact that plants can be subjected without injury to much lower degrees of cold than was formerly supposed.

SOME REMARKABLE EARTHQUAKE EFFECTS.

MR. R. D. OLDHAM'S elaborate report on the great earthquake of June 12, 1897, published in the *Memoirs* of the Geological Survey of India (vol. xxix.), has been referred to on several occasions in these columns; and an abstract has been given of its most important contents (vol. lxii. p. 305, July 26, 1900). There are many striking illustrations of earthquake effects in the report, and three of the plates are here reproduced.

That pillars and other similar objects may be left standing, but with one part twisted round upon another, has long been known as a fantastic effect of severe earthquakes, and even in some cases of earthquakes which can scarcely be called severe. There is, however, no instance where cases of this kind were so numerous, and so various in the nature of the object rotated, as the Indian earthquake. The most imposing and striking of the many instances of twisting found by Mr. Oldham is that of the monument to George Inglis, erected in 1850 at Chhatak. This conspicuous landmark takes the form of an obelisk, and, rising from a base 12 feet square, must have been over 60 feet high before the earthquake. It is built of broad, flat bricks, or tiles, laid in mortar and plastered over, and is represented in its present state in Fig. 1. About 6 feet of the monument was broken off and fell to the south, and 9 feet to the east. Of the remainder, the top 20 feet was separated at a height of about 23 feet from the ground, and twisted in the opposite direction to that of the hands of a watch lying face upwards on the ground.

The view in Fig. 2 shows some tombs in the cemetery at Cherrapunji. All the tombs are of the oblong form with sloping tops, and are built of rubble stone masonry. Few are broken up, but nearly all have sunk down into the loose sand beneath them, and are leaning over at various angles to the north. The cemetery is situated on the top of one of the small knolls of sandstone which are scattered over the Cherra plateau. This sandstone originally rested upon the limestone of the plateau, which has been dissolved away from beneath it, and is accordingly much broken. The earthquake seems to have shaken the surface down into a perfect quicksand, into which the tombs sank.

A direct measure of the amplitude of the earth-wave, or of the greatest movement of the wave particle backward and forward, was obtained at Cherrapunji. Mr. Oldham concludes, from observations of the length of a depression scooped out by the movement of the ground against some tombs which remained stationary, that the extreme range of motion cannot have been less than ten

FIG. 1.—Monument at Chhatak, with part twisted by earthquake. The part of the monument left standing is about 46 feet high.

inches, may have been as much as eighteen inches, and was probably about fourteen inches. The amplitude or range of the wave particle on either side of its original position would be half these amounts.

The banks of the Brahmaputra are fissured at intervals on each side along a length of 260 miles, and fissures

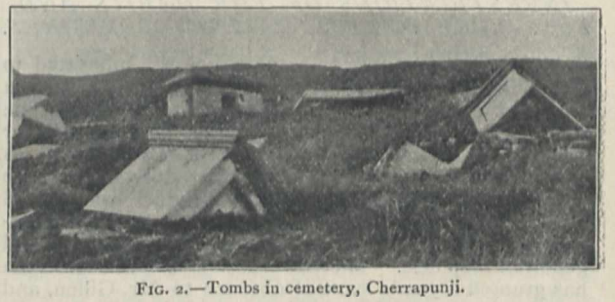

FIG. 2.—Tombs in cemetery, Cherrapunji.

extend along the banks of all the minor branches of the river and its tributaries within the disturbed area. As a rule, the fissures run parallel to the bank of the river, and where this is not the case, some peculiarity in the contour of the ground—a drop, for instance, from a higher to a lower level—can usually be found to account for the

change of direction. At Rowmari, for instance, besides the fissures parallel to the bank of the Brahmaputra, which here runs nearly north-east and south-west, a large fissure runs to the south-east at right angles to the river bank for a distance of at least 500 yards, where it becomes lost in a jheel, and is said to be traceable for a distance of nine miles. Sand and mud were ejected from the fissure to a depth of at least four feet. Other fissures

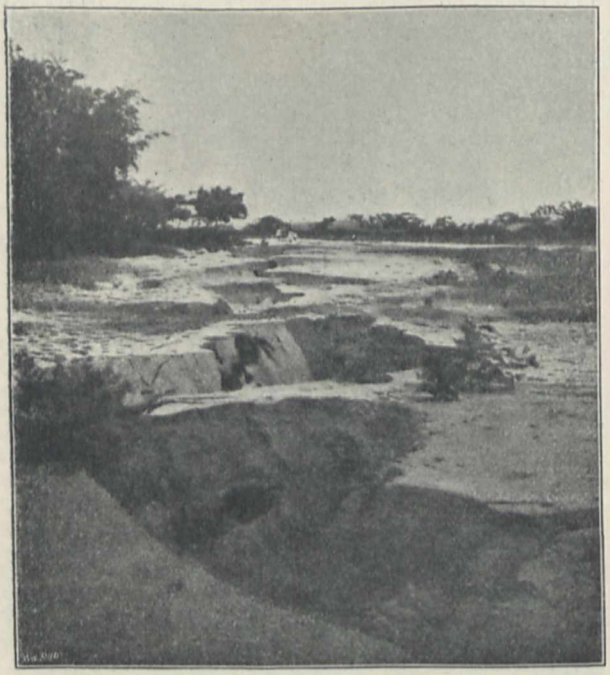

FIG. 3.—Fissure at Rowmari.

branch off from this. Subsequent to the ejection of the sand, the surface sank down to a depth proportional to the amount of material ejected, and several crater-like hollows were formed as the water drained back into the fissure. Illustrations of this and many other effects are given by Mr. Oldham, and his complete report upon the Indian earthquake, in all its scientific aspects, is a memoir which will take its place among classical papers on seismology.

INVESTIGATIONS OF THE HABITS AND FOLK LORE OF AUSTRALIAN ABORIGINES.

EARLY in the summer a memorial was submitted to the Governments of South Australia and Victoria praying that facilities might be granted to Mr. Gillen, one of the inspectors of aborigines, and Prof. Baldwin Spencer for the continuance of their investigations into the habits and folk-lore of the natives of Central Australia and the Northern Territory. The memorial, which was signed by all British anthropologists and many prominent representatives of other sciences, has met with a prompt and generous response. The Government of South Australia has granted a year's leave of absence to Mr. Gillen, and the Government of Victoria has provided a substitute for Prof. Spencer during his absence from Melbourne. Mr. Syme, the proprietor of the Melbourne *Age*, has contributed 1000*l.* towards the ordinary expenses of the expedition. The Government of South Australia has also allowed the expedition to make use of the depôts and staff of the Transaustralian telegraph for the forwarding and storage of supplies. The explorers start in February, and it may be confidently anticipated that, if the winter rains make conditions favourable for travelling, they will be rewarded with the same conspicuous success which attended their expedition of three years ago; although the task before them requires even greater tact, since the natives of the Northern Territory are more difficult to deal with than the aborigines of the centre, who know Mr Gillen and regard him with the utmost confidence. The tribes of the MacDonnell Ranges will be studied even more minutely than before, and afterwards the explorers will go towards the Gulf of Carpentaria, along the Roper River, and, time permitting, proceed down the Daly and Victoria Rivers.

To quote from the *Adelaide Advertiser* of October 4, "It scarcely needs a scientific mind to appreciate the value of the task which Messrs. Gillen and Spencer are about to renew, and possibly complete. The mystery their labours will contribute to unveil may well captivate the fancy of the most unlearned 'man in the street.' . . . The breath of the white man has scorched out of existence so many aboriginal races and tribes that civilisation may be thankful that there are still untutored savages left to throw light on its own beginnings."

NOTES.

SIR JOSEPH HOOKER has been elected a Foreign Associate of the Paris Academy of Sciences.

THE death is announced of Prof. G. F. Armstrong, Regius professor of engineering at Edinburgh University since 1885.

THE death is announced of the Rev. Father Armand David, Correspondant of the Paris Academy of Sciences, in the Section of Geography and Navigation.

WE learn from the *Athenaeum* that the Amsterdam Society for the Advancement of Medical and Natural Science has conferred its Swammerdam Medal upon Prof. Carl Gegenbauer, of Heidelberg.

DR. HERMAN S. DAVIS, recently expert computer of the U. S. Coast Survey, has been appointed observer at the International Latitude Observatory at Gaithersburg, Maryland, one of the six stations established by the Centralbureau der Internationalen Erdmessung for an investigation of variations of latitude.

WE are asked to announce that the Thomson Foundation Medal of the Royal Geographical Society of Australasia will be awarded to the author of the best original paper on each of the following subjects:—(1) The commercial development, expansion and potentialities of Australia—or, briefly put, the commerce of Australia. To be sent in not later than October 15, 1901. (2) The pastoral industry of Australia, past, present and probable future. To be sent in not later than June 15, 1902.

THE College of Physicians of Philadelphia announces that the next award of the Alvarenga Prize, being the income for one year of the bequest of the late Señor Alvarenga, amounting to about 180 dollars (36*l.*), will be made on July 14, 1901, provided that an essay deemed by the Committee to be worthy of the prize shall have been offered. Essays intended for competition may be upon any subject in medicine, but must be unpublished. They must be received by the secretary of the college on or before May 1, 1901. The Alvarenga Prize for 1900 has been awarded to Dr. David de Beck, of Cincinnati, Ohio, for his essay entitled "Malarial Diseases of the Eye."

We learn from *Science* that the New York Board of Health is building, at a cost of 4000*l.*, a laboratory to be wholly devoted to the study of the bubonic plague. Special care will be taken in its construction. The ground floor will be occupied chiefly with eight stalls for horses that will supply the anti-plague serum. A staircase from the outside will lead to the upper floor, where experiments will be carried on. The walls and floor are to be of steel and cement, so as to be rat proof, and the windows are to be especially screened to keep out flies and mosquitoes.

IT will be remembered that shortly after the death of the late Mr. G. J. Symons, F.R.S., the founder of the British Rainfall organisation, a movement was started for the foundation of a memorial to him. It was resolved that the memorial should take the form of a gold medal, to be awarded from time to time by the Council of the Royal Meteorological Society for distinguished work in connection with meteorological science. The committee appointed to take the necessary steps to raise a fund for that purpose announce that the appeal has met with a hearty response from meteorologists, water engineers and other admirers of Mr. Symons's work. The fund will be open until the end of January next, and subscriptions should be sent to the treasurer, Dr. C. Theodore Williams, 70, Victoria Street, Westminster.

THE Vienna correspondent of the *Times* states that two facts of considerable importance, both to sanitary authorities and the general public, are set forth in the definitive report of the Austrian Medical Commission of the Vienna Imperial Academy of Science, sent to Bombay in 1897 to study the issue of a work on the morphology and biology of the bacillus and on artificial infection, &c. It has been prepared by Drs. Albrecht and Ghon, both surviving colleagues of Dr. Müller, who died of the plague in Vienna two years ago under melancholy circumstances reported at the time. The experiments recorded in the work now published show that certain species of animals are easily infected by rubbing the virulent matter lightly on the skin even when it is perfectly intact and free from injury. This is said to be the most frequent and important form of infection in the case of human beings. The second result of the experiments conducted in Vienna, which were forbidden after the unfortunate accident that cost the life of Dr. Müller and two other victims in 1898, has been to prove that perfect immunity can be given to the most susceptible animals against injections which would otherwise be absolutely fatal.

THE mode of infection with plague was referred to by Prof. A. Calmette in the second Harben lecture, delivered at the Examination Hall of the Royal College of Physicians and Surgeons on November 14. In the course of his lecture, Prof. Calmette said (reports the *Lancet*) that certain epidemics of plague had been remarkable for the fact that all the cases presented a primitive pneumonic form, the mode of entry having been, therefore, exclusively through the nose or mouth, while in others the infection had been produced by the skin, either following slight excoriations or bites of fleas, bugs, and other parasitical insects. During the epidemic in Portugal last year, he observed with Salimbeni a case in which the infection was through a bug-bite. Hankin and Simond, in India, had cited several examples of individuals who had contracted plague from touching diseased or dead rats. It was probable that the transmission of the plague to the man was by fleas living on the rats. Experiment in the laboratory had shown how quickly a healthy rat would contract the plague if caged with a diseased rat which was infested with fleas, while a healthy rat remained healthy when shut up with one which was diseased but was free from fleas. Whatever the mode of entry of the virus, multiplication of the plague bacillus resulted first in the lymphatic channels and then in the blood.

THERE ought to be a ready and liberal response to the appeal for contributions to establish a permanent memorial to the late Miss Mary Kingsley; for her works on the customs and institutions of the native races of West Africa are admired by a large public. A strong and representative committee has been formed, and it has been decided that, if sufficient funds are obtained, the memorial shall take the form of a small hospital, to be established in connection with the Liverpool School of Tropical Medicine, and shall also be used to institute "The Mary Kingsley Society of West Africa," to stimulate research and collect information concerning West Africa. Much information of the required kind as to West African sociology is already on record, scattered through the works of the older writers on those parts, as well as in more recent books of travel, in papers published in periodicals, in Blue-books and in official reports; and a very great deal more may still be gathered by Government officials, traders, missionaries, travellers and by the small but remarkable band of natives who are already educated. It is proposed that the "Mary Kingsley Society" should employ a trained ethnologist, both to collect and arrange in scientific form the material which is thus already on record, and to institute and direct research for further material of the same sort. Subscriptions may be assigned by the donors to either the hospital or the society, and the two funds will be kept separate. Contributions for the "Mary Kingsley Memorial Hospital" should be sent to Mr. A. H. Milne, B. 10, Exchange Buildings, Liverpool, and for the "Mary Kingsley Society of West Africa" to Mr. George Macmillan, St. Martin's Street, London, W.C.

THE U.S. Pilot Chart of the North Atlantic Ocean for November gives the longitude at which a number of vessels bound round Cape Horn crossed the latitude of 50° S. in the Atlantic and the Pacific respectively, and shows the courses followed by ships making the best and worst passages. The time occupied varied from eight to thirty days. Some of the captains kept as closely as possible to Cape Horn, while others reached the parallel of 60° S. In no other part of the world are the meteorological conditions more trying, owing to the persistency and violence of the westerly winds, the turbulence of the sea and frequent blinding squalls of hail and sleet. The Hydrographic Office has, therefore, rendered good service in pointing out the route to be followed, and the necessity of adapting it to the prevailing meteorological conditions, especially with regard to barometric pressure. A vessel fortunate enough to encounter easterly winds in rounding the Horn can only retain them as long as possible by remaining on the southern side of the low barometric pressure which they surround, instead of standing at once to the N.W., regardless of the indications of the barometer.

THE report of the Prussian Meteorological Office for the year 1899 points with satisfaction to the increased uniformity of action between all the German States as regards the methods of discussion and publication of observations, and to the tendency towards augmenting the number of observing stations where necessary. An important investigation has been carried out by Dr. Edler, at the suggestion of Dr. v. Bezold, on the influence of stray currents from electric tramways on the instruments for measuring terrestrial magnetism, with a view to determining the minimum distance to which magnetic observatories should be removed. The result shows that the observatory must be at least five miles from the line, and, for researches of a delicate nature, at least twice that distance is required. Special attention is paid to the investigation of the upper air by means of kites and balloons. Two of the unmanned balloons reached, during the year in question, about 22,000 and 26,000 feet respectively, and we learn from other sources that these important investigations are being actively carried on during the current year.

IN the *Journal* of the College of Science, Imperial University of Tokio, Prof. H. Nagaoka and Mr. K. Honda discuss the changes of volume and of length in iron, steel and nickel ovoids by magnetisation, and a separate paper by Mr. K. Honda deals with the combined effect of longitudinal and circular magnetisation on the dimensions of tubes of these metals. Among various results of the combined investigation we notice that :—(1) the transient current, as well as the longitudinal magnetisation produced, by twisting an iron or steel wire is opposite to that produced by twisting one of nickel up to moderate fields; (2) the transient current, as well as the longitudinal magnetisation produced, by twisting an iron, steel or nickel wire reaches a maximum in low fields; (3) in strong fields the direction of the current, as well as the longitudinal magnetisation, is the same in iron, steel and nickel. In alluding to this work we cannot but draw attention to the evidence of Japanese enterprise that is afforded by the publication of a journal containing scientific papers in English and German by Japanese professors and university graduates.

IN the *Philosophical Magazine* for September Dr. Sydney Young discusses the Law of Cailletet and Mathias, according to which the mean of the densities of a liquid and its saturated vapour for any stable substance is a rectilinear function of the temperature. It appears, among other results of this investigation, that the law, though approximately satisfied, is not absolutely true unless the ratio of the actual to the theoretical density at the critical point has the normal value 3·77. In most cases if the mean density be expanded in powers of the temperature, the sign of the coefficient of the second power depends on whether the ratio in question is greater or less than the normal. The coefficient of the second power is so small that the linear formula may be used to calculate the critical density from observations at temperatures above the boiling point, but the error thus introduced becomes considerable if it be required to calculate the critical density from observations of mean densities at lower temperatures; moreover, as pointed out by Guye, the law fails when the molecules differ in complexity in the liquid and gaseous states.

IN the *Journal de Physique* for September, M. E. Mathias discusses two interesting groups of loci relating to the thermodynamic properties of a liquid in presence with its saturated vapour. The first is the locus in the (p,v) plane of points, such that the volume of the liquid is equal to that of the vapour (the total mass being unity). This locus, the author finds, is a curve constantly convex towards the axis of abscissæ, and is the only one of the curves defined by the constancy of the ratio of the volumes of the liquid and vapour, which cuts the curve of saturation at a finite angle at the critical point. M. Mathias proves that the locus has no point of inflexion, but that the angular coefficient increases with the temperature. The second group discussed consists of the curves for which the masses of the liquid and vapour are constant. In accordance with Raveau's investigation, the only one of these curves which cuts the curve of saturation at a finite angle is that corresponding to equal masses of liquid and vapour.

MR. S. H. BURBURY communicates to Wiedemann's *Annalen* a reply to certain objections raised by Herr Zemplén Győző against his modifications of the Kinetic Theory of Gases. In it he gives certain amplifications of his proof of the property that the mean values of the products of velocities of neighbouring molecules of a gas are positive, and discusses the point at which his method diverges from those leading to the ordinary Boltzmann-Maxwell distribution.

THE U.S. Department of Agriculture has issued a bulletin containing records of investigations made by Mr. M. E. Jaffa, at the Agricultural Experiment Station of the University of California. A number of analyses of food materials were made, and dietary studies were conducted with a football team and with a chemist's family, as well as with a number of infants. In one instance the metabolism of nitrogen of an infant was also studied. Such investigations cannot fail to furnish aid in fixing upon dietary standards, and the proper factors to be used in computing the amounts eaten by persons of different ages as compared with an adult man.

FROM Messrs. B. O. Peirce and R. W. Wilson we have received a paper on the thermal diffusivities of different kinds of marble, published in the *Proceedings* of the American Academy of Arts and Sciences, xxxvi. 2. The tables which the authors give of the specific heats of various marbles are useful for several purposes, and the law of variation of the specific heat of dry Carrara marble with the temperature appears to be well represented by the formula $S = 0{\cdot}1844 + 0{\cdot}000379\, t^2$.

AT the last meeting of the Liverpool Geological Society, a paper was read on the carboniferous limestone of Anglesey, by the late Mr. G. H. Morton. The paper was left by the author in a finished state, and was intended by him to be the concluding portion of the series of papers on the carboniferous limestone of North Wales, on which he had been engaged for a period of nearly forty years. We are informed that, in addition to the paper itself, Mr. Morton left revised lists of fossils brought up to date with their comparative rarity or otherwise, for the districts previously described, but unfortunately the list for Anglesey was not completed, as he intended to visit one or two localities this summer to check his lists. It is intended to print the completed lists, but not the Anglesey list. Lists for certain localities in Anglesey were incorporated by Mr. Morton with his paper, which will be printed in full in the Society's *Proceedings*.

A LECTURE on the coal resources of Victoria, Australia, was delivered at the Imperial Institute, on Monday evening, by Mr. James Stirling, mining representative of the Colony. The attention of most nations is now turned to their coals. The demand to-day, owing to the rapid development of industries and extension of commerce, is greater than it has ever been before. The Australian Colonies have large areas of coal-bearing territory, and up to the present have produced a million tons of coal, the largest output having been from New South Wales. After giving a short account of the first discovery of coal in Victoria, Mr. Stirling said that about ten years ago he had been deputed to investigate the Gippsland coalfields, and he had been able to prove that within an area of 3,000 square miles of Jurassic rocks there were a number of seams of good black coal from 2 to 5 feet in thickness. But it is in brown coal that Victoria is specially rich. From borings carried on over a distance of 50 miles in the Latrobe Valley, Mr. Stirling has estimated that there cannot be less than 31,144,400,000 tons of brown coal. In several places shafts had been sunk through beds of from 20 to 200 feet thick, and at one place a coal bed, 70 feet thick, is being worked as a quarry by open face. Various analyses of these coals have shown them to be superior to the average German brown coal, and to have a much smaller percentage of ash. Austria, Germany and Italy have put their smaller deposits of this coal to commercial uses by compressing it into briquettes, distilling oils, etc., and the same could be done in Victoria, besides converting the fuel directly into electrical energy.

THE Geological Survey has published the second part of "The Geology of the South Wales Coal-field," in which the country around Abergavenny, included in the new series map, No. 232, is described by Messrs. A. Strahan and W. Gibson. A study of

the northern part of the Usk inlier of Silurian rocks confirms the opinion that a well-defined plane of division separates these strata from the Old Red Sandstone. A small portion of the Black Mountains, with the Old Red Sandstone Sugar Loaf, and the fine escarpment of the Blorenge, formed of Old Red Sandstone and Lower Carboniferous rocks, come in for description, to which Mr. J. R. Dakyns contributes. The Carboniferous Limestone displays the phenomenon of dolomitisation with unusual clearness, and notes on microscopic sections of the rock are contributed by Prof. W. W. Watts. Special attention is naturally given to the Coal-measures, and it is pointed out that while the coals are more extensively worked than formerly, the iron-ores are now hardly worked at all. The Glacial Drifts present many features of interest, notably in the case of a transported mass of Carboniferous grit, which forms a small hill upwards of 200 yards in length, and rests on Boulder Clay.

IN the October issue of the *American Naturalist*, Prof. H. F. Osborn reconsiders the evidence in favour of the existence in the Permian of a common ancestral stem from which have diverged dinosaurs and birds. It is argued that many of the resemblances between these groups are adaptive rather than genetic, while the apparent close correspondence in the structure of the pelvis between adult birds and the herbivorous dinosaurs (which are specialised types) is due in a considerable degree to a misinterpretation of the homology of some of their elements. Nevertheless, the resemblances between the two groups are so numerous as to justify the belief of kinship. And special importance attaches to the opinion that some sort of bipedalism was a common character of all dinosaurs, the suggestion being countenanced that certain forms, like Stegosaurus, have reverted from a bipedal to a quadrupedal mode of progression. Our present knowledge, therefore, justifies us in saying that "in this bipedal transition, with its tendency to form the tibiotarsus, the avian phylum may have been given off from the dinosaurian. This form of the Huxleyan hypothesis seems more probable than that the avian phylum should have originated quite independently from a quadrupedal proganosaurian reptile, because the numerous parallelisms and resemblances in dinosaur and bird structure, while quite independently evolved, could thus be traced back to a potentially similar inheritance."

VOLUME II., part 3, of the *Annals* of the South African Museum is occupied by the continuation of Sir George Hampson's synopsis of the moths of South Africa.

THE interest attaching to the great skua gull, on account of its narrow escape from extermination in the Shetlands, will cause many ornithologists to hail with satisfaction the account of its habits in the southern hemisphere, published by Mr. R. Hall in the October number of the *Victorian Naturalist*. The extent of the geographical range of this bird—from the Shetland Islands past Kerguelen's Land to New Zealand, and sparingly between the Cape of Good Hope, Ceylon and Southern Australia—is very remarkable.

THE latest issue of the *Morphologisches Jahrbuch* (vol. xxix. part 1) contains the results of an elaborate investigation by Dr. O. Grosser into the anatomical structure of the nasal cavity and throat of the species of bats indigenous to Germany. In the same number Prof. L. Balk describes and figures a human vertebral column presenting the rare abnormality of only six (instead of seven) cervical vertebræ. The comparative anatomy of the eye-muscles forms the subject of a communication by Herr H. K. Corning; while the nature of the partition between the pericardiac and peritoneal cavities engages the attention of Herr F. Hochstetter.

THE first three parts of a lavishly illustrated work on the "Living Races of Mankind" have been published by Messrs. Hutchinson and Co. The work is by the Rev. H. N. Hutchinson, the author of "Extinct Monsters" and other works of popular natural science, assisted by Prof. J. W. Gregory and Mr. R. Lydekker, F.R.S. There will be eighteen parts, published at fortnightly intervals, and when complete the work will be an attractive, as well as instructive, account of the customs, habits, pursuits, feasts, and ceremonies of the peoples of the world. Much care and trouble have been expended in collecting the photographs to illustrate the text, and it is to be hoped that the enterprise will meet with success. It is highly important that the British public should be interested in the study of ethnology, and the work now in course of publication will assist in attaining this end.

A FEW weeks ago Sir William White, the president of the Institution of Mechanical Engineers, brought before the Institution a letter from the Association of German Engineers suggesting that scientific and technical societies in the United States, France, Germany and England should unite in the preparation of an English, French and German technical dictionary. It was decided not to officially take part in the scheme, but the members of the Institution were invited to assist in the work. We are reminded of this by the appearance of the second volume of a "Practical Dictionary of Electrical Engineering and Chemistry, in German, English and Spanish," by Mr. Paul Heyne, which has just been received from Messrs. H. Grevel and Co. The dictionary is published in three volumes, one with German words alphabetically arranged, and their English and Spanish equivalents in parallel columns, and the two other volumes with English and Spanish words alphabetically arranged. The dictionary should be of value in manufactories and business houses concerned with engineering work.

THE second volume of "A Hand-List of the Genera and Species of Birds," by Mr. R. Bowdler Sharpe, has been issued by the Trustees of the British Museum. This volume contains the parrots and those birds commonly known as "Picarians," thus leaving the Passerines for the third volume. We propose to postpone a detailed notice of this useful work till the issue of the last volume.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*) from India, presented by Mr. D. Nagle; a Barbary Ape (*Macacus inuus*) from North Africa, presented by Mr. Thomas Pink; a Common Squirrel (*Sciurus vulgaris*), British, presented by Mr. C. W. Labarte; two Black Kites (*Milvus migrans*) from East Africa, presented by Mr. Campbell Hansburg; two Auriculated Doves (*Zenaida auriculata*) from South America, presented by Mrs. Aston; a Redbreast (*Erithacus rubecula*), British, presented by Canon Wilberforce; a Common Fox (*Canis vulpes*), British, presented by Mr. W. B. Spiers; a Horned Lizard (*Phrynosoma cornutum*) from California, presented by Mr. H. L. Brackenbury; a Common Chameleon (*Chamaeleon vulgaris*) from North Africa, presented by Mr. Small; two Brown Hyænas (*Hyaena brunneus*, ♂ ♀) from South Africa, a Common Wolf (*Canis lupus*, white var.), European, a Crab-eating Raccoon (*Procyon cancrivorus*) from South America two Rosy Parrakeets (*Palaeornis rosa*, ♂ ♀) from Burmah, two Vernal Hanging Parrakeets (*Loriculus vernalis*) from the East Indies, a Malabar Mynah (*Poliopsar malabaricus* from Hindostan, a Grey Monitor (*Varanus griseus*) from North Africa, three Giant Toads (*Bufo marinus*) from South America, deposited; an Indian Cobra (*Naia tripudians*) from the East Indies, purchased.

OUR ASTRONOMICAL COLUMN.

THE LEONID METEORS.—As was anticipated, the Leonid meteors failed to appear in any numbers last week. In a letter to the *Times*, Mr. W. H. M. Christie, the Astronomer Royal, states that a watch was kept at the Royal Observatory on the nights of November 13–14, 14–15 and 15–16, but comparatively few Leonids were seen. The following is a statement of the number of meteors noted by three observers on the three nights in question :—

	Length of watch.	Total number of meteors.	Number of Leonids.
November 13–14 ...	5 hours ...	25 ...	5
,, 14–15 ...	2 ,, ...	20 ...	6
,, 15–16 ...	4½ ,, ...	55 ...	23

It will be seen that there was nothing in the nature of a shower of Leonids.

Mr. E. C. Willis, writing from Norwich, says :—"Watches for the Leonids were first undertaken on the morning of November 10, and continued at various intervals until the evening of November 16. The total duration of the actual watches was 12¼ hours, but a considerable portion of this time was more or less cloudy, and the moon was above the horizon nearly the whole of it. The total number of Leonids recorded was 42, while the other meteors numbered 110. No Leonids were observed before the morning of November 11, or after the morning of November 16, and although it is no doubt very possible that the shower may have extended over a much longer period, it is certain that in that case it must have been of a very weak character.

"To determine the true maximum of the shower, it is necessary to combine the records of observers from various parts of the earth's surface, so as to obtain a continuous record. The maximum, however, as deduced from my own observations only, decidedly occurred on the morning of November 14. On this occasion the Leonids numbered about two-thirds of all the meteors seen, while on every other occasion they were decidedly in the minority. The hourly rate was about thirteen, but it is evident that many more would have been seen if the conditions had been more favourable, as hardly any of those observed were of less than the second magnitude. This portion of the shower seems to have ended a little before 17h. 30m., as between that time and 18h. none were observed.

"Perhaps the most remarkable point brought out by the observations was the extraordinary paucity of Leonids on the night of November 15. Watches were kept for 2¼ hours at various times between 11h. 15m. and 16h. 15m. In all, 32 meteors were seen, but only two of these were Leonids."

Prof. J. P. O'Reilly, of Dublin, informs us that on November 13, at about 5.51 p.m., he observed "a shooting star of much brilliancy, which seemed to start from about the Pleiades and to shoot in the direction of the south in a rising direction of about 25° to 30° with the horizon, and being visible over an arc of about 12° to 15°."

Balloon ascents were made from Paris on the nights of November 14, 15 and 16, but only a few stray meteors were seen.

ELEMENTS OF COMET 1900*b* (BORRELLY-BROOKS).—Prof. C. D. Perrine gives the following computed elements of this comet in the *Astronomical Journal*, No. 484, vol. xxi. :—

T = 1900 August 3d. ·20726 G.M.T.

$$\left.\begin{array}{ll} \omega = 12^\circ\ 26'\ 13''\cdot2 & \\ \Omega = 328\ \ 0\ \ 30\cdot1 & \} 1900\cdot0 \\ i = 62\ \ 30\ \ 46\ 3 & \end{array}\right.$$

$$\log.\ q = 0\cdot006390$$

NEW VARIABLE STAR IN LYRA.—Mr. A. Stanley Williams has detected another small variable in Lyra, and in the *Astronomische Nachrichten*, Bd. 153, No. 3671, gives the following co-ordinates for its position :—

$$\left.\begin{array}{l} \text{R.A.} = 18\text{h. } 54\text{m. } 22\text{s.} \\ \text{Decl.} = +34^\circ\ 45'\cdot5 \end{array}\right\} (1855\cdot0).$$

The variation in brightness, as measured from photographs taken with a 4·4 inch portrait lens during the period 1899 September 2 to 1900 October 21, is from 9·3 to 11·0 magnitude. No regular series of observations are given, but the period would appear to be about thirty days.

VISUAL OBSERVATION OF CAPELLA (α-AURIGÆ).—Prof. W. W. Campbell having some time ago discovered that this star was a spectroscopic binary with a period of 104 days, and the discussion of its parallax with the calculated dimensions of the orbit suggesting the possibility that it might be seen as a visual double star, Prof. W. J. Hussey has made a number of careful examinations of it with the 36-inch Lick telescope. In the *Astronomical Journal*, No. 484, vol. xxi, he furnishes the result of his observations. From the spectroscopic results it was indicated that the most favourable dates of observation would be April 15, June 6 and July 28, as at these times the components would be at their maximum separation. During these observations no evidence of the duplicity of the star could be detected. On August 2 and 5 further examination was made, using powers of 1000, 1500, 1900 and 2600. With all powers the star image appeared round. The "seeing" on these latter days was excellent, and it is considered that any elongation of the image as great as the tenth of a second of arc would have been perceptible even with the lowest power. On one occasion colour screens of various shades were used to reduce the light, but the result was exactly as before.

HUXLEY'S LIFE AND WORK.[1]

I ACCEPTED with pleasure the invitation of your Council to deliver the first Huxley lecture, not only on account of my affection and admiration for him and my long friendship, but it seemed also especially appropriate as I was associated with him in the foundation of this Society. He was President of the Ethnological Society, and when it was fused with the Anthropological we, many of us, felt that Huxley ought to be the first President of the new Institute. No one certainly did so more strongly than your first President, and I only accepted the honour when we found that it was impossible to secure him.

But the foundation of our Institute was only one of the occasions on which we worked together.

Like him, but, of course, far less effectively, from the date of the appearance of "The Origin of Species," I stood by Darwin and did my best to fight the battle of truth against the torrent of ignorance and abuse which were directed against him. Sir J. Hooker and I stood by Huxley's side and spoke up for Natural Selection in the great Oxford debate of 1860. In the same year we became co-editors of the *Natural History Review*.

Another small society in which I was closely associated with Huxley for many years was the X Club. The other members were George Busk, secretary of the Linnean Society; Edward Frankland, president of the Chemical Society; T. A. Hirst; head of the Royal Naval College at Greenwich, Sir Joseph Hooker; Herbert Spencer; W. Spottiswoode, president of the Royal Society; and Tyndall. It was started in 1864, and nearly nineteen years passed before we had a single loss—that of Spottiswoode; and Hooker, Spencer and I are now, alas! the only remaining members. We used to dine together once a month, except in July, August and September. There were no papers or formal discussions, but the idea was to secure more frequent meetings of a few friends who were bound together by common interests and aims, and strong feelings of personal affection. It has never been formally dissolved, but the last meeting was in 1893.

In 1869 the Metaphysical Society, of which I shall have something more to say later on, was started.

From 1870 to 1875 I was sitting with Huxley on the late Duke of Devonshire's Commission on Scientific Instruction; we had innumerable meetings, and we made many recommendations which are being by degrees adopted.

I had also the pleasure of spending some delightful holidays with him in Switzerland, in Brittany, and in various parts of England. Lastly, I sat by his side in the Sheldonian Theatre at the British Assocation meeting at Oxford, during Lord Salisbury's address, to which I listened with all the more interest knowing that he was to second the vote of thanks, and wondering how he would do it. At one passage we looked at one another, and he whispered to me, "Oh, my dear Lubbock, how I wish we were going to discuss the address in Section D instead of here!" Not, indeed, that he would have omitted any part of his speech, but there were other portions of the address which he would

[1] The first "Huxley Memorial Lecture" of the Anthropological Institute, delivered on November 13, by the Rt. Hon. Lord Avebury, F.R.S., D.C.L., LL.D.

have been glad to have criticised. I was therefore for many years in close and intimate association with him.

Huxley showed from early youth a determination, in the words of Jean Paul Richter, "to make the most that was possible out of the stuff," and this was a great deal, for the material was excellent. He took the wise advice to consume more oil than wine, and, what is better even than midnight oil, he made the most of the sweet morning air.

In his youth he was a voracious reader, and devoured everything he could lay his hand on, from the Bible to Hamilton's "Essay on the Philosophy of the Unconditioned." He tells us of himself that when he was a mere boy he had a perverse tendency to think when he ought to have been playing.

Considering how preeminent he was as a naturalist, it is rather surprising to hear, as he has himself told us, that his own desire was to be a mechanical engineer. "The only part," he said, "of my professional course which really and deeply interested me was physiology, which is the mechanical engineering of living machines; and, notwithstanding that natural science has been my proper business, I am afraid there is very little of the genuine naturalist in me; I never collected anything, and species work was a burden to me. What I cared for was the architectural and engineering part of the business; the working out the wonderful unity of plan in the thousands and thousands of diverse living constructions, and the modifications of similar apparatus to serve diverse ends."

In 1846 Huxley was appointed naturalist to the expedition which was sent to the East under Captain Owen Stanley in the *Rattlesnake* and good use indeed he made of his opportunities. It is really wonderful, as Sir M. Foster remarks in his excellent obituary notice in the Royal Society's *Proceedings*, how he could have accomplished so much under such difficulties.

"Working," says Sir Michael Foster, "amid a host of difficulties, in want of room, in want of light, seeking to unravel the intricacies of minute structure with a microscope lashed to secure steadiness, cramped within a tiny cabin, jostled by the tumult of a crowded ship's life, with the scantiest supply of books of reference, with no one at hand of whom he could take counsel on the problems opening up before him, he gathered for himself during those four years a large mass of accurate, important and, in most cases, novel observations, and illustrated them with skilful, pertinent drawings."

The truth is that Huxley was one of those all-round men who would have succeeded in almost any walk in life. In literature his wit, his power of clear description and his admirable style would certainly have placed him in the front rank.

He was as ready with his pencil as with his pen. Every one who attended his lectures will remember how admirably they were illustrated by his blackboard sketches, and how the diagrams seemed to grow line by line almost of themselves. Drawing was, indeed, a joy to him, and when I have been sitting with him at Royal Commissions or on committees, he was constantly making comical sketches on scraps of paper or on blotting-books which, though admirable, never seemed to distract his attention from the subject on hand.

Again, he was certainly one of the most effective speakers of the day. Eloquence is a great gift, although I am not sure that the country might not be better governed and more wisely led if the House of Commons and the country were less swayed by it. There is no doubt, however, that, to its fortunate possessor, eloquence is of great value, and if circumstances had thrown Huxley into political life, no one can doubt that he would have taken high rank among our statesmen. Indeed, I believe his presence in the House of Commons would have been of inestimable value to the country. Mr. Hutton, of the *Spectator*—no mean judge—has told us that in his judgment "an abler and more accomplished debater was not to be found even in the House of Commons." His speeches had the same quality, the same luminous style of exposition, with which his printed books have made all readers in America and England familiar. Yet it had more than that. You could not listen to him without thinking more of the speaker than of his science, more of the solid, beautiful nature than of the intellectual gifts, more of his manly simplicity and sincerity than of all his knowledge and his long services. His Friday evening lectures at the Royal Institution rivalled those of Tyndall in their interest and brilliance, and were always keenly and justly popular. Yet, he has told us that at first he had almost every fault a speaker could have. After his first Royal Institution lecture he received an anonymous letter recommending him never to try again, as whatever else he might be fit for, it was certainly not for giving lectures. It is also said that after one of his first lectures, "On the relations of Animals and Plants," at a surburban Athenæum, a general desire was expressed to the Council that they would never invite that young man to lecture again. Quite late in life he told me, and John Bright said the same thing, that he was always nervous when he rose to speak, though it soon wore off when he warmed up to his subject.

No doubt easy listening on the part of the audience means hard working and thinking on the part of the lecturer, and, whether for the cultivated audience at the Royal Institution or for one to working men, he spared himself no pains to make his lectures interesting and instructive. There used to be an impression that Science was something up in the clouds, too remote from ordinary life, too abstruse and too difficult to be interesting; or else, as Dickens ridiculed it in Pickwick, too trivial to be worthy of the time of an intellectual being.

Huxley was one of the foremost of those who brought our people to realise that science is of vital importance in our life, that it is more fascinating than a fairy tale, more thrilling than a novel, and that any one who neglects to follow the triumphant march of discovery, so startling in its marvellous and unexpected surprises, so inspiring in its moral influence and its revelations of the beauties and wonders of the world in which we live and the universe of which we form an infinitesimal, but to ourselves at any rate, an all important part, is deliberately rejecting one of the greatest comforts and interests of life, one of the greatest gifts with which we have been endowed by Providence.

But there is a time for all things under the sun, and we cannot fully realise the profound interest and serious responsibilities of life unless we refresh the mind and allow the bow to unbend. Huxley was full of humour, which burst out on most unexpected occasions. I remember one instance during a paper on the habits of spiders. The female spider appears to be one of the most unsociable, truculent and bloodthirsty of her sex. Even under the influence of love, she does but temporarily suspend her general hatred of all living beings. The courtship varies in character in different species, and is excessively quaint and curious; but at the close the thirst for blood which has been temporarily overmastered by an even stronger passion, bursts out with irresistible fury, she attacks her lover and, if he be not on the watch and does not succeed in making his escape, ends by destroying and sucking him dry. In moving a vote of thanks to the author, Huxley ended some interesting remarks by the observation that this closing scene was the most extraordinary form of marriage settlements of which he had ever heard.

He seemed also to draw out the wit of others. At the York "Jubilee" meeting of the British Association, he and I strolled down in the afternoon to the Minster. At the entrance we met Prof. H. J. Smith, who made a mock movement of surprise. Huxley said "you seem surprised to see me here." "Well," said Smith hesitatingly, "not exactly, but it would have been on one of the pinnacles, you know."

His letters were full of fun. Speaking of Siena in one of his letters, contained in Mr. Leonard Huxley's excellent Life of his father, he says: "The town is the quaintest place imaginable, built of narrow streets on several hills to start with, and then apparently stirred up with a poker to prevent monotony of effect."

And, again, writing from Florence:—

"We had a morning at the Uffizii the other day, and came back with minds enlarged and backs broken. To-morrow we contemplate attacking the Pitti, and doubt not the result will be similar. By the end of the week our minds will probably be so large, and the small of the back so small, that we should probably break if we stayed any longer, so think it prudent to be off to Venice."

By degrees public duties and honours accumulated on him more and more. He was Secretary, and afterwards President, of the Royal Society, President of the Geological and of the Ethnological Societies, Hunterian Professor from 1863 to 1870, a Trustee of the British Museum, Dean of the Royal College of Science, President of the British Association, Inspector of Fisheries, Member of Senate of the University of London, Member of no less than ten Royal Commissions, in addition to which he gave many lectures at the Royal Institution and elsewhere, besides, of course, all those which formed a part of his official duties.

In 1892 he was made a Member of the Privy Council, an unwonted but generally welcome recognition of the services which science renders to the community.

As already mentioned, he was elected a Fellow of the Royal Society in 1851. He received a Royal Medal in 1852, the Copley in 1888, and the Darwin Medal in 1894.

Apart from his professional and administrative duties, Huxley's work falls into three principal divisions—Science, Education and Metaphysics.

Scientific Work.

Huxley's early papers do not appear to have in all cases at first received the consideration they deserved. The only important one which was published before his return was the one "On the Anatomy and Affinities of the Family of the Medusæ."

After his return, however, there was a rapid succession of valuable Memoirs, the most important, probably, being those on Salpa and Pyrosoma, on Appendicularia and Doliolum and on the Morphology of the Cephalous Mollusca.

In recognition of the value of these Memoirs he was elected a Fellow of the Royal Society in 1851, and received a Royal Medal in 1852. Lord Rosse, in presenting it, said: "In these papers you have for the first time fully developed their (the Medusæ) structure, and laid the foundation of a rational theory for their classification." "In your second paper, 'On the Anatomy of Salpa and Pyrosoma' the phenomena, &c., have received the most ingenious and elaborate elucidation, and have given rise to a process of reasoning the results of which can scarcely yet be anticipated, but must bear, in a very important degree, upon some of the most abstruse points of what may be called transcendental physiology."

A very interesting result of his work on the Hydrozoa was the generalisation that the two layers in the bodies of Hydrozoa (Polyps and Sea Anemones), the Ectoderm and the Entoderm correspond with the two primary germ layers of the higher animals. Again, though he did not discover or first define protoplasm, he took no small share in making its importance known, and in bringing naturalists to recognise it as the physical basis of life, and in demonstrating the unity of animal and plant protoplasm.

Among other important memoirs may be mentioned those "On the Teeth and the Corpuscula Tactus," "On the Tegumentary Organs," "Review of the Cell Theory," "On Aphis," and many others.

His palæontological work, for which he has told us that at first "he did not care," began in 1855. That "On the Anatomy and Affinities of the Genus Pterygotus" is still a classic; in another, "On the Structure of the Shields of Pteraspis," and in one "On Cephalaspis" in 1858 he for the first time clearly established their vertebrate character; his work "On Devonian Fishes" in 1861 threw quite a new light on their affinities; and amongst other later papers may be mentioned that "On Hyperodapedon"; "On the Characters of the Pelvis," "On the Crayfish," and one botanical memoir, "On the Gentians," the outcome of one of his Swiss trips.

One of the most striking results of his palæontological work was the clear demonstration of the numerous and close affinities between Reptiles and Birds, the result of which is that they are regarded by many as forming together a separate group, the Sauropsida; while the Amphibia, long regarded as Reptiles, were separated from them and united with Fishes under the title of Ichthyopsida. At the same time he showed that the Mammalia were not derived from the Sauropsida, but formed two diverging lines springing from a common ancestor. And besides this great generalisation, says the Royal Society obituary notice, "the importance of which, both from a classificatory and from an evolutional point of view, needs no comment, there came out of the same researches numerous lesser contributions to the advancement of morphological knowledge, including, among others, an attempt, in many respects successful, at a classification of birds."

In conjunction with Tyndall, he communicated to the *Philosophical Transactions* a memoir on glaciers, and his interest in philosophical geography was also shown in his popular treatise on physiography.

But it would be impossible here to go through all his contributions to science. The Royal Society Catalogue enumerates more than a hundred, everyone of which, in the words of Prof. S. Parker, "contains some brilliant generalisation, some new and fruitful way of looking at the facts of science. The keenest morphological insight and inductive power are everywhere apparent; but the imagination is always kept well in hand, and there are none of those airy speculations—a liberal pound of theory to a bare ounce of fact—by which so many reputations have been made." Huxley never allowed his study of detail to prevent him from taking a wide general view.

I now come to his special work on Man.

In the "Origin of Species," Darwin did not directly apply his views to the case of Man. No doubt he assumed that the considerations which applied to the rest of the animal kingdom must apply to Man also, and I should have thought must have been clear to every one, had not Wallace been in some respects, much to my surprise, of a different opinion. At any rate, it required some courage to state this boldly, and much skill and knowledge to state it clearly.

He put it in a manner which was most conclusive, and showed, in Virchow's words, "that in respect of substance and structure Man and the lower animals are one. The fundamental correspondence of human organisation with that of animals is at present universally accepted."

This, I think, is too sweeping a proposition. It may be true for Germany, but it certainly is not true here. Many of our countrymen and countrywomen not only do not accept, they do not even understand, Darwin's theory. They seem to suppose him to have held that Man was descended from one of the living Apes. This, of course, is not so. Man is not descended from a Gorilla or an Orang-utang, but Man, the Gorilla, the Orang-utang and other Anthropoid Apes are all descended from some far away ancestor.

"A Pliocene Homo skeleton," Huxley said, "might analogically be expected to differ no more from that of modern men than the *Œningen canis* from modern Canes, or Pliocene horses from modern horses. If so, he would most undoubtedly be a man—genus Homo—even if you made him a distinct species. For my part, I should by no means be astonished to find the genus Homo represented in the Miocene, say, the Neanderthal man, with rather smaller brain capacity, longer arms, and more movable great toe, but at most specifically different."

In his work "On Man's Place in Nature," while referring to the other higher Quadrumana, Huxley dwelt principally on the chimpanzee and the gorilla, because, he said, "It is quite certain that the ape, which most nearly approaches man in the totality of its organisation, is either the chimpanzee or the gorilla."

This is no doubt the case at present; but the gibbons (Hylobates), while differing more in size, and modified in adaptation to their more skilful power of climbing, must also be considered, and, to judge from Prof. Dubois' remarkable discovery in Java of Pithecanthropus, which half the authorities have regarded as a small man, and half as a large gibbon, it is rather down to Hylobates than either the chimpanzee or the gorilla that we shall have to trace the point where the line of our far-away ancestors will meet that of any existing genus of monkeys.

Huxley emphasised the fact that monkeys differ from one another in bodily structure as much or more than they do from man.

We have Haeckel's authority for the statement that, "after Darwin had, in 1859, reconstructed this most important biological theory, and by his epoch-making theory of natural selection placed it on an entirely new foundation, Huxley was the first who extended it to man; and in 1863, in his celebrated three lectures on 'Man's Place in Nature,' admirably worked out its most important developments."

The work was so well and carefully done that it stood the test of time, and writing many years afterwards Huxley was able to say, and to say truly, that

"I was looking through 'Man's Place in Nature' the other day; I do not think there is a word I need delete, nor anything I need add except in confirmation and extension of the doctrine there laid down. That is great good fortune for a book thirty years old, and one that a very shrewd friend of mine implored me not to publish, as it would certainly ruin all my prospects" ("Life of Prof. Huxley," p. 344).

He has told us elsewhere ("Collected Essays," vii. p. xi.) that "it has achieved the fate which is the Euthanasia of a scientific work, of being inclosed among the rubble of the foundations of knowledge and forgotten." He has, however, himself saved it from the tomb, and built it into the walls of the temple of science, and it will still well repay the attention of the student.

For a poor man—I mean poor in money, as Huxley was all

his life—to publish such a book at that time was a bold step. But the prophecy with which he concluded the work is coming true.

"After passion and prejudice have died away," he said, "the same result will attend the teachings of the naturalist respecting that great Alps and Andes of the living world—Man. Our reverence for the nobility of manhood will not be lessened by the knowledge that man is, in substance and in structure, one with the brutes; for he alone possesses the marvellous endowments of intelligible and rational speech, whereby, in the secular period of his existence, he has slowly accumulated and organised the experience which is almost wholly lost with the cessation of every individual life in other animals; so that now he stands raised upon it as on a mountain top—far above the level of his humble fellows, and transfigured from his grosser nature by reflecting here and there a ray from the infinite source of truth" ("Collected Essays," vii. p. 155).

Another important research connected with the work of our Society was his investigation of the structure of the vertebrate skull. Owen had propounded a theory and worked it out most ingeniously that the skull was a complicated elaboration of the anterior part of the backbone; that it was gradually developed from a preconceived idea or archetype; that it was possible to make out a certain number of vertebræ, and even the separate parts of which they were composed.

Huxley maintained that the archetypal theory was erroneous; and that instead of being a modification of the anterior part of the primitive representative of the backbone, the skull is rather an independent growth around and in front of it. Subsequent investigations have strengthened this view, which was now generally accepted. This lecture marked an epoch in vertebrate morphology, and the views he enunciated still hold the field.

One of the most interesting parts of Huxley's work, and one specially connected with our Society, was his study of the ethnology of the British Isles. It has also an important practical and political application, because the absurd idea that ethnologically the inhabitants of our islands form three nations—the English, Scotch and Irish—has exercised a malignant effect on some of our statesmen, and is still not without influence on our politics. One of the strongest arguments put forward in favour of Home Rule used to be that the Irish were a "nation." In 1887 I attacked this view in some letters to the *Times*, subsequently published by Quaritch. Nothing is more certain than that there was not a Scot in Scotland till the seventh century; that the east of our island from John o' Groat's House to Kent is Teutonic; that the most important ethnological line, so far as there is one at all, is not the boundary between England and Scotland, but the north and south watershed which separates the East and West. In Ireland, again, the population is far from homogeneous. Huxley strongly supported the position I had taken up. "We have," he said, "as good evidence as can possibly be obtained on such subjects that the same elements have entered into the composition of the population in England, Scotland and Ireland; and that the ethnic differences between the three lie simply in the general and local proportions of these elements in each region. . . . The population of Cornwall and Devon has as much claim to the title of Celtic as that of Tipperary. . . . Undoubtedly there are four geographical regions, England, Scotland, Wales and Ireland, and the people who live in them call themselves and are called by others the English, Scotch, Welsh and Irish nations. It is also true that the inhabitants of the Isle of Man call themselves Manxmen, and are just as proud of their nationality as any other 'nationalities.'

. . . . . .

"But if we mean no more than this by 'nationality,' the term has no practical significance" ("The Races of the Brit. Isles," pp. 44, 45).

Surely it would be very desirable, especially when political arguments are based on the term, that we should come to some understanding as to what is meant by the word 'nation.' The English, Scotch and Irish live under one Flag, one Queen, and one Parliament. If they are not one nation, what are they? What term are we to use, and some term is obviously required, to express and combine all three. For my part I submit that the correct terminology is to speak of Celtic race or Teutonic race, of the Irish people or the Scotch people; but that the people of England, Scotland and Ireland, aye, and of the Colonies also, constitute one great nation.

As regards the races which have combined to form the nation, Huxley's view was that in Roman times the population of Britain comprised people of two types, the one fair, the other dark. The dark people resembled the Aquitani and the Iberians; the fair people were like the Belgic Gauls ("Essays," V. vii. p. 254). And he adds that "the only constituent stocks of that population, now, or at any other period about which we have evidence, are the dark whites, whom I have proposed to call "Melanochroi" and the fair whites or "Xanthochroi."

He concludes (1) "That the Melanochroi and the Xanthochroi are two separate races in the biological sense of the word race; (2) that they have had the same general distribution as at present from the earliest times of which any record exists on the continent of Europe; (3) that the population of the British Islands is derived from them, and from them only.

It will, however, be observed that we have (1) a dark race and a fair race; (2) a large race and a small race; and (3) a round-headed race and a broad-headed race. But some of the fair race were large, some small; some have round heads, some long heads; some of the dark race again had long heads, some round ones. In fact, the question seems to me more complicated than Huxley supposed. The Mongoloid race extend now from China to Lapland; but in Huxley's opinion they never penetrated much further West, and never reached our islands. "I am unable," he says, "to discover any ground for believing that a Lapp element has ever entered into the population of these islands." It is true that we have not, so far as I know, anything which amounts to proof. We know, however, that all the other animals which are associated with the Lapps once inhabited Great Britain. Was man the only exception? I think not, more especially when we find, not only the animals of Lapland, but tools and weapons identical with those of the Lapps. I must not enlarge on this, and perhaps I may have an opportunity of laying my views on the subject more fully before the Society; but I may be allowed to indicate my own conclusion, namely, that the races to which Huxley refers are amongst the latest arrivals in our islands; that England was peopled long before its separation from the mainland, and that after the English Channel was formed, successive hordes of invaders made their way across the sea, but as they brought no women, or but few, with them, they exterminated the men, or reduced them to slavery, and married the women. Thus through their mothers our countrymen retain the strain of previous races, and hence perhaps we differ so much from the populations across the silver streak.

Summing up this side of Huxley's work, Sir M. Foster has truly said that, "whatever bit of life he touched in his search, protozoan, polyp, mollusc, crustacean, fish, reptile, beast and man—and there were few living things he did not touch—he shed light on it, and left his mark. There is not one, or hardly one, of the many things which he has written which may not be read again to-day with pleasure and with profit, and, not once or twice only in such a reading, it will be felt that the progress of science has given to words written long ago a strength and meaning even greater than that which they seemed to have when first they were read."

In 1870, Huxley became a member of the first London School Board, and though his health compelled him to resign early in 1872, it would be difficult to exaggerate the value of the service he rendered to London and, indeed, to the country generally.

The education and discipline which he recommended were:—

(1) Physical training and drill.

(2) Household work or domestic economy, especially for girls.

(3) The elementary laws of conduct.

(4) Intellectual training, reading, writing and arithmetic, elementary science, music and drawing.

He maintained that "no boy or girl should leave school without possessing a grasp of the general character of science, and without having been disciplined more or less in the methods of all sciences."

As regards the higher education, he was a strong advocate for science and modern languages, though without wishing to drop the classics.

Some years ago, for an article on higher education, I consulted a good many of the highest authorities on the number of hours per week which in their judgment should be given to the principal subjects. Huxley, amongst others, kindly gave me his views. He suggested 10 hours for ancient languages and literature, 10 for modern languages and literature, 8 for arithmetic and mathematics, 8 for science, 2 for geography, and 2 for religious instruction.

For my own part I am firmly convinced that the amount of

time devoted to classics has entirely failed in its object. The mind is like the body—it requires change. Mutton is excellent food; but mutton for breakfast, mutton for lunch, and mutton for dinner would soon make any one hate the sight of mutton, and so Latin grammar before breakfast, Latin grammar before lunch, and Latin grammar before dinner is enough to make almost any one hate the sight of a classical author. Moreover, the classics, though an important part, are not the whole of education, and a classical scholar, however profound, if he knows no science, is but a half-educated man after all.

In fact, Huxley was no opponent of a classical education in the proper sense of the term, but he did protest against it in the sense in which it is usually employed, namely, as an education from which science is excluded, or represented only by a few random lectures.

He considered that specialisation should not begin till sixteen or seventeen. At present we begin in our Public School system to specialise at the very beginning, and to devote an overwhelming time to Latin and Greek, which, after all, the boys are not taught to speak. Huxley advocated the system adopted by the founders of the University of London, and maintained to the present day that no one should be given a degree who did not show some acquaintance with science and with at least one modern language.

"As for the so-called 'conflict of studies,'" he exclaims, "one might as well inquire which of the terms of a Rule of Three sum one ought to know in order to get a trustworthy result. Practical life is such a sum, in which your duty multiplied into your capacity, and divided by your circumstances, gives you the fourth term in the proportion, which is your deserts, with great accuracy" ("Life of Prof. Huxley," p. 406).

"That man," he said, "I think, has had a liberal education, who has been so trained in youth that his body is the ready servant of his will, and does with ease and pleasure all the work that, as a mechanism, it is capable of; whose intellect is a clear, cold, logic engine, with all its parts of equal strength, and in smooth working order; ready, like a steam engine, to be turned to any kind of work, and spin the gossamers as well as forge the anchors of the mind; whose mind is stored with a knowledge of the great and fundamental truths of nature and the laws of her operations; one who, no stunted ascetic, is full of life and fire, but whose passions are trained to come to heel by a vigorous will, the servant of a tender conscience; who has learned to love all beauty, whether of nature or of art, to hate all vileness and to respect others as himself."

He was also strongly of opinion that colleges should be places of research as well as of teaching.

"The modern university looks forward, and is a factory of new knowledge; its professors have to be at the top of the wave of progress. Research and criticism must be the breath of their nostrils; laboratory work the main business of the scientific student; books his main helpers.

Education has been advocated for many good reasons: by statesmen because all have votes, by Chambers of Commerce because ignorance makes bad workmen, by the clergy because it makes bad men, and all these are excellent reasons; but they may all be summed up in Huxley's words that "the masses should be educated because they are men and women with unlimited capacities of being, doing and suffering, and that it is as true now as ever it was that the people perish for lack of knowledge."

Huxley once complained to Tyndall, in joke, that the clergy seemed to let him say anything he liked, "while they attack me for a word or a phrase." But it was not always so.

Tyndall and I went, in the spring of 1874, to Naples to see an eruption of Vesuvius. At one side the edge of the crater shelved very gradually to the abyss, and, being anxious to obtain the best possible view, I went a little over the ridge. In the autumn Tyndall delivered his celebrated address to the British Association at Belfast. This was much admired, much read, but also much criticised, and one of the papers had an article on Huxley and Tyndall, praising Huxley very much at Tyndall's expense, and ending with this delightful little bit of bathos:—"In conclusion, we do not know that we can better illustrate Prof. Tyndall's foolish recklessness, and the wise, practical character of Prof. Huxley, than by mentioning the simple fact that last spring, at the very moment when Prof. Tyndall foolishly entered the crater of Vesuvius during an eruption, Prof. Huxley, on the contrary, took a seat on the London School Board."

Tyndall, however, returned from Naples with fresh life and health, while the strain of the School Board told considerably on Huxley's health.

Huxley's attitude on the School Board with reference to Bible teaching came as a surprise to those who did not know him well. He supported Mr. W. H. Smith's motion in its favour, which indeed was voted for by all the members except six, three of whom were the Roman Catholics, who did not vote either way.

"I have been," he said, "seriously perplexed to know by what practical measures the religious feeling, which is the essential basis of conduct, was to be kept up, in the present utterly chaotic state of opinion on these matters, without the use of the Bible. Take the Bible as a whole; make the severest deductions which fair criticism can dictate for shortcomings and positive errors; eliminate, as a sensible lay-teacher would do if left to himself, all that it is not desirable for children to occupy themselves with; and there still remains in this old literature a vast residuum of moral beauty and grandeur. And then consider the great historical fact that for three centuries this book has been woven into the life of all that is best and noblest in English history; that it has become the national epic of Britain, and is as familiar to noble and simple, from John o' Groat's House to Land's End, as Dante and Tasso were once to Italians; that it is written in the noblest and purest English, and abounds in exquisite beauties of mere literary form; and, finally, that it forbids the veriest hind who never left his village to be ignorant of the existence of other countries and other civilisations, and of a great past, stretching back to the furthest limits of the oldest nations in the world. By the study of what other book could children be so much humanised and made to feel that each figure in that vast historical procession fills, like themselves, but a momentary space in the interval between two eternities, and earns the blessings or the curses of all time, according to its effort to do good and hate evil, even as they also are earning their payment for their work?"

(*To be continued*).

THE NUMBERS OF THE AMERICAN BISON.

IT is eleven years since Mr. Hornaday published his interesting account of the extermination of the American Bison—a work that was fully noticed in these columns at the time. The author then estimated the number of living survivors of the species at 1091, of which 256 were in captivity and 835 running wild in British North America, the Yellowstone Park, and a few other localities. Recently Mr. Mark Sullivan has attempted to make a fresh census of the species, the results of which form the subject of a long article published in the *Boston Evening Transcript* of October 10.

As the result of his inquiries, Mr. Sullivan estimates the number of bison living at the present time as approximately 1024, of which 684 are in captivity and 340 running wild or half wild. His investigations appear to have been conducted with great care; and in the case of the greater number of domesticated herds—whether American or foreign—the numbers are practically accurate. The number of those running wild in the neighbourhood of the Great Slave Lake has, however, been arrived at by a process of "averaging;" and the extent of the herd in the Yellowstone is to a large degree a matter of guess-work. Another element of uncertainty is introduced by the alleged existence of wild bison in the mountains of Colorado; for while a Government official vouches for their occurrence in considerable numbers, old bison-hunters are very sceptical whether there are any at all. Admitting that the report of their existence in this district may be true, the author allows 21 as their conjectural number. He adds that reports of wild bison in other parts of the United States are pure fabrications.

The largest herd of pure-bred domesticated bison living in the United States is one belonging to the heirs of the late Mr. C. Allard, which ranges over the Flathead Indian Reserve in Montana, and numbers 259 head. Next to this comes the herd of Mr. Jones Goodnight, in Armstrong County, Texas, with a total of 110 head. The number living in countries other than America is given at 100, of which 26 are in England, the Duke of Bedford's herd of 12 at Woburn Abbey being probably the largest in this country.

Whatever may be the real number of wild bison, it is evident from the figures given above that they have decreased very seriously since 1887, while those living in captivity exhibit, on

the other hand, a very marked increase in numbers. Although the bison in the Yellowstone are protected so far as possible from poachers, many of them fall victims to beasts of prey, and their rate of increase seems to be slow. Those in British territory are much harried by Indians, and are consequently decreasing daily in number.

It is accordingly to the domesticated and semi-domesticated herds that we have to look for the maintenance of the species. And with the example of the Lithuanian herd of European bison before us, coupled with the larger size of several of the American herds, and the facilities that exist for the introduction of fresh blood to counteract the ill-effects of inbreeding, there would seem, at first sight, to be a great probability that the American bison may survive for many generations.

It has, however, been brought to the notice of the writer of the article under consideration that, in the case of animals living under conditions other than those which properly belong to them, there is a great tendency for the proportion of males among the offspring to increase in an alarming degree at the expense of the females. And to such an extent does this abnormality prevail in some of the herds, that in Bronx Park, New York, every calf is put down as a bull as a matter of course. If this were universal, the fate of the species would evidently be soon sealed; but fortunately it is not so, and as the Allard herd wanders almost at will under what are practically the natural conditions of the species, there still appears (in spite of certain disabilities) hope that the final extinction of *Bos bison* is a remote contingency. R. L.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Mr. A. J. Evans, Keeper of the Ashmolean Museum, will give three public lectures on "The Palace of Knossos: its Art Treasures and Clay Archives," explanatory of his recent work in Crete; the dates announced are November 22, November 29, December 6.

The trustees of the Craven Fellowships have made a grant of 200*l.* to assist Messrs. Grenfell and Hunt in their Egyptian researches.

On Thursday, November 15, the new degree of Doctor of Letters was conferred upon Mr. B. P. Grenfell, Mr. A. S. Hunt, and Mr. J. Rhys, Principal of Jesus College, and the degree of Doctor of Science upon Prof. A. E. H. Love and Mr. H. W. Lloyd Tanner.

Prof. Miers has been appointed a delegate for the inspection and examination of schools.

The report of the Delegacy for the Training of Teachers states that there were twenty-six students on the books of the College at the end of the academical year. Mr. Roscoe, having been appointed Lecturer on Education in the University of Birmingham, has been succeeded by Mr. A. W. Priestley as Master of Method at the Day Training College.

CAMBRIDGE.—The syndicate appointed to superintend the erection of the Hopkinson wing of the engineering laboratory report that the work has been successfully caried out at a cost of 5516*l.* Of this, Mrs. Hopkinson and her family contributed 5000*l.* Additional donations, amounting to 1700*l.*, have been received for the furnishing and equipment of the building, which have thus been carried out without expense to the University. The classes, however, are still growing rapidly, and the accommodation is already insufficient. A further extension will soon have to be undertaken, and new workshops are much needed.

The Medical School Syndicate propose that the existing Museum of Surgery and Pathology, which has become so infected with dry-rot that it endangers the contiguous structures, shall be demolished, and that the new Humphry Museum shall be erected on its site at a cost of some 8000*l.* Over 1000*l.* has been specially contributed for this memorial to the late Sir George Humphry, and it is hoped that if the work is actually begun other donations to the building fund may be received.

THE *British Medical Journal* states that under the will of the late Dr. D. J. Leech, professor of materia medica and therapeutics in the Owens College, Manchester, that college will eventually benefit to the extent of 10,000*l.*, which Dr. Leech bequeathed for the purpose of endowing a chair of materia medica and therapeutics. The bequest will take effect upon the demise of Mrs. Leech.

LORD ROSEBERY dealt with many Imperial questions in his Rectorial address at Glasgow University on Friday last, but none were of more importance than those concerned with the factors of industrial progress, and their educational relationships. The following extracts from the *Times* report of his speech are of particular interest to all who are engaged in the work of science or scientific education:—The United States Consul at Chemnitz has remarked that, "If an industry in Germany languishes, immediately a commission inquires into the causes and recommends remedial measures, among which usually is the advice to establish technical or industrial schools, devoted to the branch of business under consideration." In a word, they go to the root, to the principle, to the source. This is thoroughness, this is the scientific method applied to manufacture, and we see its success. The Americans, I gather, have hitherto applied themselves rather less to the principles than the applications of science. I do not pretend to say which are right. The Germans are alarmed at the development of American commerce, and we are alarmed at both. At any rate, both in Germany and the United States you see an expenditure and a systematic devotion to commercial, and technical, and scientific training. I know that much is done, too, in Great Britain. But I doubt if even that is carried out in the same methodical way; nor is there anything like the same lavish, though well-considered, expenditure. It always seems to me as if in Germany nothing, and in Britain everything, is left to chance.

For the practical purposes of the present day, said Lord Rosebery at Glasgow, a University which starts in the twentieth century has a great superiority over a University founded in the fifteenth, more especially when it is launched with keen intelligence of direction and ample funds, as is the new University of Birmingham. These practical Universities are the Universities of the future; for the average man, who has to work for his livelihood, cannot superadd the learning of the dead to the educational requirements of his life and his profession. There will always be Universities, or, at any rate, colleges, for the scholar, the teacher, and the divine; but year by year the ancient Universities will have to adapt themselves more and more to modern exigencies. There was a time, long years ago, when the spheres of action and of learning were separate and distinct, when laymen dealt hard blows and left letters to the priesthood. That was to some extent the case when our oldest Universities were founded. But the separation daily narrows, if it has not already disappeared. It has been said that the true University of our days is a collection of books. What if a future philosopher shall say that the best University is a workshop? And yet the latter definition bids fair to be the sounder of the two. The training of our schools and colleges must daily become more and more the training for action, for practical purpose. Are there not thousands of lads to-day plodding away, or supposed to be plodding away, at the ancient classics who will never make anything of those classics, and who, at the first possible moment, will cast them into space, never to reopen them? Think of the wasted time that that implies; not all wasted, perhaps, for something may have been gained in power of application, but entirely wasted so far as available knowledge is concerned. And if you consider, as you will have to consider in the stress of competition, that the time and energy of her citizens is part of the capital of the commonwealth, all those wasted years represent a dead loss to the Empire. If, then, these recent events and the present conditions of the world induce thinkers and leaders in this country to test our strength and methods for the great struggle before us, they must reckon the training of man. On that, under Providence, depends the future, and the immediate future, of the race; and what is Empire but the predominance of race?

SOCIETIES AND ACADEMIES.

LONDON.

Linnean Society, November 1.—Prof. S. H. Vines, F.R.S., President, in the chair.—Mr. J. E. Harting exhibited and made remarks upon the following birds which had been recently forwarded to him for examination:—(1) A hybrid between blackcock and red grouse, shot at Brechin, N.B., September 14. (2) A glossy ibis, killed at Saltash, Devon, October 4. (3) A little owl, obtained at Dunmow, Essex, October 22. Mr. F. D. Godman concurred in identifying the game-bird as a hybrid

between the species named, and considered such hybrids of rare occurrence, while examples of a cross between blackcock and pheasant were not nearly so uncommon. Mr. Howard Saunders regarded the little owl (*Carine noctua*) as having little if any claim to be considered a British bird; its occasional appearance in England being due to the fact that a good many had been turned out from time to time in different counties.—Mr. George Massee exhibited a series of coloured drawings and an extensive collection of fungi.—Dr. Charles Chilton, M.A., F.L.S., read a paper on the terrestrial isopods of New Zealand.—M. J. E. S. Moore read a paper on the character and origin of the "park-lands" in Central Africa. These park-lands in the Tanganyika district have quite the appearance of having been formed by the hand of man, but are really natural growths, due to the fact that light surface-soil has been laid down over what appear to have been lake-deposits. Any given line of country will show large plantations, with quite a home-like look, separated by grass-lands; and, as Tanganyika is approached, they dwindle in size till they consist of a few shrubs, overshadowed by giant euphorbias, cactus-like in appearance. Then come stretches of grass, dotted with euphorbias, and, last of all, the salt steppes by the lake, which is now held to have had at one time an outlet to the sea. Mr. Moore's explanation is that at first only the euphorbias would grow on the salt steppes; but as these sprang up they afforded a shade and shelter to self-sown shrubs, each of which, as it established a footing, contributed to the natural planting of the area by the distribution of its seeds, till this process reached its highest development in the large plantations where the shrubs overtopped the euphorbias to which they owed their growth.

Geological Society, November 7.—J. J. H. Teall, F.R.S., President, in the chair.—Additional notes on the drifts of the Baltic coast of Germany, by Prof. T. G. Bonney, F.R.S., and the Rev. E. Hill. The authors, prior to revisiting Rügen, examined sections of the drift to the west of Warnemünde, with a view of comparing it with that of the Cromer coast. The authors give reasons to show that neither solution of the chalk, nor ice-thrust, nor folding, nor even faulting, can satisfactorily explain the peculiar relations of the drift and chalk in Rügen; and they can find no better explanation than that offered in their previous paper.—On certain altered rocks from near Bastogne and their relations to others in the district, by Dr. Catherine A. Raisin. Prof. Renard, from the petrographical study of specimens, and Prof. Gosselet, after description of the district and its stratigraphy, have attributed the changes in these rocks to mechanical disturbances. Dumont had previously described many examples, and inclined to the view of contact-alteration, which was favoured by Von Lasaulx's discovery of a granite in the Hohe Venn, and M. Dupont's identification of chiastolite from Libramont. The present paper treats especially of the garnetiferous and hornblendic rocks, giving the full petrographical and field-details of a few examples. It points out that the effects of pressure are evident over the whole district, while mineral modifications resembling the results of slight contact-action are found in certain areas. In a few cases these modifications are more marked, and sometimes increase as we approach veins composed of quartz, felspar and mica, such as might be connected with a concealed granite. The peculiar garnetiferous and hornblendic rocks, although occurring within the zone of alteration, are extremely limited, often forming patches or bands a few feet across. They differ, as described in the paper, from ordinary contact-altered rocks. The evidence, in the authoress's opinion, is in favour of Prof. Bonney's suggestion that they are due to some form of hot-spring action.

Entomological Society, November 7.—Mr. G. H. Verrall, President, in the chair.—Mr. G. S. Saunders exhibited specimens, from Devonshire, of *Pieris rapae* and *Plusia gamma*, caught by the proboscis in flowers of *Araujia albens*, Don., a climbling plant of the natural order *Asclepiadaceae*; and explained the nature of the mechanism by which the insects were entrapped by the flowers. He also showed specimens of the "bedeguar" gall formed apparently on the "hips," or fruit, of *Rosa canina*. Mr. Gahan remarked that the capture of insects by the plant named had recently been investigated in France by MM. Marchand and Bonjour, whose account appeared in the *Bulletin* de la Soc. des Sciences Nat. de l'Ouest de la France, for 1899. These authors concluded that insects were captured only by immature flowers, the anther-wings, in the cleft between which the proboscis of the insect is caught, being at that time stiff and resistant; but when the flowers are ripe the anther-wings become less rigid and do not offer sufficient resistance to the withdrawal of the proboscis, which carries with it the pollinia ready to be transferred to the stigma of the next flower visited by the insect.—Mr. W. J. Kaye exhibited *Hydrocampa stagnalis*, var., with examples of the typical form for comparison; the variety differed in having the basal line nearly obsolete, the sub-median double line much strengthened internally and reduced externally, and the cross band connecting the sub-median and post-median bands almost entirely obliterated.—Mr. F. Merrifield exhibited a variety of *Argynnis dia* taken with a few examples of the ordinary form at Ilanz in the Vorder Rhein valley early in September last, when what was, he believed, a third brood of this species, was abundant; the variety was much blackened on the basal half of all the wings.—Canon Fowler exhibited a specimen of *Orochares angustatus*, Erichs., a Staphylinid beetle new to the British list, taken at Leverstock Green, Herts, by Mr. Albert Piffard.—The Rev. F. D. Morice mentioned, as a fact of some interest, that in a nest of *Formica sanguinea* at Weybridge, in which he found males and workers of that species, he found also males and females as well as workers of the slave-ant *Formica fusca*, an experience somewhat different to that of Huber and Darwin, who stated that workers only of the slave species were found in the nests of *sanguinea*.—The Secretary read "Some notes on variations of *Zeritis thysbe*, Linn.," communicated by Mr. H. L. L. Feltham, and exhibited one female and two male specimens of one of the rare forms referred to in the paper.

Mathematical Society, Nov. 8.—Lord Kelvin, G.C.V.O., President, in the chair.—Reports from the Treasurer and Secretaries were read and received. The ballot was taken and the gentlemen whose names appeared in NATURE for October 18 were declared to have been duly elected to serve on the Council for the session 1900–1901. Lord Kelvin, on leaving the chair, thanked the Society for having elected him to the office, and regretted that the distance (400 miles) of his home from town had caused him to be so rarely able to take the chair. He then cordially welcomed his successor, Dr. Hobson, and expressed his pleasure in having him for his successor. The new President thanked the members for electing him, and then called upon Lord Kelvin to deliver his address "On the transmission of force through a solid." The address was a very interesting one, and on the motion of Dr. Glaisher, seconded by Dr. Larmor and backed by the acclamation of the members present, Lord Kelvin consented to put his remarks into a shape fitted for publication in the Society's *Proceedings*.—Dr. Glaisher then communicated two papers: (i) A general congruence theorem relating to the Bernoullian function; (ii) On the residues of Bernoullian functions for a prime modulus, including as special cases the residues of the Eulerian numbers and the I-numbers.—Mr. Tucker next communicated some notes on Isoscelians, and gave a few properties of two in-triangles similar to the pedal triangle. These triangles have their sides perpendicular to the antiparallels of the primitive triangle.—The President communicated the remaining papers by simply reading their titles. In a simple group of an odd composite order every system of conjugate operators or subgroups includes more than fifty, Dr. G. A. Miller.—Prime functions on a Riemann surface, Prof. A. C. Dixon.—On Green's function for a circular disc, H. S. Carslaw.—On the real points of inflection of a curve, A. B. Basset.—On quantitative substitutional analysis, A. Young.—On a class of plane curves, J. H. Grace.—(i) On group characteristics, and (ii) On some properties of groups of odd order, Prof. W. Burnside.—(i) Conformal space transformations, and (ii) Dynamical and other applications of algebra of bilinear forms, T. J. Bromwich.

Mineralogical Society, November 13.—Prof. A. H. Church, F.R.S., President, in the chair.—Mr. G. F. Herbert Smith described an improved form of his three-circle goniometer, in which the use of an autocollimating telescope obviates the disadvantage of the original instrument that measurements could only be made through 93°.—Mr. Harold Hilton gave a simple proof of the rationality of the anharmonic ratio of four faces of a zone.—Mr. R. H. Solly, in continuation of the investigation of sulpharsenites of lead from the Binnenthal, described the crystallographic characters of rathite.

MANCHESTER.

Literary and Philosophical Society, October 30.—Prof. Horace Lamb, F.R.S., President, in the chair.—A paper on the solubility of certain lead glasses or fritts used in the preparation

of pottery glazes, by William Jackson and Edmond M. Rich, was read. The paper described experiments carried out to determine what factors, apart from chemical composition, affect the amount of lead oxide yielded to dilute hydrochloric acid by lead fritts as used by potters. It was found that the solubility is increased in a very marked manner by increase of fineness, so that it appears that if details are given of the solubility of fritts they should be accompanied by particulars of its degree of fineness. The solubility of the same fritt reduced to different degrees of fineness varied from 1 to 15 per cent. of the material used. It was found also that after the action of the acid has proceeded for a short time it appears that the whole of the soluble lead has been extracted. This, however, was due, not to the absolute insolubility of the remainder, but to the formation of an insoluble layer on the surfaces exposed to the action of acid which protects the particles from further action. By removing this layer by chemical or physical means it was found possible to extract more lead oxide from the fritt, and by continually removing this insoluble layer it was possible to extract continually more lead oxide, until practically the whole of the lead oxide passed into solution.—A paper on the phloem of *Lepidophloios* and *Lepidodendron* was read by Prof. F. E. Weiss. The author had examined sections of these two nearly allied fossil plants in which the tissues have been exceptionally well preserved. The examination of these specimens led him to the conclusion that the phloem region is not occupied by large secretory sacs, and that the tissue is not partially disorganised during the life of the plant, as has been suggested, but that it consists of cells not fundamentally different from those composing the phloem of living lycopods. In those stems, however, in which secondary thickening is found to have taken place, an active division of some of the phloem cells can be observed. The author discussed the possible reasons for the usual destruction of the phloem elements, and considered that it must take place previous to mineralisation, but after the death of the plant. He attributed the more ready destruction of the phloem cells to the peculiar nature of the cell walls, which he thought were probably composed—as in the case of the nearly allied lycopods—of amyloid, a semihydrate of cellulose. This substance is more easily acted upon by water than cellulose, and consequently the phloem would be more liable to rapid decay than the rest of the tissues.

November 13.—Prof. Horace Lamb, F.R.S., President, in the chair.—Prof. Reynolds mentioned a curious phenomenon observed at sunset during the summer, in the form of a narrow beam of light proceeding vertically from the sun and persisting for about half an hour after sunset. A similar appearance was seen by Mr. Thorp when crossing the Mediterranean in the early summer.—Dr. Lees called attention to a useful expression for calculating the circumference of an ellipse to a close degree of approximation, more simple than those ordinarily given in engineers' text-books.—Mr. Thorp described a method by which he had succeeded in silvering his diffraction films, and he referred to a device by which he expects to obtain similar films from concave surfaces.—Prof. Dixon discussed the reversal of lines of the spectrum of an explosion wave observed by Profs. Dewar and Liveing, and gave an alternative explanation to that offered by them. He also discussed Mendeléeff's theory as to the nature of the action which takes place when hydrogen and oxygen or other pairs of gases combine, and suggested an alternative view of the nature of the reaction.

EDINBURGH.

Royal Society, November 5.—Sir Arthur Mitchell, Vice-President, in the Chair.—As usual at the first meeting of the session, the chairman gave a short review of the work of the preceding session. In particular, attention was drawn to the bequest to the Society made by the late Prof. Piazzi Smythe; to the representation which the Society had made to the Geological Survey Committee as to the advisability of completing the survey of Scotland on the six-inch scale; and to the Scottish Antarctic Expedition now being organised by Mr. W. S. Bruce.—A paper was read by Drs. O. Noel Paton, J. C. Dunlop and Elsie Inglis on dietary studies of the poorer classes in Edinburgh. The diets of fifteen families, including ninety-five individuals belonging to the labouring classes, were studied by the method employed by Atwater in America. It was found that the average diet of the thrifty poor contained 108 grms. of proteid and 3275 large calories of energy per man per diem; but among the thriftless and ignorant very defective diets were observed. Such a deficient diet cost, for an average family of father, mother and four or five children, about 15*s.* 6*d.* per week, which leaves out of a labourer's wage of 20*s.* to 22*s.* a sum too small for the other necessaries of life and nothing for recreation.—In a note on the relations amongst the thermo- and electro-magnetic effects, Dr. W. Peddie showed how the Hall, the Nernst, the Ettingshausen and the Leduc effects may be represented in mutual relation, so that when, say, the Leduc effect is known, the others may be predicted. For this purpose consideration is taken of the direction of the resultant heat flow induced in consequence of the changes of temperature gradient evidenced in the Thomson effect. The Leduc effect is known only in the case of bismuth, yet, in the case of other metals, the possible signs of the remaining effects can be deduced; and the actual signs are found to be included in these in all cases except those of cobalt and zinc.

Mathematical Society, Nov. 9.—Mr. R. F. Muirhead in the chair.—The following papers were read: Euclidian proof of Pascal's theorem, by Mr. R. F. Davis.—Note on the expression for the area of a triangle, by Mr. C. Tweedie.—Proof of a theorem in co-ordinate geometry, by Mr. J. Jack (communicated by Mr. A. Milne).—The following were elected office-bearers for the current session: President, J. W. Butters; Vice-President, Geo. Duthie; Hon. Secretary, D. C. McIntosh; Hon. Treasurer, James Archibald.

PARIS.

Academy of Sciences, November 12.—M. Maurice Lévy in the chair.—On the next appearance of the Leonids, and their aërostatic observation, by M. J. Janssen. In order to prevent the interference of clouds with the observations of the Leonids, arrangements had been made for a balloon ascent on each of the three nights, November 13–14, 14–15, and 15–16, during which Leonids may be expected.—On the conditions affecting chemical activity under the action of silent electrical discharges, by M. Berthelot. The effects of silent electrical discharges ("effluve") and of atmospheric electricity are compared, the production of oxides of nitrogen, ozone and nitric acid being possible in this way without actual lightning. Some of the effects produced in Deville's hot and cold tube experiments, and ascribed by him to dissociation, are also ascribed by the author to similar electrical effects.—On the order of formation of the elements of the central cylinder in the root and stem, by M. Gaston Bonnier. The central cylinder presents the sam general structure in both root and stem, the constitution and the order of development of the tissues being the same in both cases, except as regards the position of the ligneous poles. The paper is illustrated by six diagrams showing sections of *Thalictrum silvaticum*, *Chenopodium polyspermum*, *Ricinus communis*, *Pulmonaria officinalis* and *Ranunculus acris*.—The Perpetual Secretary announced to the Academy the death of M. l'Abbé Armand David, Correspondent for the Section of Geography and Navigation.—On surfaces which possess a non-linear series of rational curves, by M. S. Kantor.—On the series analogous to Lagrange's series, by M. A. Bougaïev.—Superficial lines appearing in the sawing of metals, by M. Ch. Frémont. Six photographs are given of sections of different shapes cut by sawing. A series of lines, differing from the saw markings, are produced, which vary with the shape of the piece cut, the systems of lines being parallel to the edges cut by the saw. They differ from Lüder's lines.—On the experiments of Prof. Rowland relating to the magnetic effect of "electrical convection," by M. V. Crémieu. In previous communications the author has described experiments which led him to the conclusion that the so-called "electrical convection" produced no magnetic effect. Further experiments are now described, corresponding exactly to those of Rowland and of Himstedt, in which a charged disc rotates round a magnetised needle. In the first experiment no deviation of the needle was observed, although the effect should have been from 12 to 175 mm. In other experiments a deviation was obtained, but it is shown that these deviations are not due to the magnetic effect of the electrical convection, since they can be suppressed by the intervention of a metallic plate. The whole work tends to show that, contrary to the experiments of Rowland, electrical convection produces no magnetic effect.—On the splitting-up by alkalis of acetylenic ketones, by MM. Ch. Moureu and R. Delange. Ketones of the type $R-C\equiv C-CO.R'$ are split up by heating with alkalis. An acid and a ketone would, in general, appear to be produced simultaneously, thus benzoylphenylacetylene, $C_6H_5.C\equiv C.CO.C_6H_5$, gives benzoic acid and acetophenone.

Acetylphenylacetylene behaves in an exceptional manner, giving phenylacetylene and acetic acid.—On the constitution of camphoric acid and the migrations which occur within its molecules, by M. G. Blanc.—On the evolution of terpene derivatives in the geranium, by M. Eug. Charabot. Acidity diminishes as the plant grows, and the amount of ester increases, possibly at the expense of the geraniol. The ketonic compounds occur chiefly at the time when the plant possesses the maximum respiratory activity.—On the presence of invertine or sucrase in grapes, by M. V. Martinand.—The old course of the Aar, near Meiringen (Switzerland), by M. Maurice Luglon.—On the regeneration of confined air by means of sodium peroxide, by MM. Desgrez and Balthazard. A reclamation of priority against H. G. F. Jaubert.

NEW SOUTH WALES.

Linnean Society, September 26.—The Hon. James Norton, President, in the chair.—Phosphorescent fungi in Australia, by D. McAlpine. Phosphorescent fungi are generally natives of warm climates, and the largest number of Agarics possessing this property, for any locality, has been met with in Australia. Out of twenty-one species known altogether, fifteen occur in Australia, while five of them are confined to the Island Continent. *Pleurotus candescens*, F.v.M., is very common in the neighbourhood of Melbourne during April and May, and was specially studied in connection with the phenomenon of phosphorescence or luminosity. Luminosity was practically confined to the gills, which were found to be decidedly acid. The light probably proceeded from excreted luminous metabolic products known as phosphorescents.—On a new genus and two new species of Australian *Coccidae*, by E. Ernest Green. A species of *Rhizococcus* from *Acacia decurrens* at Mittagong, N.S.W., and one of *Antecerococcus* (gen. nov.) from *Pittosporum eugenioides*, at Bathurst, N.S.W., are described.—Observations on the tertiary flora of Australia, with special reference to Ettingshausen's theory of the tertiary cosmopolitan flora, Part ii., by Henry Deane. The aspect of the subject particularly considered in this paper is the venation of leaves and its untrustworthiness in the determination of botanical affinities. Plants cannot be classified by their leaves, as their form and venation do not in any way correspond to the acknowledged botanical divisions. It is found that the same types occur in widely different orders and different types in the same genus. As to variability of types in the same genus, examples from the genera *Quercus* and *Eucalyptus* were given; and illustrations of closely similar and even undistinguishable leaves of distinct genera and orders were mentioned.—Notes on the botany of the interior of New South Wales, Part i., by R. H. Cambage. This first instalment is descriptive of the characteristics, distribution and relation to geological formation, of the more conspicuous members of the flora, such as the Eucalypts, Acacias, &c., noticeable between Bourke and Cobar, a distance of about 100 miles.—A fish disease from George's River, by R. Greig Smith. Under the proposed name of *Vibrio bresmiae* an organism is described which was isolated from the carcass of a fish found dying under suspicious circumstances in George's River. The organism is pathogenic to fish, producing death in about two days. It is non-phosphorescent, but is otherwise closely allied to this group of vibrions.—Australian land planarians: descriptions of new species, and notes on collecting and preserving, No. ii., by Thos. Steel. Three new species of *Geoplana* from Western Australia are described, and the occurrence of a new variety of *G. quinquelineata*, F. and H., is noted. These are of interest as being the first land planarians recorded from this part of Australia. The same new variety of *G. quinquelineata* is also recorded from South Australia, and a description of it is given. Another *Geoplana* found in the vicinity of Sydney is described as new.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 22.

ROYAL SOCIETY, at 4.30.—Further Note on the Spectrum of Silicium: Sir Norman Lockyer, K.C.B., F.R.S.—On Solar Changes of Temperature and Variations in Rainfall in the Region Surrounding the Indian Ocean: Sir Norman Lockyer, K.C.B., F.R.S., and Dr. W. J. S. Lockyer.—On the Restoration of Co-ordinated Movements after Nerve Crossing with Interchange of Function of the Cerebral Cortical Centres: Dr. R. Kennedy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Telegraphs and Telephones at the Paris Exhibition, 1900: John Gavey.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—On the Berbers of Algeria, and their Connections with Prehistoric Egypt: D. Randall-Maciver and A. Wilkin.

FRIDAY, NOVEMBER 23.

PHYSICAL SOCIETY, at 5.—An Automatic Wheatstone's Bridge: W. C. D. Whetham.—The Anomalous Dispersion of Carbon: Prof. R. W. Wood.—The Liquefaction of Hydrogen: Dr. M. W. Travers.—On the Refraction of Sound by Wind: Dr. E. H. Barton.

SATURDAY, NOVEMBER 24.

ESSEX FIELD CLUB (Museum of Natural History, Stratford), at 7.—On the Variations in the Marine Animals on Coast of Essex during the last Ten or Twelve Years: Dr. H. C. Sorby, F.R.S.—Notes on the Eocene Fauna and Flora of Walton-on-Naze: J. P. Johnson.—British Wild Flowers Photographed from Nature: J. C. Shenstone.

MONDAY, NOVEMBER 26.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Expedition to Lake Tanganyika and the Country to the North: J. E. S. Moore.

SOCIETY OF ARTS, at 8.—Electric Oscillations and Electric Waves: Prof. J. A. Fleming, F.R.S.

INSTITUTE OF ACTUARIES.—Inaugural Address by the President, C. D. Higham.

TUESDAY, NOVEMBER 27.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—On Stone Implements from Tasmania: J. Paxton Moir.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Paper to be further discussed*: The Metropolitan Terminus of the Great Central Railway: G. A. Hobson and E. Wragge.—*Paper to be read and discussed, time permitting*: Machinery for the Manufacture of Smokeless Powder: Oscar Guttmann.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Analytical Portraiture: Francis Galton, F.R.S.

WEDNESDAY, NOVEMBER 28.

SOCIETY OF ARTS, at 8.—Malaria and Mosquitoes: Major Ronald Ross.

THURSDAY, NOVEMBER 29.

GOLDSMITHS' INSTITUTE CHEMICAL SOCIETY, at 8.30.—The Profession of an Industrial Chemist: Dr. J. Lewkowitsch.

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