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THE BUTTERFLIES OF THE BORDERLAND BETWEEN NORTH AND SOUTH AMERICA.

Biologia Centrali-Americana. Insecta—Lepidoptera—Rhopalocera. Vols. i. and ii., 1879–1901. Pp. xlvi + 487 + 782. By Frederick Ducane Godman, F.R.S., and the late Osbert Salvin, F.R.S.

WE often hear, and are unfortunately compelled to admit, that the claims of learning are far too much neglected in our country, and that the wealth which is accumulated so much faster than in past times is but rarely under the control of men inspired as were the "pious founders and benefactors" of old. With humiliation and some perplexity we are forced to recognise that in younger lands the ancient spirit is as strong as it has ever been in history. Modern conditions have nothing to do with the indifference to learning exhibited by the average wealthy Englishman; for wealth is brought together under the newest of new conditions in the countries where it is lavishly spent in establishing and maintaining the centres of learning. And this is not only true of the most recent of Colonial and American universities. The older American universities date far back into colonial times. The life of Harvard as a university of an independent Power is even now shorter than its life in a British Colony; and yet Harvard, Yale and the other older American universities yearly receive benefactions for which Oxford and Cambridge look in vain. The needs of both Oxford and Cambridge are widely known in the country, as well as the serious lack in efficiency which both of them suffer for want of an assistance which on the other side of the Atlantic would be freely given. The difference in spirit seems to lie in a glorious "fashion" formerly dominant and powerful, but at present weak and enfeebled, in this country while it reigns supreme elsewhere. Such an interpretation is hopeful; for fashions may, and often do, revive, and even surpass, their former influence. All honour to those who in these latter days have helped on the good work in our land. Among these noble efforts on behalf of learning a prominent place will always be assigned to the munificence which has placed the investigation of the biology of Central America to the credit of British science.

The great work of which an important section forms the subject of the present article is now drawing to its close. It is, therefore, not inappropriate to say something of the biogeographical area of which the plants and animals are described in this vast monograph, or rather series of monographs, and to attempt to ascertain the reasons which induced F. D. Godman and the late Osbert Salvin to make the choice of their life-work.

However they may be divided and named, the life-bearing land-masses of the world are essentially arranged as an incomplete ring girdling the Arctic Ocean and sending three great extensions towards the south. P. L. Sclater's original classification of the zoological regions of the south, which has never been equalled by any of the later suggestions and would-be improvements, divides the northern ring into two regions, an Old-World segment and a New. It is admitted that this division is chiefly adopted for the sake of convenience and not because of any great difference between these two sections. The faunas of the three southern extensions differ widely from each other and also from those of the Holarctic belt. Interest is therefore concentrated on the point of junction between each southern extension and the northern ring, which more or less directly connects it with the two other extensions. The Ethiopian land-mass is cut off from the belt by a vast desert area. The most peculiar and interesting southern parts of the Indo-Australian mass are cut off by sea, the nearer less peculiar part by the most mighty mountain range in the world. There remains the Neotropical extension, in certain groups the most peculiar of the three, in species probably the richest, and, unlike the others, freely connected with the northern belt, the desert barrier penetrated by continuous north-and-south-running mountain ranges. Free continuity at no very distant period is in this case also proved by the reappearance of characteristic northern genera on the temperate southern Neotropical mountain ranges, such forms being wanting from the corresponding Ethiopian mountains. Furthermore, the east and west ranges of the Old-World part of the belt form barriers against which many plants were driven and exterminated by the advancing cold of the Glacial period, while in the New World the same species were able to escape southwards and return when the period came to an end.

From these considerations it is obvious that the point of junction between a south-extending land-mass, as peculiar as any of the three and far more freely continuous with the north than any other, is the most interesting and critical region in the world, and one which was bound to throw most light upon the problems of distribution. The vast importance of the thorough working out of this transition area Godman and Salvin had the genius to seize upon, as the result of their first visits, singly or together, in 1857–8, 1859–60, 1861–3—early days, when the "Origin" had only just appeared and the problems of distribution were first beginning to be attacked. So successful was the investigation, and carried on with such energy, enterprise and munificence, that this area, then obscure and little studied, has become probably better known than any other part of the world which can in any way compare with it in richness. The collections have been worked out by the most distinguished specialists, the descriptions published in the "Biologia," and with splendid generosity the whole material, labelled and complete, has been handed over to the nation, so that for all time the British Museum will be the one place in which the biology of Central America must be studied. Whatever may be true of the political sphere, the Monroe Doctrine of learning has been infringed on so magnificent a scale that any attempt at repair is hopeless, and our American friends will probably find their revenge by annexing biological territory in the Old World.

The completion of the two volumes on the Lepidoptera Rhopalocera of Central America is of especially deep interest. Here, as in the volumes on the bird fauna, we have the labour of the editors themselves, working together as more than brothers until the pathetic death of Osbert Salvin, on June 1, 1898, left the most obscure and difficult

part of this great monograph still unfinished. Three more years were required before the work was completed by F. D. Godman, who speaks of the large amount of help rendered him by the skill and energy of G. C. Champion, and the value of Dr. Holland's excellent book, which would have been a still greater assistance had it become available at an earlier date.

The immense development of the Central American Hesperiidæ, that difficult group which so long delayed the completion of the work, will be appreciated when the number of species, upwards of 550, is compared with the 178 of the New-World segment of the northern belt and the 66 of the Old-World segment. The study of the Pamphilinæ was a special cause of delay, and not only here, but in the whole family, an examination of the male genitalia, requiring the preparation of immense numbers of dissections, was found to be necessary.

"In Thanaos several of the species are absolutely inseparable by external peculiarities, but markedly different in their genital structure."

Such cases are remarkable and interesting, and range with those in which the males, as in many Enploeinæ, have not hitherto been separated except by the wide difference in secondary sexual characters, viz. the conspicuous "brand" on the wings. That species should be separable only by the characters directly or indirectly associated with the reproductive system of a single sex, while these sole differentiating criteria are strongly marked and evident, suggests the possibility of sexual dimorphism, rather than specific distinction, as an interpretation. Carefully conducted breeding experiments upon a few well-chosen examples would be well worth a trial, and would speedily decide beyond the possibility of doubt as to the interpretation of an immense mass of interesting facts of which the discovery is recorded in this monumental work.

Turning to the bearing of this section of the "Biologia" upon the broad principles of geographical distribution—one of the most important aspects of the whole work—it becomes necessary first to define precisely the extent and limits of the term Central America as employed by the editors. The area will be best understood by the enumeration of the following eight component districts:—North Mexico, South Mexico, British Honduras, Guatemala, Honduras, Nicaragua, Costa Rica and Panama. An excellent account is given of the physical geography of each of these divisions, into which, for the sake of convenience, the editors have separated the whole of their area. They find that the butterfly fauna, which includes many specially modified forms, is mainly a northern prolongation of the tropical South American, and extends to Mazatlan on the Pacific side and to a little beyond Ciudad Victoria in Tamaulipas on the Atlantic, although some purely tropical genera (Eutresis, Scada, Hetæra, Ithomeis, &c.) do not extend north of Nicaragua, Costa Rica or Panama. The Atlantic slope to as far south as Costa Rica has a more abundant rainfall, a more luxuriant vegetation and an immensely richer butterfly fauna than the Pacific, the difference being especially marked in Ithomiinæ, Erycinidæ, Thecla, Papilio, &c.

While the southern forms extend northwards over the coast areas, the Holarctic fauna presses southwards along the high central plateau into Mexico and to some extent even to Guatemala, where the northern genera Argynnis, Vanessa, Limentis and Grapta are met with, and various northern species of Colias occur. On the higher levels, no strictly Alpine forms are found, the insects above timber-line being mostly stragglers from below, while the highest forests are peopled, as in corresponding Andean localities, with species of such genera as Euptychia, Archonias, Catasticta, Pereute, Enantia, &c.

From the account given above, it is clear that the boundary between the northern belt and southern extension takes, roughly, the form of an attenuated U with its concavity directed toward the north. It has already been stated that no two regional faunas in the world are more unlike than the Holarctic and Neotropical. Their extraordinary differences can only be explained by geographical separation for an immense period. At length occurred that "psychological moment" in the organic history of the world when the boundaries fused together and the two contrasted faunas were geographically free to contend and to intermix. The insight of Godman and Salvin led them to investigate the one tract of the land surface of the globe which tells us most of the results of such a struggle. The main conclusion which is impressed by the vast array of facts in the "Biologia" is that stated by Darwin in the "Origin," viz., the predominance of the organic over the inorganic environment of living beings. By the "long results of time," in other words natural selection operating for a vast period, the northern fauna as a whole has been adapted to one environment and the southern fauna to another; and when the two are at length free to invade and to intermix, very little invasion and intermixture occurs. Each fauna is "an army of all arms," as Rolleston used to express it, strong enough in its own territory to repel the attacks of the other. The metaphor is an exceedingly good one, in that it emphasises the truth that each species of the whole fauna (and flora) is not only adapted to its inorganic environment, but also to countless other species of the fauna and flora of the same region. The U-like shape of the boundary line between the two regions expresses the fact that the northern forms gain advantage in the cooler higher ground, the southern in the hotter low-lying coast areas. The occurrence of northern genera on high ground towards the south of South America can best be explained by oscillations of level and changes of climate along the north-and-south-running mountain ranges, which have given northern forms an advantage over the southern and enabled bands of immigrants to press southwards until they reached a latitude to which they were permanently better adapted than the Neotropical fauna. Further changes of level and climate would then rapidly ensure the extinction of such species in tropical latitudes, so that the southward-extending bay of the U-formed boundary in the north and the colony of mountain forms cut off in the south remain as the only evidence of invasion.

The impression made upon the north by invaders from the south is doubtless far stronger, chiefly because the northern fauna being so much poorer the successful invaders make up a higher proportion of the whole. One marked result of successful invasion is certainly seen in the 178 species of Nearctic Hesperiidæ as against the

66 Palæarctic, the effect being doubtless mainly due to that exceptionally strong power of flight to which the authors attributed the unusually wide distribution of butterflies belonging to this family. Other still more interesting intruders are the great Danaine butterflies, of which *Anosia plexippus*, the "Monarch," is the best known and the widest ranging, inasmuch as it extends far into Canada. The peculiar interest of these settlers lies in the fact that certain species of the Holarctic fauna have been profoundly modified into mimicry of them, thus proving beyond the possibility of doubt that the invasion is no new thing—like the spread of the great Danaine *plexippus* into the Philippines, the Fijis, Australia, Hong Kong, &c.

The whole of the vast mass of material in these and the great series of companion memoirs is a remarkable testimony to the insight of P. L. Sclater in drawing the outlines of his regions, of Darwin in laying down the principles of geographical distribution in the "Origin," and of Wallace in his masterly development of the subject in his great works on the geographical distribution of animals. These principles have been tested by an appeal to the facts collected with consummate skill and care from the most critical area in the world, and assuredly they have not been found wanting.

The work is printed and brought out in the same beautiful and costly style as the rest of the series. It contains 112 plates, with more than 2000 admirably executed hand-coloured figures representing 1250 species, and nearly 550 uncoloured figures of the structural parts of butterflies.

The total number of species of Rhopalocera recognised in Central America as here defined is 1805, as against 642 in the New-World and 716 in the Old-World segment of the Holarctic belt. Of these 1805, 360 (almost exactly one-fifth) are described as new. A valuable table of genera shows distinctly and at a glance the relative numbers of the species in each of the eight districts of Central America, in South America, in North America and in the West Indies. The extraordinary poverty of the fauna of the latter is well brought out by this comparison.

The classification adopted is mainly that of H. W. Bates in his paper on the insect fauna of the Amazon Valley (*Journal of Entomology*, ii. pp. 175–185, 1864). The Libytheidæ, instead of being included in the Erycinidæ, are kept as a separate family, represented in the area under consideration by a single species. One slight criticism may be suggested; the monograph begins with the most specialised subfamily the Danainæ, but within the subfamily itself the more specialised group the Ithomiina follows, instead of precedes, the less specialised Danaina.

This vast undertaking has required the cooperation of some of the best living collectors of insects. In addition to the visits of the editors, Mr. G. C. Champion, Mr. H. H. Smith and many others have remained in Central America for long periods of time collecting material for the "Biologia." Great collections, such as those of H. W. Bates and Herbert Druce, have been acquired as a whole and added to the mass of material, which was steadily accumulating for forty years. Wherever Central American specimens could be acquired or borrowed, they have been studied for the purpose of this great work; the single exception was due to the impossibility of receiving the loan of Plötz's quoted but unpublished figures. It is unnecessary to say anything further of a difficulty thus gratuitously thrown in the way of a memorable advance in zoological science, a great gift, not restricted to any single nation, but conferred upon the learning of the world.

The thorough treatment of the more obscure Central American groups and genera is such as to render the work absolutely necessary for the study of the related species in other parts of the world.

It would be inappropriate to discuss the details of this great monograph at any length on the present occasion, but all naturalists should gain a knowledge of the general results, in part briefly discussed in this article, which are lucidly set forth in the introductory chapter. And every naturalist, before he reaches the end of the record of results and conclusions, will feel how deep is the debt that he owes to the research and munificence which have led to so notable a widening of the boundaries of knowledge. E. B. P.

PRINCIPLES OF DYNAMICS.

Sur les Principes de la Mécanique Rationelle. Par C. de Freycinet, de l'Institut. Pp. viii + 167. (Paris: Gauthier-Villars, 1902.) Price fr. 4.

M. DE FREYCINET first became known to the world as the author of a treatise on dynamics of some bulk and repute, which was published in 1858, and the essay before us shows that at the end of his long and distinguished career of active public life his interest in the subject remains unabated. Referring to his publications during the intervening period, we find two relating to dynamics. In 1887, he communicated to the Academy of Sciences (*Comptes rendus*, cv., pp. 903–910) a note containing the rather interesting suggestion that the term "dynamical capacity" should be adopted in the place of the term "density" as derived from dynamical considerations, on the analogy of calorific capacity; also some proposals about units which were not likely to meet with acceptance. He proposed a standard unit of length derived from the value of gravity at Paris, recommending it by the remark that the length of a pendulum can be measured more conveniently than that of a meridian of the earth. In 1896, he published his essays on the philosophy of the sciences, containing some chapters on mechanics.

The book before us gives the impression of not being up to date, and repetitions from the author's former works which we find in it afford some explanation of this. He does not appear to be well acquainted with the modern literature of the subject. One might expect to find some sign of the influence of Mach, but there is none. The framework of the essay is a constructive sketch of the subject, which cannot be regarded as of much value. It is chiefly interesting on account of the satisfactory tone of protest against *a priori* judgments with regard to the principles of dynamics and on account of some attempts which are made to amend the phraseology of the subject, among which "dynamical capacity" figures prominently. It is disfigured by some inaccuracies and obscurities.

It seems, for example, hopeless to attempt to understand what is meant (p. 86) by the fixity of the sun relative to the earth, which we are told would result from the attraction between the sun and the earth losing its reciprocal character. And the explanation (p. 134) of the mechanical equivalent of heat by the example of the coal consumption required for working an elevating machine, as compared with that required for raising the temperature of water, is not a happy one, even with the addition of a parenthetical reference to unavoidable losses.

The author thinks that there has been too great a tendency among the writers of treatises on dynamics to deal with the subject as a merely abstract science, with but little reference to the basis supplied by the observed motions of actual bodies. But he omits to notice what has perhaps been the most unsatisfactory feature of such treatises, namely, their frequent neglect to deal with the question of the establishment of a base relative to which to measure motions for the purpose of the laws of motion, obscurity thus arising with regard to a fundamental point. Indeed, the book before us affords as good examples as could be found of obscurity due to an attempt to construct statements dealing with the motion of actual bodies without clear specification of the base employed.

In the treatment of dynamics as an abstract science, a base may be assumed at the outset, without any reference to the question whether or how such a thing can actually be identified in nature; but so long as this question is postponed, any comparisons with actual motions are apt to be inaccurate or puzzling. Newton's adoption of the postulate of an "absolute motion," as he called it, stands in the forefront of his statement of the theory. He expounded what he meant by absolute motion sufficiently for his purpose, and for a time his followers were content to accept his statement. But a stumbling block was found in the use of the word "absolute," and this word fell into disuse without any more appropriate terminology taking its place, and thereupon the point in question, instead of taking the first place in any statement of the theory, fell so much into the background as to be in danger of being overlooked altogether. The fact remains that the so-called laws of motion apply only to motions relative to a suitably chosen base, one which is probably connected with other phenomena of physics, but may naturally, and must in the first instance, be regarded merely as a creature of the theory, with no right to a title involving such words as "absolute" or "fixed."

THE DISCOVERY OF JAPAN.

Geschichte des Christentums in Japan. Von Pfarrer Hans Haas. I. Erste Einführung des Christentums in Japan durch Franz Xavier. (Tokyo, 1902.)

IN this large octavo volume of 300 pages, admirably printed at the Rikkyo Gakuin Press, we have the first instalment of what promises to be as full and accurate an account of the discovery of Japan and of the rise, course and downfall of Christianity in that country during the sixteenth and following centuries as the accessible materials render possible. A distinguishing feature is the extent to which native sources of information have been consulted, and though these are neither ample nor very trustworthy, their use lends an interest and an authority to the work which are lacking to the results of previous efforts to present the subject to European readers.

The first notice of Japan was brought to the west by Ser Marco Polo. In a passage pregnant with consequences to East and West, he, or his literary friend to his dictation, writes:—

"Zipangu (Jihpênkwo *anglicé* Jippunkwo, *i.e.* Orient Land) is an island in the high seas lying eastward [of China] . . . . it is of great extent . . . . the inhabitants . . . . are idolaters and independent. And I can tell you that the quantity of gold they possess is inexhaustible . . . . the exportation is forbidden . . . . hence they have an immeasurable surplus of gold."

It is not too much to say that the Venetian traveller's words, scouted in his own day, led to the discovery of America, and to the discovery and temporary Christianisation of Japan. Marco Polo's travels were printed in 1477. What he wrote about "Zipangu" came to the ears of Columbus through Toscanelli, and in 1492 the great navigator sailed westwards to discover the great eastern island about which his contemporaries thought him "extravagant and clean possessed." It was his Ophir, and such he held it to be to the end of his days. Yet the wealth of Japan was a mere fable—even in 1887 its production of gold did not surpass some 500 kilos. It was thus a delusion that led to the discovery of America, or rather prepared the way for that discovery of the Pacific Ocean which proved America not to be a portion of Eastern Asia.

For the discovery of Japan the world had to wait another half-century. It was not the result of design, but indirectly of the division of the undiscovered world by Pope Alexander VI., in 1493, between Spain and Portugal, in return for their armed support of the Roman system—probably the biggest deal the world has seen—and directly of the shipwreck, in 1543, of a Chinese piratical junk having three Portuguese deserters on board on the shores of the island of Tanegashima, lying south of the southernmost point of the island empire. As early as 1508, as Mr. Donald Ferguson has recently shown in his interesting "Letters from Portuguese Captives in Canton, 1534-6," Lopes de Sequeira had been ordered to inquire after the Chijns (Chinese), and in 1517 definite commercial relations were established with Canton. Galvano and Xavier both mention the discovery, but the various accounts, including the Japanese, differ as to time and locality. Nevertheless, it is pretty certain that it took place as above stated, and to this day in Japan "Tanegashima" means a gun or pistol.

But in his famous Peregrinação, Fernão Mendez Pinto lays claim to the discovery as his own—through the mischance also of the Chinese junk, on which he was taking a passage from "Sanchan" to "Lailo" with two companions, being driven by stress of weather to seek shelter off the same island of Tanegashima. Pinto was dubbed by Cervantes the Prince of Braggarts, and our own Congreve uses him as a type wherewith to compare a "liar of the first magnitude." A letter of his own and others of his brethren of the Society of Jesus in which we should expect to find some reference to this exploit

do not mention it, and I agree with Herr Haas that the story is a mere invention.

Of the arrival at Malacca some time in 1547 and of the subsequent conversion by Xavier of three Japanese there can be no doubt, however much we may distrust Pinto's account of his share in bringing about their visit. The chief of the three, Anjiro (Hachiro ?) induced Xavier himself to go to Japan, and in 1549 the great apostle of the east landed at Kagoshima, famous some three centuries later for its stout resistance to an English squadron.

Of Xavier's labours I can say little here. He remained two years and some months in Japan, founded three churches and baptized some 800 converts. Herr Haas speaks highly of his labours. But he seems to have been satisfied with mere external observances, and his ignorance of the language must have reduced his dogmatic teaching to its least expression. What would be interesting and instructive to know would be what the Japanese, especially the Buddhists and Confucianist scholars, thought of his doctrines. No hint has come down to us—perhaps they took no thought of a strange religion that seemed of no great importance. The chapters on the social and political conditions of Japan in the sixteenth century are interesting—particularly the account they give of Buddhism and Confucianism, both in themselves and as a setting to Xavier's apostolate.

Herr Haas's style is not unattractive, and in the eulogy of Xavier rises into eloquence. But—to an Englishman at least—many of the sentences, often occupying half a page or more, are both tedious and obscure. A portrait of Xavier taken from an old print is prefixed, which, however, bears little resemblance to that contained in Dr. Murray's "Japan." F. V. D.

CHEMICAL PHILOSOPHY.

Le Mixte et la Combinaison Chimique: Essai sur l'Évolution d'une Idée. By E. Duhem. Pp. 207. (Paris, 1902.) Price fr. 3.50.

FROM the earliest times there have existed two opposed views of the constitution of homogeneous mixtures. According to one view, the mixture was in reality as in appearance homogeneous. The elements composing it disappeared as such and were replaced by an entirely new thing, the mixture, from which, however, by appropriate treatment the original elements might be regenerated. According to the other view, the homogeneity was only apparent, and due to the feebleness of our senses. Each element consisted ultimately of atoms, which in the mixture retained their individual character, being mingled, but in no sense fused.

Prof. Duhem in the present essay, which originally appeared in the *Revue de Philosophie*, follows the fortunes and discusses the scientific evolution of these ideas from the time of Bacon and Descartes to the present day. In a series of interesting chapters, he shows the adaptation of chemical theory to facts as they accumulated, tracing the development of the notions of element, equivalent, substitution, type, valence, isomerism. It is, however, to the last chapters that chemists will probably turn with the greatest interest. In these the author gives a critique of the atomic theory and an account of chemical mechanics. His point of view may best be given by quotation.

The great achievement of atomic theory is the simple interpretation of the law of multiple proportions. But, the author asks, is the victory decisive? Who can say that this is the only possible explanation?

"When we see with what simplicity and clearness all the principles of modern chemistry may be systematically expounded, though the name and notion of atom are alike absent, and what difficulties and contradictions arise when it is desired to interpret these principles according to the doctrines of the atomists, we cannot help thinking that the sole success of the atomic theory is only an apparent victory and one without a future, that the theory does not show us the true objective basis of the law of multiple proportions, that this basis still remains to be discovered, and finally, in a word, that the evidence of modern chemistry is not in favour of the Epicurean doctrine."

In a foot-note, the author draws attention to the circumstance that what is here said of the law of multiple proportions and its interpretation by atomic hypotheses may be repeated word for word of the crystallographic law of rational indices and its interpretation either by the integrant molecules of Hauy or the space-nets of Bravais.

With regard to the general aspect of physics and chemistry to-day, the author says :—

"Physical science is not a metaphysic. It has no intention to penetrate beyond our perceptions in order to grasp the essence and ultimate nature of the objects of these perceptions. Its end is to construct by means of signs borrowed from the science of numbers and from geometry a symbolic representation of what our senses, aided by instruments, bring to our knowledge. Once constructed, this representation lends itself to reasoning more simply, rapidly and certainly than the purely experimental data for which it was substituted. By this artifice, physics assumes a breadth and precision which it could never have attained without clothing itself in this schematic garment which we call theoretical or mathematical physics. To each element which logical analysis discovers in any physical concept there now corresponds, not a metaphysical reality, but a geometrical or algebraic character of the symbol which is substituted for the concept. For the notion of a chemical substance, for example, there is substituted a chemical formula; the idea of the analogy of two chemical systems is expressed by a series of equalities between the indices which affect certain letters; the idea of derivation by substitution is represented by means of certain lines or 'bonds'; and the dissymmetry of a geometrical figure serves to represent a substance possessed of optical activity."

We can thoroughly recommend the book for the thoughtful consideration of those interested in chemical philosophy.

OUR BOOK SHELF.

Die Internationalen absoluten Masse insbesondere die elektrischen Masse. By Dr. A. von Waltenhofen. Third edition. Pp. xi + 306. (Brunswick: Friedrich Vieweg und Sohn, 1902.) Price 8 marks.

IN preparing the third edition of this book, the author has, by introducing an amount of new matter, nearly equal to the whole of the second edition, sought to make the work, not only a complete study of the international system of units and measurement, and in particular of the electrical units, but also an introduction to the study of electrical

engineering (Elektrotechnik). In a work dealing with such a subject, we should have thought the publishers would not have departed from the very sensible plan, adopted in practically all good German scientific books, of printing in the ordinary Roman type instead of in the German script. We can safely assert that the adoption of the German character will very considerably reduce the number of foreign readers.

The book is divided into two parts, the first containing chapters on the mechanical, magnetic, electrostatic and electromagnetic units, and a comparison of these two latter systems.

The second part, taking up three-quarters of the book, is entitled "Additions and Explanations" (Zusätse und Erläuterungen), and consists of a somewhat curious collection of all kinds of information and numerical examples, and we are afraid that the reader who uses the book as an introduction to the study of electrical engineering will not profit very much thereby. We think, in fact, that the two objects of the book are incompatible, as it is hardly reasonable to expect a person just beginning to study electrotechnics to grasp such conceptions as the relations of the electromagnetic and electrostatic systems of electrical units, and so forth, or to go from chapter ii. of the second part, on the calculation of dynamos and considerations of the thickness of the insulation on double cotton-covered wires, &c., to chapter iii., introducing, without a word of warning, highly involved considerations of potential theory with differential equations half a page long.

The book will be mainly useful to teachers in technical colleges and schools, who are often called upon for the satisfaction of inquiring students to work out a formula from first principles, a subject with which the practical man has neither the time nor the inclination to bother. Such a teacher would find it useful to have this book by him, and the many references and footnotes given would be additionally helpful in such cases.

In fact, the book appears to us like a collection of notes of theoretical considerations and blackboard examples acquired by a lecturer to assist him in his lectures, and as such will no doubt have its sphere of usefulness.

If we may permit ourselves one more remark, in paragraph 92, on "hydroelectric chains," examples are worked out at length on the calculation of electromotive force according to the old "Thomson" law (equivalence of heat of reaction and electrical current work), and the only warning given that this assumption is both fundamentally wrong and in many cases leads to totally false results is given in a footnote. In a work on "absolute" units, this should hardly occur. The book is indexed very well, which is an additional advantage from the above-mentioned point of view. C. C. G.

Index-tabellen zum anthropometrischen Gebrauche. By Carl M. Fürst. (Jena: Gustav Fischer, 1902.) Price 5 marks.

IN the preparation of their great work "Anthropologia Suecica, Beiträge zur Anthropologie der Schweden," Drs. Gustaf Retzius and Carl M. Fürst had to deal with a vast mass of figures. It is the custom of physical anthropologists, not merely to publish their measurements, but also to give the ratio of a given measurement to another, and this is termed an "index"; for example, the ratio of the breadth of the head to its length is called the cephalic index, and is obtained by multiplying the breadth by one hundred and dividing the product by the length. The calculating of a large number of indices is undeniably a very tedious process, and various devices have been employed to save the student this clerical labour. Certain mechanical and other devices have been invented, but these have never proved satisfactory and are not employed by serious workers. The most accurate and practical rapid method of determining an index is by means of tables which have been carefully computed. It is evident that such tables once constructed and published would materially lighten the labour of those who do this kind of work.

The first tables of this nature were published by Prof. Welcker in the *Archiv für Anthropologie* in 1868. They were calculated only for the cranial index, and even so were not of sufficient range. In 1879, Prof. Flower published some very useful and on the whole accurate tables in his well-known Osteological Catalogue of the Royal College of Surgeon's, London, Part i., Man. These were calculated for the various cranial indices which he employed in that valuable publication; though these tables have proved a great boon to workers, they are not sufficiently extensive to meet modern requirements. Of greater scope are the Broca's tables which were published by Bogdanow in the *Mittheil.* d. kaiserl. Gesells. d. Naturwiss. anth., eth. Abtheil. (Moscow, 1879.) These also had some clerical errors, and the size of the page rendered it somewhat unwieldy. This publication was very difficult to obtain, and as a matter of fact the tables were not generally used by anthropologists.

Now all this is changed, as Dr. Fürst has published his extensive tables in a convenient form and at a low price, and has placed at the disposal of his colleagues, in twenty-nine tables, the result of the enormous labour of Fräulein Ellen Anderson-Gülich, who has made the requisite calculations.

Anthropologists will find in these tables practically all the indices they are likely to require, but there are certain indices which have not been carried sufficiently far to include some of the more extreme measurements that can be made on the living subject of non-European peoples; this will affect but few investigators, and that only rarely. Our hearty thanks are due to Dr. Fürst.

Jahrbuch der Chemie, 1901. Herausgegeben von Richard Meyer. (Brunswick: F. Vieweg und Sohn.) Price 15 marks.

THE Jahrbuch for 1901 is the eleventh of the series, and has for its object a review of the chemical work done during the year. Very few alterations are to be noted in comparison with the previous publications so far as arrangement and scope of the work are concerned. Several changes have, however, taken place on the editorial staff. In consequence of the death of Prof. Märcker, the chapters on agricultural chemistry, technology of the carbohydrates and brewing industries have been relegated respectively to Profs. Morgen, Herzfeld and Delbrück. Dr. W. Küster, of Tübingen, is now the editor of the section on physiological chemistry, and Prof. Doeltz, of Clausthal, of that on metallurgy.

The various authors appear to have given, on the whole, a satisfactory account of the research work carried out in their respective provinces, and the reader will obtain a good idea of what has been accomplished during the past year in both pure and applied chemistry. It seems doubtful, however, whether a compilation of this kind, in which nearly all the collaborators are of German nationality, gives the best possible account of the work of men of science in other countries. The greater part of the researches in pure chemistry carried out by English chemists is published in the *Transactions* of the Chemical Society. The editors of the various sections of the Jahrbuch apparently consider themselves in many cases capable of giving a clear and succinct account of these investigations by reference to the short notes in the *Proceedings* of the Society. It is unnecessary to point out the impossibility of such a mode of procedure being attended with any measure of success, and the practice must be strongly condemned.

It is to be hoped that, in future publications of the year book, greater care will be exercised in rendering an account of the work of English chemists. Its claims to

furnish a faithful review of the most important research work accomplished during the year can only be justified on that condition. H. M. D.

Observations Géologiques sur les Îles Volcaniques explorées par l'Expédition du "Beagle," et Notes sur la Géologie de l'Australie et du Cap de Bonne Esperance. Par Charles Darwin. Traduit de l'Anglais sur la Troisième Edition par A. F. Renard, Professor à l'Université de Gand. Pp. xxii+218; 14 figures, one plate. (Paris: Schleicher Frères, 1902.)

THIS volume is the first part of a French translation by Prof. Renard of the geological portion of the "Journal of a Naturalist," which book, as he remarks in his preface, preceded the "Origin of Species" by fifteen years and shows how surely Darwin had laid in his own mind the foundations for the development of that classic work. We should, indeed, have said that the geological observations proved at what a cost to this science the new birth of biology was obtained did we not remember that the idea of evolution has not only reanimated palæontology, but also has led to a new way of regarding even the inorganic world. Time has not deprived of their value those sections of "Geological Observations" which deal with St. Paul's Rocks, with the fluxional and spherulitic structures in the obsidians of Ascension Island, and with other volcanic islands and the order of eruptive rocks. They, indeed the whole work, can still teach geologists, and not only those who are beginners, the right methods in both observation in the field and the inductive treatment of facts; in a word, how to grapple with new problems. Prof. Renard's intimate knowledge, not only of geology, but also of the English language, so fits him for the work of translation that it is almost needless to say this has been admirably done, and he has added to the value of the volume by including in it the introductory essay which was contributed by Prof. Judd to the volume of the Minerva Library of Famous Books containing Darwin's geological works.

Galvanic Batteries: their Theory, Construction and Use. By S. R. Bottone. Pp. xvi + 376. (London: Whittaker and Co., 1902.) Price 5*s*.

ALTHOUGH the subtitle of this book indicates a comprehensive aim, it is only the construction of primary batteries that receives at all full treatment. In this respect the work is pretty thorough, since the author describes more than 200 different types of cell. The descriptions are short, but are supplemented in many instances by drawings, and should be sufficient to give any reader a clear idea of the essential features of the cell. Data as to the E.M.F., internal resistance and discharge are also given for a fair number of typical batteries. As a handy reference book to which one can turn for information of this sort, this volume should prove very useful, especially, perhaps, to the amateur or to the inventor who is anxious to see if amongst these 200 odd cells there is room for yet one more. From a scientific point of view, the work is disappointing; the tabulation of the different cells is not carried out upon any definite system of classification, so far as we can see, and the theoretical discussion in the first seventy pages is inadequate and unsatisfactory. It is hardly adequate, for example, only to describe the Grotthuss theory (as modified by Clausius) and to speak of this as the "accepted theory of to-day." Again, the fundamental conceptions do not appear to have been clearly grasped by the author, who seems to think that energy and force are the same, and that electricity is a form of energy and may be defined as "a mode of motion in the atoms of bodies." We should not comment upon these errors in a work which is more particularly of a practical character did not the author claim in his preface that "the theory of the battery has been carefully gone into." Should another edition be called for, we think Mr. Bottone would be well advised to omit the theoretical part altogether and confine himself to the careful tabulation of the cells; the information contained in the descriptive part must have needed considerable pains to collect and can hardly fail to prove useful.

The illustrations are, for the most part, clear; there are one or two minor errors, such, for example, as the misspelling of the names of Sir W. Thomson, Latimer Clark and Grotthuss, which we should like to see corrected. M. S.

The Elements of Agricultural Geology: a Scientific Aid to Practical Farming. By Primrose McConnell, B.Sc. Pp. x + 329. (London: Crosby Lockwood and Son, 1902.) Price 2*1s*. net.

MR. PRIMROSE MCCONNELL is well known as a shrewd writer on practical farming and as one who has done a good deal to bring the facts of science within the reach of the farming community. The present work is on the fascinating subject of agricultural geology. It has evidently been written *con amore*, and we are told in the preface has occupied the author for many years. He treats first of the origin of soils, then follows a chapter on mineralogy, another on physiography and one on water supply. We then come to the most important section of the book, entitled "Formations and Farming," occupying about 110 pages. The volume closes with a section dealing with the evolution of the present breeds of horses, cattle, sheep and pigs.

The most valuable section, and the one containing most original matter, is that relating to formations and farming. We should much like to see this section greatly expanded and its very various subjects treated in full detail, and the whole accompanied by a good geological map of the United Kingdom, which the present volume, notwithstanding its high price, fails to supply. Such a work would be of standard value. Much of the rest of the volume has apparently been compiled from well-known text-books, references to which are freely given.

To the value of the central section we have already referred, but of the book generally we cannot speak so highly. The book has been loosely written, without much attention to scientific exactness, and hasty statements are from time to time made which require at least serious qualification.

The author views the soil as in every case the chief determining factor of agricultural results, whether relating to crops or animals, and a result is said to follow because the soil is Red Sandstone or Mountain Limestone. The considerable influence of varying climate in a country such as our own is seldom taken into account.

A Teacher's Manual of Geography to accompany Tarr and McMurry's Series of Geographies. By Charles McMurry, Ph.D. Pp. 107. (New York: The Macmillan Company, 1902.) Price 2*s*. 6*d*.

TO teach successfully it is not only necessary for a teacher to have a good knowledge of his subject, but he should also know how best to present its parts to his class, and be familiar, in the case of subjects like geography, with the use to which the common objects of the neighbourhood of the school can be put in rendering lessons clear and interesting. This little book abounds in helpful hints to teachers of geography; it explains how the best results are to be obtained from school excursions, and it should convince the reader that geography is something more than topography, and should be made a means of arousing interest in such subjects as the formation of soils, the cause of scenery, and other changes which are too often ignored in school courses of geography.

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.*]

Refractivities of the Elements.

IN NATURE for October 16 I drew attention to the relation which exists between the refractivities of the inert gases of the atmosphere and that of hydrogen. Further comparison with the values obtained for other elements shows that the occurrence of simple ratios between the refractivities of allied elements is so frequent as to reduce greatly the possibility that they may be due to chance.

Thus, in the table previously published, there was a gap between krypton and xenon to be filled by an element the refractivity of which should be four times that of hydrogen. This condition is exactly fulfilled by mercury, the vapour of which is also monatomic. The refractivities of chlorine, bromine and iodine are almost exactly in the ratio of 2, 3, and 5, corresponding to those of argon, krypton and xenon; and it is remarkable that the latter trio occupy places in the periodic table which are adjacent to those of the former trio respectively. I cannot find that the value of the refractivity of fluorine has yet been directly determined; but, if there is any law connecting these figures, it should probably bear the same relation to that of chlorine which the refractivity of neon bears to that of argon, *i.e.* $\frac{1}{4}$. It should, therefore, be equal to $\frac{1\cdot468}{4}=0\cdot192$ (H=0·139).

Again, making allowance for the density of sulphur vapour (96), the refractivity of sulphur is to that of oxygen as 2 is to 1. The following are the figures:—

Element.	Refractivity (Air=1.)	Refractivity (H=·139).	Ratio to H.	Error per cent.
Helium [1] ...	0·1238		$\frac{1}{4}$	−4·4
Neon [1]	0·2345		$\frac{1}{2}$	+0·9
Hydrogen [1] ...	0·4733		1	
Argon [1] ...	0·968		2	−2·2
Krypton [1] ...	1·450		3	−2
Mercury [2] ...	1·893	0·556	4	0
Xenon [1]	2·364		5	+0·1
			Ratios to Cl=2	
Chlorine [3] ...		0·768	2	
Bromine [4] ...		1·125	3	−2·4
Iodine [4] ...		1·920 Violet 2·050 Red	5	0
			(Ratio to O=1)	
Oxygen [3] ...		0·270	1	
Sulphur × 3 [2]		1·629	2	+0·6
Nitrogen [3] ...		0·297		
Phosphorus [2]		1·364		
Arsenic [2] ...		1·114		

The values for Hg, S, P and As were published by Le Roux in 1861 and do not appear to have been verified since. At least, no other determinations are published either by Dufet or by Landolt and Börnstein. Iodine shows anomalous dispersion, and the choice of the value 1·920, which represents the refractive index of the least refracted rays, is arbitrary.

The values for N, P and As do not fit into the scheme, and a redetermination of them would be interesting.

CLIVE CUTHBERTSON.

9 York Terrace, N.W., November 3.

[1] Ramsay and Travers, *Phil. Trans.*, cxcvii., A. 1901.
[2] Le Roux, *Ann. Ch. et de Ph.*, lxi., p. 385, 1861.
[3] Mascart, from Dufet, "Recueil des Données numériques," i., p. 75.
[4] Hurion, *Ann. de l'École Normale, sup.* (2e série), t. vi., p. 380, 1877.

Artificial Mineral Waters.

I THANK you for your kindly notice of my little book in your issue of October 16 (vol. lxvi. p. 602), and I am quite content to leave your reviewer's remarks concerning its blemishes to the judgment of your readers with the one exception of that dealing with the precautions for preventing the contamination of the carbonic acid gas with ammonia. If your reviewer will call to mind the fact that in the generating vessel there is a mixture with an alkaline reaction until the charge is exhausted, he will not consider it as so very astonishing that ammonia may pass into the gas holder. At all events, manufacturers of mineral waters have suffered too much in time past from the presence of gaseous impurities in the carbonic acid gas to permit them to allow the smallest trace of such impurities to contaminate the waters. The conditions of manufacture are such as not to warrant the expectation that either the alkali or the acid in the generator will suffice to hold back traces of either acid or alkaline gases.

WILLIAM KIRKBY.

I UNDERSTAND that Mr. Kirkby objects to the statement I made, in my recent review of his book on "The Evolution of Artificial Mineral Waters," to the effect that precautions to avoid the contamination of the carbonic acid gas with ammonia derived from such traces of ammonium salts as might exist in the sodium bicarbonate employed were unnecessary. In reference to this I would point out that sodium bicarbonate does not decompose ammonium salts under the conditions in question, and that any tendency to become converted into the normal carbonate owing to rise of temperature is effectually checked by the constant production of carbonic acid gas in the liquid in the generator. This is what I meant by saying that the acid used constitutes a sufficient precaution, and if Mr. Kirkby will try the experiment, as I have done, he will find that no trace of ammonia passes from the generating vessel. That manufacturers of foods and beverages should take every possible precaution to avoid the contamination of their products is, of course, highly desirable, but any precautions specially taken for the purpose of avoiding the presence of this particular impurity are, I still maintain, quite unnecessary. THE REVIEWER.

Light-Therapeutics.

AS a constant reader of your valuable and interesting paper I shall esteem it a favour if any of your scientific correspondents can inform me what is the action of the red rays of light on the hair, and what authority is there for supposing that they have a beneficial effect on the scalp.

In what periodicals, &c., could I find reference to this question? P. H. BAILY.

Leadenhall House, London, E.C., November 6.

Waste of Energy from a Moving Electron.

IN my last week's letter, I observe some corrections are required. Equation (11); the depth of the shell should be $vdt\{1-(u/v)\cos\theta\}$. Equation (13); insert the factor $(1-u^2/v^2)$ on the right side. Equation (14); divide the second term on the right by R. OLIVER HEAVISIDE.

BRITISH ASSOCIATION GEOLOGICAL PHOTOGRAPHS.

PROBABLY no instrument—not including the bicycle—has more facilitated the labours of the geologist than the photographic camera, which has for some time past become almost as necessary a part of his outfit as the indispensable hammer. Professional and amateur workers alike carry it, and photographs of geological features do increasingly abound. This was already true in 1888, when the happy idea occurred to Mr. Osmund W. Jeffs of forming a public collection of geological photographs, which should be lodged in some central and readily accessible place. As he rightly pointed out, "photographic records of sections and other geological features . . . are not only invaluable aids to geological instruction, but serve also to preserve for future reference the details of many exposures of strata and other landscape features, which in course of time . . . are in danger of

becoming obliterated." At Mr. Jeffs's suggestion, a Committee of the British Association was appointed at the Bath meeting, charged with the duty of obtaining geological photographs, which were to be duly preserved, catalogued, dated and described. The Committee commenced its labours by inviting contributions from all British geologists, and its appeal met with a most generous response. Photographs at once began to flow in, and have continued to do so ever since, so that a vast mass of valuable material is now accumulated in the Museum of Geology, Jermyn Street, which was selected as the home of the collection.

The usefulness of the collection has now been largely increased by the action of the Committee in resolving to publish a selected number of its best photographs, and geologists are greatly indebted to the secretary of the Committee, Prof. W. W. Watts, for the admirable manner in which he has carried this resolution into effect. The success of his efforts is witnessed by the first issue, now before us. It comprises twenty-two photographs, contained in a neat portfolio case; each is accompanied by descriptive letterpress, the date when it was taken and the name of the photographer. The descriptions are terse and to the point, as might be expected when it is added that they are all contributed by well-known geologists; among others, we notice the names of Sir Archibald Geikie, Prof. Bonney, Mr. J. E. Marr and Prof. Watts himself. To show how thoughtfully even smaller matters have been attended to, we may point out that a duplicate copy of the letterpress is provided, printed on one side of the paper only and gummed on the other, so that when mounted each photograph may bear its own description secured to it. Further, in addition to the paper prints, which are platinotype and therefore permanent, there is another

FIG. 1.—Carboniferous Limestone resting unconformably on Ludlow Slates; Arco Wood Quarry, west side of Ribblesdale, about four miles north of Settle, Yorkshire. Photographed by Prof. S. H. Reynolds, 1889. The horizontal beds at the base of the Mountain Limestone here rest unconformably on the upturned and denuded edges of the Ludlow Slates. The latter formed a plane of marine denudation which quickly subsided, causing the absence of mechanical sediments. The district furnishes evidence that many thousands of feet of Lower Palæozoic rock were denuded before the deposition of the Carboniferous strata. An inconstant conglomerate, a few feet in thickness, with pebbles of Lower Palæozoic rock in a calcareous matrix, is found in places, but it is absent in the section photographed. The Ludlow beds are seen dipping south at a very high angle. A marked bedding-plane is seen at the south (left) end of the photograph (above the initials S.H.R.). The more prominent planes visible in the photograph, traversing the slates, are cleavage planes, inclined to the north at an angle higher than that of the bedding. The straight face of the limestone is due to dominant joints. The cliff, from the base of the quarry to the sky line, is many scores of feet in height. JOHN E. MARR.

issue in the form of lantern slides, which should prove of great value in the lecture room.

Where all are excellent it is difficult to choose, and the accompanying photographs, which, with the kind permission of their photographers, we select for reproduction on a reduced scale, are no better or worse than the remainder of the series.

The issue is the first of three, the second of which may be expected to appear before the end of the current

FIG. 2.—Widened joints ("grikes") and rain-gullies in Carboniferous Limestone; Hampsfell, near Grange, Lancashire. Photographed by Mr. Godfrey Bingley. The top of Hampsfell, near Grange, presents a weird and desolate aspect. There is no soil, the surface being barren limestone, whereupon but a few stunted bushes contrive to grow. Chemical denudation is at work, every joint and small crack in the limestone is widened, and its edges smoothed off by the solvent action of "carbonated water." The limestone is so pure that little argillaceous matter is left, after solution, to support vegetation, so that instead of the usual soil and grass-covered surface we have an arid corrugated waste, more resembling in appearance the "frozen fury" of a cooled lava-flow than the gentle undulating outlines we are accustomed to associate with weathered surfaces of stratified rocks in these islands. A. S. REID.

year. The price of these photographs is so small that they are sure to be much used in museums, colleges and schools for teaching purposes. The subscription list is nominally closed, but we understand that subscribers will still be admitted on the original terms until the end of November.

In congratulating the Committee of the British Association and its secretary on this admirable piece of work, the hope may be expressed that now the way has been shown, foreign societies, if they have not already done so, may follow suit; the subject is one that might well be brought before the notice of the International Geological Congress at its meeting next year in Vienna.

THE CRUISE OF THE "GAUSS" FROM CAPE TOWN TO KERGUELEN.

THE second part of the joint publication of the Berlin Institutes for Oceanography and Geography contains the official report of the work of the German Antarctic expedition on board the *Gauss* on its outward voyage from Cape Town to Kerguelen. The stay in Cape Town was prolonged in order to caulk the ship, which was leaking considerably though not to a dangerous degree, and to make certain changes in the gear and fittings which experience showed to be desirable. Six members of the crew were landed at their own request or as undesirables, and substitutes for them had to be found, and at the last moment two Norwegian volunteers were also taken on board. Prof. Drygalski acknowledges very warmly the hearty reception given him by the authorities at the Cape, which culminated in a military band playing German airs at the pierhead as the *Gauss* took her departure on November 27, 1901.

A course was set for Kerguelen, and the scientific work *en route* was reduced so as not to cause undue delay; still, the opportunity was taken to make thirteen deep-sea

soundings along a track where none existed before. Eleven of these were more than 1000 fathoms, five were more than 2000 fathoms, and the deepest was 2830 fathoms, in 42° 30′ S., 33° 45′ E. The weather was unfavourable with occasional calms, frequent head winds and almost always a very heavy sea rendered the ship extremely uncomfortable. The most interesting episode on the way was a landing which was successfully made on Possession Island of the Crozet group on Christmas Day. Possession Island and East Island came in sight at 5 a.m., the latter thickly veiled in fog, which gradually cleared. The landing was made in one of the numerous small bays of the north-west coast of Possession Island, where the party stepped ashore on a low basalt rock into an idyllic beast-world of slumbering sea-elephants, penguins drawn up in lines of military precision, and sea-birds fluttering curiously close overhead. The coast of the island as a whole was diversified with off-lying rocks and deeply cut caverns, the variety being due to the contrast of the alternate horizontal sheets of hard basalt and soft volcanic agglomerate. Moss grew luxuriantly, and above the cliffs the gentle slopes were in some places covered with marshy vegetation so deeply as to require the greatest care in crossing them. The sea-elephants and penguins furnished a supply of fresh meat which seems to have been appreciated on board; but the Kerguelen cabbage (which seems to have been nearly extirpated by rabbits in Kerguelen itself) was found bitter and unpleasant.

There was no trace of glaciation on the island. A puzzling appearance was presented by the loose material covering the slopes of one of the old craters and stretching down to the sea in stripes alternately wide and narrow in regular sequence, the wide of red, comparatively fine débris, the narrow of coarser fragments of black rock. Neither water nor wind action could account for these remarkable stone streams.

During the three hours on shore, large collections of every kind were made. Fifteen flowering plants were found, three times the number of species formerly known from the Crozets, though all are of species already known from Kerguelen or other islands of the South Indian Ocean. The fauna was found very rich in insects and spiders, several of the species not yet identified being apparently unknown in Kerguelen.

The voyage to Kerguelen continued until January 2, 1902, when the *Gauss* anchored in Observatory Bay, where the land party, who had arrived from Australia some months before, were waiting somewhat uncomfortably. The ship that had brought them had not been able to remain, and her Chinese crew had been such worthless workmen that the labour of installing the land station had been left for the crew of the *Gauss*, who had also to take on board the coal, stores and dogs that had been left for them. Much time was necessarily consumed in this work, everything having to be carried by hand to the boats and rowed out to the ship. About 130 tons of coal had to be left behind, the *Gauss* being full up with 400 tons.

The *Gauss* sailed on January 31 for her destination in the Antarctic with provisions for nearly three years on board. Prof. von Drygalski proposed to visit and if possible land on Heard Island, and then make straight for Wilkes' Termination Island, sailing along the ice towards the west so as to have the prevailing easterly winds of high southern latitudes in his favour, and ultimately turning southward and entering the ice. All on board were full of enthusiasm and confidence, satisfied with the ship, pleased with her equipment and determined to stay in the far south as long as they possibly could. The leader warns his friends not to suppose he is lost if pieces of wreckage from the *Gauss* should be discovered at sea, for she is very likely to lose some of her gear. He thinks it possible he may be able to send news home by June, 1903, but the expedition is planned for two summers in the ice, and no news will be good news until June, 1904.

Dr. Bidlingmaier appends a summary of the meteorological conditions of the whole voyage out from Hamburg to Kerguelen. There are two maps and several illustrations.

MR. CHAMBERLAIN ON EDUCATION.

MR. CHAMBERLAIN visited University College School on Wednesday, November 5, to unveil a memorial tablet to old boys who have fallen in the war, and was afterwards presented with an address from the students of University College. The address, read by the president of the Students' Union Society, referred to the keen support of higher education shown by the Colonial Secretary in his interest in the foundation of the University of Birmingham. We quote the following from the report of Mr. Chamberlain's reply in the *Times*:—

I thank you very cordially for the warmth of your reception. I appreciate the kindness which led you to offer to me this address. I have, as the address states, a very great interest in the higher education of the country. Thirty years ago some of us in Birmingham were prominent in securing for all the children of the country an efficient primary education. We thought it was right that, whatever might be the social position of any child born in this land, he ought to have, as it were, the tools put into his hands in order to carve out a career for himself. That, I believe, was a great and important work. As you know, the Government of which I am a member is now, at this very moment, engaged in the endeavour to develop it. But it left untouched a work which, perhaps, from one point of view, at any rate, is of even greater importance—that is the work of secondary and higher education. It is not everyone who can, by any possibility, go forward into the higher spheres of education; but it is from those who do that we have to look for the men who, in the future, will carry high the flag of this country in commercial, scientific and economic competition with other nations. At the present moment I believe there is nothing more important than to supply the deficiencies which separate us from those with whom we are in the closest competition. In Germany, in America, in our own colony of Canada and in Australia, the higher education of the people has more support from the Government, is carried further than it is here in the old country; and the result is that in every profession, in every industry, you find the places taken by men and by women who have had a University education. And I would like to see the time in this country when no man should have a chance for any occupation of the better kind either in our factories, our workshops or our counting-houses who could not show proof that, in the course of his University career, he had deserved the position that was offered to him. What is it that makes a country? Of course you may say, and you would be quite right, the general qualities of the people, their resolution, their intelligence, their pertinacity, and many other good qualities. Yes; but that is not all, and it is not the main creative feature of a great nation. The greatness of a nation is made by its greatest men. It is those we want to educate. It is to those who are able to go, it may be, from the very lowest steps in the ladder, to men who are able to devote their time to higher education, that we have to look to continue the position which we now occupy as, at all events, one of the greatest nations on the face of the earth. And, feeling as I do on these subjects, you will not be surprised if I say that I cordially agree with what is said in this address. I think the time is coming when Governments will give more attention to this matter, and perhaps find a little more money to forward its interests. When we are spending, as we are, many millions —I think it is 13,000,000*l.*—a year on primary education, it certainly seems as if we might add a little more, even a few tens of thousands, to what we give to University and secondary education.

THE REV. THOMAS WILTSHIRE, M.A., D.Sc.

THE Rev. Thomas Wiltshire, whose death, as already announced, took place on October 26, was for some years professor of geology and mineralogy at King's College, London. To geologists he was, perhaps, best known as the honorary secretary of the Palæontographical Society, a post which he held for thirty-six years, in the course of which time he laboured with unceasing energy in the editing of the annual quarto volumes.

He was educated at Trinity College, Cambridge, and, after taking his degree in 1850, he was ordained deacon by the Bishop of Rochester, and in 1853 priest by the Bishop of London. He resided for many years at the rectory, Bread Street, London, E.C., and took duty in various city churches. While at college his attention became arrested in geological subjects, but his literary contributions were few. Among them were essays on the Red Chalk of Hunstanton and on the history of coal. His work was mainly that of a helper of others. He was one of the earliest members of the Geologists' Association, and served as president from 1859 to 1862. Tothe Geological Society of London he rendered good service on the council, and for many years acted as treasurer. He had also been secretary of the Ray Society.

NOTES.

SCIENCE is represented in the long list of birthday honours by three names. Mr. W. H. Power, F.R.S., principal medical officer to the Local Government Board, has been made a Companion of the Order of the Bath ; Sir J. J. Trevor Lawrence has been appointed a Knight Commander of the Royal Victorian Order ; and Mr. H. J. Chaney, superintendent of the Standards Department, Board of Trade, has been made a Companion of the Imperial Service Order.

THE following is a list of those who have been recommended by the president and council of the Royal Society for election into the council for the year 1903 at the anniversary meeting on December 1. The names of new members are printed in italics :—President, Sir William Huggins, K.C.B., O.M.; treasurer, Mr. A. B. Kempe ; secretaries, Sir Michael Foster, K.C.B., and Dr. Joseph Larmor ; foreign secretary, Dr. T. E. Thorpe, C.B.; other members of the council, Mr. W. Bateson, Dr. W. T. Blanford, *Prof. H. L. Callendar*, *Mr. F. Darwin*, *Prof. H. B. Dixon*, Prof. G. Carey Foster, Right Hon. Sir John E. Gorst, *Prof. J. W. Judd, C.B.*, *Right Hon. The Lord Lister, O.M.*, *Prof. G. D. Liveing*, *Prof. A. E. H. Love*, Prof. H. A. Miers, *Prof. E. A. Schäfer*, *Capt. T. H. Tizard, R.N.*, *C.B.*, Prof. H. H. Turner, *Sir J. Wolfe Barry, K.C.B.*

ALL who are familiar with the services rendered to science and humanity by the late Prof. Virchow will be glad to know that a movement has been started with the object of erecting a statue to him at Berlin. It is felt by many admirers of Virchow that the memorial should be more than an exclusively German one, for his labours have benefited the world at large, and in this country in particular he has numerous disciples who would regard it a privilege to give evidence of their esteem for him. The proposed formation of a British Committee to assist the Berlin Committee of the Virchow Memorial will therefore meet with substantial support. Lord Lister has undertaken the chairmanship of the Committee and Sir Felix Semon is the honorary secretary *pro tem.* A meeting will shortly be held to elect officers of the Committee and decide upon a form of appeal for contributions. When the invitation to subscribe to the memorial has been issued, there should be a ready response to it, so that Great Britain shall be worthily represented at the monument of a great benefactor of the human race.

THE Earl of Crawford, F.R.S., who is about to take a winter tour round the world in his famous steam yacht *Valhalla*, has invited Mr. M. J. Nicoll, a member of the British Ornithologists' Union, to accompany him as naturalist. After passing through the Straits of Magellan, the *Valhalla* will visit the principal island-groups of the South Pacific, where its naturalist will have ample opportunities for collecting and observing birds and other animals. The return will be made by the Indian Ocean and Suez Canal.

A MOVEMENT is in progress at the Cape to establish in South Africa a society on the lines of the British Association, to be called the "South African Association for the Advancement of Science." Sir David Gill, K.C.B., F.R.S., H.M. Astronomer at the Cape of Good Hope, is to be the first president of the new association, and Mr. W. L. Sclater, director of the South African Museum, has been asked to preside over the zoological section. The first meeting of the association will probably be held at Cape Town at Easter next year.

THE seventh International Congress of Agriculture will be held at Rome next spring.

A REUTER message from Christiania announces, on the authority of Prof. F. Nansen, that an expedition under the leadership of Captain Amundsen will leave in 1903 for Greenland and King William's Land to locate the magnetic pole. The expedition will afterwards continue its way west and will return home *via* Bering Strait. Captain Amundsen will make systematic magnetic observations in the regions traversed, and will also carry on geographical exploration.

WE learn from the *Times* that M. Trouillot, the French Minister of Commerce, and M. Bérard, Under-Secretary for Posts and Telegraphs, are about to pay visits to all the inventors of systems of wireless telegraphy with a view to the ultimate adoption of one of them.

A REUTER telegram from Rome reports that the Captain of the Italian cruiser *Carlo Alberto* has informed the Italian Ministry of Marine that the vessel was in daily communication by wireless telegraphy with Poldhu, in Cornwall, throughout the voyage from England to Canada, and even when the vessel had entered Port Sydney Harbour. The telegram further states that this achievement confirms the possibility of holding simultaneous communications with Europe and America during the navigation of the Atlantic at least up to a distance of 3000 miles.

ACCORDING to the *Electrician*, some of the wireless telegraph messages transmitted from Poldhu to the *Carlo Alberto* on her recent cruise were recorded on installations not belonging to the Marconi Company or put up on their system. In the last issue but one a letter from the Marconi Company recalls, and repeats, the challenge which Mr. Marconi recently made to Sir W. H. Preece or Sir O. Lodge to show that they could pick up his messages, and questions the ability of the *Electrician* to prove that their messages were genuinely intercepted. In reply, the *Electrician* published last week the tape records with an article by Mr. Nevil Maskelyne describing the circumstances under which they were obtained at the wireless telegraph station erected by the Eastern Telegraph Co. at their cable terminus at Porthcwmow (Cornwall). We call attention to the discussion because it is of special interest in view of the proposed Berlin conference, and of the necessity which we have had occasion to point out on one or two recent occasions for consolidation of the competing systems of wireless telegraphy.

THE annual course of Christmas lectures, specially adapted to young people, at the Royal Institution, will be delivered by Prof. H. S. Hele-Shaw, F.R.S., whose subject is "Locomotion :—on

the Earth; through the Water; in the Air." The first lecture will be given on Saturday, December 27, and the dates of remaining are December 30, 1902, and January 1, 3, 6 and 8, 1903.

AT the annual meeting of the London Mathematical Society to be held this evening, Mr. Robert Tucker is retiring from the office of honorary secretary. Mr. Tucker was elected secretary in 1867, very shortly after the foundation of the society, and has held the office continuously until now. During this long period he has grudged neither time nor labour in the interests of the society; it is in large measure owing to his zeal and devotion extended over so many years that the society has advanced from a comparatively local beginning to be the representative society of mathematical science in Great Britain. A circular has just been issued, signed by four past presidents of the society, expressing their belief that many members of the society will concur with them in wishing to offer to Mr. Tucker some permanent mark of their appreciation of his services, and requesting that subscriptions for that object may be sent to Dr. J. Larmor, St. John's College, Cambridge, as soon as possible.

WRITING under date November 6, the Paris correspondent of the *Times* states that M. Lacroix, the chief of the French scientific expedition to Martinique, has sent a fresh report to the Colonial Office on the situation in that island. It appears that the zone devastated by the recent eruption is less extensive than was at first thought to be the case. The aspect of the volcano has much changed. A cone has been formed in the crater exceeding in height the former summit. So long as it exists the matter projected will fall in all directions instead of being localised as before on the southern and south-western slopes.

PROF. F. A. FOREL sends us from Morges, Switzerland, a cutting from the *Gazette de Lausanne* of October 31 containing a letter in which he describes the sunset effects at Morges on the evenings of October 28 and 29. Half an hour after the disappearance of the sun, following the gradual extinction of the sunset colours, a peculiar secondary brightening of the western sky was observed and lasted for a second half hour. To begin with, the illumination was of a yellowish-green colour, becoming orange later, and sometimes shading into red near the horizon. Now and then a large, purple-lilac coloured circle with a faint halo and ill-defined contours appeared in the west, having for its centre the sun below the horizon. After observing these effects and noting their remarkable similarity to the sunset displays of 1883 following the eruption of Krakatoa, Prof. Forel expresses the conviction that the phenomena noticed by him in October are due to the impalpable dust particles in the higher regions of the atmosphere which are to be traced to the recent volcanic disturbances in the West Indies.

PARTICULARS of the amounts contributed by the various Powers interested in the international scheme of the North Sea fisheries scientific investigation have been given by the Board of Trade. The amount to be expended in this matter by Great Britain during the next three years is 42,000*l.*, inclusive of 1250*l.* towards the maintenance of a central organisation at Copenhagen. The contributions of other countries (exclusive of the latter item) are as follows:—Denmark—initial expenditure, 9600*l.*; annual expenditure, 5500*l.* Germany—initial expenditure, 16,500*l.* (for steamer), 875*l.* (for equipment); annual expenditure, 6250*l.* Holland—initial expenditure, 666*l.* (instruments, &c.); annual expenditure, 2587*l.* Norway—initial expenditure, 9500*l.* (steamer); annual expenditure, 7370*l.* Sweden—initial expenditure, 1055*l.*; annual expenditure, 1066*l.* Russia—initial expenditure, 16,000*l.* (steamer without equipment); annual expenditure, 12,800*l.* Finland—initial expenditure, 6,000*l.*; annual expenditure, 2,228*l.*

THE utilisation of the internal heat of the earth has often been suggested as an engineering problem of the future. The Rev. E. Rattenbury Hodges directs our attention to an issue of the *Boston News Bureau* in which a scheme is seriously proposed by the official geologist for Pennsylvania of the U.S. Geological Survey and also by Prof. Hallock, of Columbia University, New York, for drawing on the earth's internal heat by means of deep borings. The idea is to admit cold water into a deep boring and utilise the hot water and high-pressure steam produced. Mr. Hodges points out that he made similar suggestions in the *Popular Science News* for January, 1894, in an article on "Our Heat Resources of the Future." He remarked, however, at the time, "The great objection to this drawing on the earth's ancient store of thermal energy would be that her cooling and consequent shrinking would be accelerated; in other words, earthquakes would necessarily become more frequent, and possibly more violent and destructive in their effects."

THE Atlantic forecasts issued at Washington are based on American, Atlantic and European telegraphic reports, and were begun, the chief of the U.S. Weather Bureau states in his last report, at the beginning of 1901. They were, on June 1 of the same year, made a part of the regular general night forecasts published by the Bureau. In a number of instances, when storms of marked strength were passing eastward off the American coast, advices were issued as to the character of the weather which would probably be experienced by steamers leaving European ports westward bound, and by an arrangement with Lloyd's these forecasts have been cabled over here. In addition to the daily forecasts of wind and weather and special storm warnings, predictions of fog have been issued when conditions favourable for fog developments have been indicated in the steamer tracks west of the fiftieth meridian. Reports from Transatlantic steamships have again and again verified these forecasts and special warnings.

THE Meteorological Council has issued a valuable supplement to the temperature tables for the British Islands which were published in the early part of this year. Those tables gave the monthly means of the daily maximum and minimum readings for 117 places; the present volume contains the same stations, grouped as before under districts. The table for each month is divided into two parts, showing (1) the values for thirty years and for each five years (for the observations which extend over the whole time), together with the correction which must be applied to reduce the five years' period to the thirty years' period; (2) the five-yearly mean values for those stations for which the observations extend over less than thirty years, but for which an appropriate correction may be obtained from the values in the first part to enable the mean for thirty years to be computed with a fair approximation to accuracy. The work will be found very useful to actual or intending observers who may wish to compare their results with those of longer series at the same or neighbouring localities.

AS already stated, the eruption of the St. Vincent Soufrière in the night of October 15–16 was followed by another considerable fall of volcanic ash on the island of Barbados, 100 miles to windward. The particles were found to consist chiefly of minute fragments of felspar, with a little volcanic glass, some ferro-magnesian minerals and a very little magnetite, thus differing considerably from the May samples, which consisted largely of ferro-magnesian minerals, with a considerable amount of magnetite. On this account, the dust of last month is likely to prove of greater fertilising value than that of May last. In connection with the latest dust-storm, the officials of the Department of Agriculture endeavoured to determine the effect produced on insect pests and other pests in the field. Two-

winged flies, "cow-bees," "wild-bees" and other Hymenoptera suffered severely, but other groups escaped practically unharmed, and there is no doubt that the dust has had little, if any, effect on the insect pests. The dust, in fact, destroyed not the pests, but the useful two-winged flies, &c., which prey on the caterpillars and other pests, so that in this way the volcanic ash has tended to disturb the balance of nature. Its effect is declared to be possibly a harmful one except in the case of the present corn crop, as the dust, lodging in the heart of the young plants, prevents the worms eating into the young leaves.

THE third part of the general report and statistics for 1901 relating to the output and value of the minerals raised in the United Kingdom, the amount and value of the metals produced, and the exports and imports of minerals, edited by Prof. C. Le Neve Foster, F.R.S., has been issued as a Blue-book. The first year of the new century has an unfavourable record so far as the mineral industry is concerned. Quantities have been smaller and prices lower. The value of the coal raised during 1901 represented 88·8 per cent. of the total mineral output for the year, but was six million tons less than the previous year, this being the first interruption in the steady rise since the great strike of 1893. Although the output of coal was less than in 1900, more persons were employed in and about the mines. The output of iron ore has continued to fall since 1899, and the diminution of $1\frac{3}{4}$ million tons in 1901 represents $12\frac{1}{2}$ per cent. of the quantity raised in the previous year. The comparative unimportance of the metallic ores, other than iron, is easily understood when it is stated that their value only amounts to 800,000*l.*, which is just half the value of the sandstone and far less than that of the limestone, the slate or the igneous rocks. The oil-shale mines of Scotland yield a product of greater money importance than the tin mines of Cornwall.

WE have received a report on observations of the tidal currents and undercurrents in the Strait of Dover, published by the Hydrographic Department of the Admiralty. The report consists of two parts. The first part contains observations made by Mr. M. F. J. Wilson, engineer-in-charge of the extension works at the Admiralty pier at Dover, with the object of ascertaining whether a report by divers, that the tidal stream changed its direction at the bottom a very long time before the surface, was correct; the result shows that the report was unfounded. The second part contains observations taken by Captain A. M. Field in H.M.S. *Research* in the Dover channel, in order to test the accuracy of conclusions suggested by the observations made by Captain W. V. Moore in 1896, to the effect that on the English side of the Strait the water below a certain depth was still, while the surface current was strong. The earlier observations are shown to have been erroneous, as the tidal streams run to the bottom of the Strait.

Terrestrial Magnetism and Atmospheric Electricity for September contains a biographical sketch of General Sir Edward Sabine, accompanied by a photographic reproduction of the portrait belonging to the Royal Society.

THE Italian Meteorological Office has forwarded us Nos. 4–6 of its *Bolletino mensuale*, or monthly weather review, containing a note on Count Almerico da Schio's attempts at aërial navigation. The form preferred by Count da Schio is a fish-shaped balloon with flexible keel, the Buchat motor yielded 12 horse-power, and the work of construction has been carried on in a private workshop.

A PAPER by Dr. Loria (Genoa), on the origin and development of geometry prior to 1850, has been translated in the *Monist* by Dr. G. B. Halstead. So far as it is possible to sum up briefly the author's conclusions, it would appear that: (1) While it is impossible to determine the first origin of geometrica research, it is certain that the Assyrians and Babylonians studied many important geometrical problems. (2) The geometry of the Egyptians was of far greater importance, and had a particular tendency towards practical applications. (3) Thales and the Ionic period represent the twilight preceding the dawn of Greek geometry. (4) The "golden period" of Greek geometry came within the Alexandrine epoch, its most conspicuous representatives being Euclid, Archimedes and Apollonius. (5) In the list of Greek geometers, Heron of Alexandria and Claudius Ptolemy play a prominent part, and the "silver period" of Greek geometry was notable for the appearance of Eutocius and Proclus, and especially Pappus. (6) The ascendency of the Romans and the subsequent middle ages represent a period of decadence for geometry. (7) The renaissance of mathematics commenced with the appearance of Leonardo Fibonacci (1200 *circa*), and before the end of the sixteenth century we note the names of Tartaglia, Cardan and Ferrari. (8) The primacy of mathematics in France was attained by the appearance of Viète, Mydorge, Pascal and Desargues; Henry Savile of Oxford and Kepler also belong to this period. (9) A new era was introduced by the analytical methods of Fermat and Descartes. (10) In the next section, Prof. Loria traces the influence of infinitesimal methods on the study of geometry, and (11) considers in particular the development of the study of curves and surfaces in three dimensions.

M. G. LIPPMANN, writing in the *Journal de Physique* for October, describes ingenious methods for verifying whether a ruler or sliding bar is rectilinear, and for fixing a collimator in the focal plane of a lens or telescope objective. For the first purpose he attaches one telescope with cross wires to a "chariot" which runs along the ruler, and observes the image of the wires in a second telescope which is fixed. If the two systems of cross wires remain coincident as the chariot runs along the ruler, M. Lippmann concludes that the ruler is rectilinear, and the only exception that could be made to this inference would be if the surface of the ruler formed a series of waves of length equal to the wheel-base of the chariot. To fix the collimating wires in the focal plane of a lens, M. Lippmann now fixes the auxiliary telescope to the chariot in such a way that it can be displaced parallel to its axis, and he uses it to view the wires in the telescope to be tested. If these remain unchanged in position when the auxiliary telescope is shifted, the collimation is correct; if not, the shift of the image determines the amount by which the wires must be adjusted in order to bring them into the focal plane of the lens. The chariot runs on a sliding piece which has been previously tested by the first method.

MR. BASIL THOMPSON, in his "Notes upon the Antiquities of Tonga" (*Journ. Anth. Inst.*, xxxii. p. 81), describes the famous trilithon, or *Haamonga*. He inclines to one traditional account which relates that it was erected by Tui-ta-tui in the latter half of the fourteenth century. It was built for him to sit upon during the Kava ceremonies out of reach of his people, as he so dreaded assassination.

SEVERAL years ago, Mr. Henry Balfour published an important memoir on the musical bow, and in the current *Journal* of the Anthropological Institute (vol. xxxii. p. 156) he describes a superficially similar instrument, the *goura*, which Frobenius and Ankermann have confused with the musical bow proper. The *goura* is a bow-like instrument; one end of its string is fastened to a flattened quill, the other end of which is fastened to the bow, and the string is thrown into vibration through the medium of the quill, which is caused to oscillate by being blown upon. Those musical bows which have no resonator are held to the mouth when playing in order to increase the sound, but

with the *goura* the breath causes the vibration, whereas the vibration in the musical bow is caused by tapping or plucking the string.

THE November issue of the *Irish Naturalist* is entirely devoted to the Belfast meeting of the British Association, special attention being directed to papers connected with Ireland.

"PLANKTON" forms the subject of two papers in the *Biologisches Centralblatt*; the September issue contains an account of river-plankton by Mr. A. S. Skorikow, while in the October number Mr. W. Ostwald brings to a close his survey of the theory of plankton in general.

A RECENT issue (vol. iv. part iii.) of *Annotationes Zoologicae Japonensis* contains an account, by Messrs. Ijima and Ikeda, of a rare squid collected at a great depth in the Sagami Sea. The specimen, which is so delicate and translucent that it recalls a jelly-fish, evidently belongs to the genus Amphitretus, founded on a single somewhat damaged example dredged during the cruise of H.M.S. *Challenger*. It is apparently also referable to the type and only species of that genus, hitherto definitely known solely by the original specimen, although a squid taken some time ago in the Agulhas Stream may pertain to the same form. Amphitretus, as its name indicates, differs from all other cephalopods in having the mantle fused in the middle line with the siphon, so that there are two openings of the gills into the gill-cavity on each side.

MESSRS. LAMB AND HANNA have made some interesting experiments upon the neutralising power of anti-venomous serum towards cobra venom and upon the deterioration of this serum through keeping. They find that the maximum amount of venom injected by a cobra into a bite is 45 milligrams, and, assuming that man is as susceptible as the most susceptible animal tested, viz. the rat, estimate that for a man weighing 60 kilograms who received this injection, about 37 c.c. of the fresh serum would be required to save life. They also find that anti-venomous serum undergoes a progressive and fairly rapid deterioration when stored in hot climates, and that this deterioration is greater and more rapid the higher the mean temperature to which it is subjected (*Scientific Memoirs*, Government of India, new series, No. 1, Calcutta, 1902).

ACCORDING to the October number of the *Agricultural Journal* of the Cape of Good Hope, the Government entomologist, Mr. C. P. Lounsbury, has made an important discovery in regard to the propagation of the South African sheep and goat disease known as "heartwater." The so-called bont-tick has nitherto been found to be the only medium of spreading the disease. "A single specimen of this species, if fed on a heartwater-sick animal as a larva or 'seed' tick, has been found capable of transmitting the malady with fatal effect. An animal pastured on veld heavily infested by the tick may drop thousands of pathogenic larvæ during its period of illness and may thus indirectly serve for the almost total extermination of a flock in a few months. The terrible mortality amongst healthy flocks, brought to the coast where the tick is abundant, is thus easily explained. Pathogenic larvæ have been found to retain their dangerous character until they are adult. They may take their second or nymphal feeding on an ox or a non-susceptible goat, and then in the third or final stage get on to a susceptible sheep or goat and give it deadly fever. On the other hand, the disease appears to be non-transmissible through the egg-stage, and the species is normally non-pathogenic in all stages. A farm may be badly infested with bont-tick, yet be entirely free from heartwater." Since the other two common species are innocuous, it is hoped that by keeping down the bont-tick the disease may gradually be stamped out.

A MONOGRAPH of the North American Umbelliferæ, representing the joint work of Prof. J. M. Coulter and Dr. J. N. Rose, has been published in the seventh volume of contributions from the U.S. National Herbarium. The same authors treated this order also for North America in 1888.

THE second quarterly *Bulletin* published by the Botanical Department of Trinidad contains brief articles on the tonka bean, newly-imported mango trees and cane seedlings. Analyses of several Trinidad seedlings yield results which are very promising. An extra number, issued by the same authorities, deals with the cultivation and curing of vanilla in Tahiti. The species grown in that island is mainly *Vanilla pompona*, which yields a less valuable fruit than *Vanilla planifolia*. The former variety has this advantage, that the beans do not split so readily and are, therefore, more easily cured; also it bears flowers twice a year. Pollination is artificially performed, and an efficient worker is said to be able to pollinate two thousand flowers in an eight hours' working day. Curing is a very critical process, as the beans sweat on exposure to the sun, and they must then be covered with blankets and dried at an even temperature.

THE report of the Dominica Botanic Station during the year ending March 31, 1902, contains much valuable information on the work of the establishment, supplied by Mr. J. Jones, the curator; on the experiment plots at the Agricultural School, by Mr. Tannock; and on the cacao experiment plots, by Mr. Whitfield Smith, the travelling superintendent of the Agricultural Department. The monthly rainfall returns from twenty-five stations in the island are also given. Of the various experiments with economic plants, it is interesting to observe that the attempts to introduce early English potatoes are far from being successful at present. Of six varieties planted, three failed completely, two did fairly well and the sixth did excellently. A shipment of 480 pounds of these last was sent to Liverpool, but was not favourably received on the market, experts considering the tubers not bright enough. Still, it is hoped that with further experiments the island may yet compete with the Canary Islands in the production of early potatoes and other vegetables for the English market.

THE Imperial Department of Agriculture for the West Indies continues its series of useful pamphlets on subjects connected with the commercial development of these islands. Mr. A. Howard writes on the treatment of fungoid pests, dealing with them under the head of root, stem, leaf and fruit diseases. The information supplied is for the most part general, but reference is made to the immunity from the so-called "foot rot" or "mal-di-gomma" of sweet orange plants which have been grafted on sour-orange or grape-fruit stocks, and the advantage of treating sugar-cane cuttings with Bordeaux mixture and coating the ends with tar. A second pamphlet gives a number of recipes for cooking West Indian yams, and is issued with the intention of educating the English and American people to appreciate this vegetable.

WE have received copies of two papers read by Mr. H. W. G. Halbaum before the Institution of Mining Engineers, dealing with the difficult problem of mine ventilation and its reduction to simple graphical calculations. One of Mr. Halbaum's objects has been to furnish mining engineers with a form of diagram which shall fulfil the same purpose in the study of mine ventilation that has been so admirably served by Watt's indicator in the case of a steam engine. The second paper deals with an extension of the equivalent orifice theory, in which the writer calculates the relation between the orifice of the ventilating fan and that of the mine in order that the fan may develop its maximum efficiency. It is found that the efficiency is greatest when the orifice of the mine is between one-

quarter and one-half that of the fan, according to the kind of fan used. If the ratio of the orifices is one-third, the efficiency in all these fans is not more than 2 to 3 per cent. below the maximum, but it falls rapidly when the ratio is outside the limits ½ and ¼. Hitherto there has been a "good old theory" among colliery workers to have large airways and plenty of them, but this theory Mr. Halbaum compares to remedying the defects of a pump by enlarging its suction pipe. The investigation is largely based on the theories of Mr. Murgue, of St. Etienne, from whom, however, Mr. Halbaum differs in certain particulars. We hope the author will be successful in convincing mine owners that mathematical calculations are of more value than "good old theories," but the slow progress which mathematicians are able to effect in breaking down conservatism in other directions does not make his outlook hopeful.

WE have received the first number of *West India*, a bi-monthly illustrated magazine of thirty pages, published by Messrs. Lightbourn's Sons, price ten cents. Its contents are of a very general character, being "devoted to questions and persons and things generally," in prose and verse. The principal article in the issue before us is one by Mr. Francis Watts, on "Glimpses of the Leeward Islands." The Picture Stone, at Harte's Bay, St. Kitts, is dealt with in verse by Dr. Branch.

UNDER the title of *The Illustrated Scientific News*, a new monthly journal devoted to popular science has made its appearance, and we offer it best wishes for a long and successful career. With the second number, an excellent full-page portrait of Lord Kelvin is presented as a supplement. The journal is concerned with inventions and other aspects of engineering work as well as with purely scientific advances. There are, for instance, articles on the 4·7 gun and the Diesel oil engine, as well as on such scientific studies as sounding the atmosphere with kites, Becquerel rays and Foucault's pendulum. Prof. H. H. Turner lightens the pages with a few anecdotes, and asks for other stories of scientific men and manners. This varied contents should find an interested public.

THE thirty-fourth volume of the *Transactions* and *Proceedings* of the New Zealand Institute, which deals with the year 1901, runs to 627 pages and is illustrated by 42 plates. When it is remembered that the Institute includes eight incorporated societies, the proceedings of each of which are here reported, and that the *Transactions* are concerned with zoology, botany, geology, chemistry, physics and miscellaneous subjects, the impossibility of describing the contents of the volume in a short note will be at once understood. In his presidential address to the Auckland Institute, Mr. J. Stewart considered, amongst others, the subject of technical education. He insisted that a youth cannot be taught a trade at a technical school in a manner to enable him to take his place among those who have served a regular apprenticeship to that trade; but that the use of his hands in mechanical handicraft is one of the easiest things for a young man to acquire. The great aim of technical education, he said, is to prepare the intellect to receive and master the scientific basis of all construction and of all manufactures. A paper, also read before the Auckland Institute, by Mr. Elsdon Best, describes very fully the diversions of the "Whare Tapere," a house where the young people of a village gathered at night in order to amuse themselves in various ways, and gives an account of the games, amusements and trials of skill practised by the Maori in former times. A second contribution by Mr. Best of the same date to the same society contains notes upon witchcraft, magic rites and various superstitions as practised or believed by the old-time Maori. Captain F. W. Hutton, F.R.S., is credited with numerous papers, treating of the beetles of the Auckland Isles and other zoological subjects. Other papers are by Profs. Dendy, Benham, A. P. W. Thomas, J. Park and T. H. Easterfield, and when the fifty-four articles brought together in the volume by the director of the Institute, Sir James Hector, K.C.M.G., F.R.S., are considered, the conclusion is reached that science is being worthily advanced by workers at the antipodes.

THE additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mr. T. Turner; a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. E. C. Holland; three Indian Porphyrios (*Porphyrio calvus*) from Java, presented by Mr. A. D. Grange; a Woodcock (*Scolopax rusticula*) European, presented by Mr. W. C. Reid; two Common Chameleons (*Chamoeleon vulgaris*) from North Africa, presented by Mr. E. V. Wash; a Smith's Dwarf Lemur (*Microcebus smithi*) from Madagascar, a Barnard's Parrakeet (*Platycercus barnardi*) from South Australia, deposited; a Stone Curlew (*Œdicnemus scolopax*) European, purchased.

OUR ASTRONOMICAL COLUMN.

COMET 1902 *b* AS OBSERVED IN CEYLON.—Mr. H. O. Barnard, of the Ceylon Survey, has communicated some interesting details of Comet 1902 *b*, as observed by him in Ceylon, to the *Ceylon Observer* of October 11.

He records the comet's appearance, using a telescope of "moderate power," as an egg-shaped mass of nebulosity having a very distinct star-like nucleus which is of a reddish colour, and a tail which extended to about 1°·5 from the nucleus on October 7, giving the whole object a "tadpole" appearance; he further adds that it was easily visible to the naked eye, whilst an opera-glass showed a faint trace of the tail, but no nucleus.

Mr. Barnard's computations show that the comet increased its distance from the earth by 45 million (37 million to 82 million) miles during the period October 8 to 28, inclusive, and that its diameter was 200,000 miles, its volume 600 times that of the earth, whilst the length of the tail, on October 7, was about one million miles.

Mr. Barnard expects the comet to be visible again, in Ceylon, just before sunrise in December.

NEW MINOR PLANETS.—Prof. Max Wolf announces, in Nos. 3821 and 3824 of the *Astronomische Nachrichten*, the discovery of five new minor planets. The dates of discovery, positions and magnitudes of these objects are as follows:—

Planet.	Date.	Heidelberg M.T.	α	δ	Mag.
		h. m.	h. m.	° ′	
1902 J.V.	Oct. 7	10 38·8	2 9·7	+10 55	12·5
,, J.W.	,, 7	13 25·8	2 5·2	3 18	13·0
,, J.X.	,, 7	,, ,,	1 52·9	2 55	13·5
,, J.Y.	,, 24	12 10·3	1 55·2	12 14	13·5
,, J.Z.	,, 24	,, ,, 1 59·2		+12 59	13·0

The daily movements of the respective planets are J.V. −0m.·7, −2′; J.W., −0m.·8, −6′; J.X., −0m.·7, −6′; J.Y., −0m.·8, −6′; J.Z., 0m.·7, −8′.

The planet discovered by Prof. Wolf on October 7 and designated 1902 J.U. proved to be the same as (106) Dione.

NEAR APPROACH OF COMET 1902 *b* TO MERCURY.—A telegram from Prof. Pickering, dated Cambridge, Mass., October 29, announces that Prof. Seagrave finds that Comet 1902 *b* will approach to within two million miles of the planet Mercury on November 29.

Herr M. Ebell, Kiel, has confirmed this telegram from the parabolic elements published by Herr Elis Strömgren in No. 3821 of the *Astronomische Nachrichten*, and which were computed from observations made at Lick (September 1), Nicolaiew (September 20·4) and Strasburg (October 8·4). From the ephemeris accompanying these elements it is seen that the declination of the comet will be too southerly for any further observations to be made in England until about the middle of February, and that its brightness at that time (February 11) will be only 2·1 times its brightness at the time of its discovery, whilst by the end of February this ratio will be reduced to 0·6 (*Astronomische Nachrichten*, No. 3821).

THREE STARS WITH LARGE PROPER MOTIONS.—M. A. Verschaffel communicates to No. 3824 of the *Astronomische Nachrichten* the positions of the stars B.D. +24°·2439, 24·2733[1] and 24·2733[2], as recently observed by him at Abbadia, and compares them with the positions given in the catalogue A.G. Berlin B. and brought to 1900 by the corrections for precession and secular variation given in the catalogue, thereby demonstrating the existence of a large amount of proper motion for each star.

THE PYRAMID SPOT ON JUPITER.—Herr Leo Brenner, in writing to *The Observatory* (No. 324), explains the great discrepancies which have appeared between the positions, and velocity, of the "pyramid" spot as determined by himself and as determined by the English observers Messrs. Denning and Phillips.

He found that the centre of the formation travelled, during a year, at the mean velocity of 0°·5 per day, and then Messrs. Denning and Phillips recorded that, according to observations made on June 28, it had moved at a mean velocity of nearly 7°·0 per day for a period of nine days. This great change of velocity seemed impossible, but Herr Brenner has found a solution to the difficulty in the observed fact that it is not *one* spot that is being observed, but a series of three or four spots, and of these, some are new formations of which Messrs. Denning and Phillips had measured the position as though they were portions of the original spot, thus obtaining the great differences in position noted above.

Herr Brenner has arrived at the conclusion that neither the markings seen by him during August and September, nor those seen by the English observers on June 28, can be identical with the "pyramid" spot of last year, and these conclusions are strengthened by the observations of Señor Comas Solá, which were published lately in the *Bulletin de la Société Astronomique de France*.

EPHEMERIS FOR COMET TEMPEL-SWIFT.—In continuation of the ephemeris given in *Astronomische Nachrichten*, No. 3811, M. J. Bossert now publishes the following ephemeris for this comet.

12*h*. *M. T. Paris.*

1902.	R.A. h. m. s.	Decl. ° ′	log *r*.	log Δ.
Nov. 10	20 3 45	−16 6·2	0·1697	0·1596
,, 15	20 14 42	−15 26·6	0·1591	0·1603
,, 20	20 26 19	−14 42·2	0·1486	0·1606
,, 25	20 38 35	−13 52·6	0·1383	0·1603
,, 30	20 51 29	−12 57·5	0·1282	0·1595
Dec. 5	21 4 57	−11 56·3	0·1184	0·1584
,, 10	21 19 0	−10 49·5	0·1089	0·1566
,, 15	21 33 38	− 9 36·7	0·1000	0·1546
,, 20	21 48 51	− 8 17·4	0·0917	0·1525
,, 25	22 4 35	− 6 52·0	0·0843	0·1502
,, 30	22 20 51	− 5 21·0	0·0776	0·1479

Kiel Circular, No. 53.

THE AUTOMATIC TELEPHONE EXCHANGE.

THE object of the automatic telephone exchange is to dispense with the assistance of a third party in making connection between two subscribers. Those who are at all familiar with the complexity of the connections and of the numerous devices needed in a modern exchange having a large number of subscribers will realise that to work out a system in which the telephone girl is replaced by an automatic arrangement is a matter requiring no little ingenuity, and will, perhaps, not be surprised that the problem has apparently only been attacked successfully on the other side of the Atlantic. The American technical papers have shown that, during the past few years, the construction of automatic exchanges has received considerable attention and that several different systems have been worked out. Some attempts have been made to introduce these into this country, but not with much success; in fact, until the last year or so England did not afford a promising field for the introduction of automatic telephones unless for small private exchanges. In America, however, matters are different, and, as we have said, descriptions of two or three different systems in actual or experimental use have been published. One of these, recently described in the *Scientific American*, is noteworthy for the fact that the automatic apparatus at the exchange is operated mechanically so far as possible, the electrical control being reduced to a minimum. Greater trustworthiness, it is said, is obtained by this means, though we should be inclined to think that the wear and tear would also be greater. We do not know whether this, the Faller, system has had any extensive trial as yet. Another system, which we propose to describe briefly, has been in operation in some parts of America for three or four years, and as it is being installed now in several large American towns, and is also being introduced into Germany and England, we may judge that it has proved both trustworthy and economical. In Chicago, an exchange on this system is being constructed with an ultimate capacity of 100,000 subscribers.

This system is known as the "Strowger" system. We have had an opportunity of inspecting a small model installation representing part of an exchange suitable for 10,000 subscribers, and were struck by the ease and simplicity of its working and its great convenience from the subscriber's point of view. Of course, working a small portion of an exchange under exhibition conditions is one thing and running the complete system continuously, with all the subscribers connected, is another; but there was little to lead one to suppose that the working under the more arduous conditions of actual service would be any less satisfactory, and indeed the success which has attended the operation of three or four large exchanges in America is direct evidence to the contrary. One of these, at Fall River, Mass., has been in operation for two years and, with an ultimate capacity of 10,000 subscribers, already has 4000 connected. Apart from the clerical staff, only five people are required to look after this exchange, and these are said to spend most of their time connecting up new subscribers; at night and on Sundays the exchange is left to take care of itself.

We may first of all consider the subscriber's instrument; this takes no more room than, and looks very much like, an ordinary wall set. There is, however, no magneto ringer, and on the front of the box is a circular metal disc having ten holes on the right-hand side numbered from 0 to 9; below this is a ringing-up push. Suppose a subscriber wishes to call up No. 5683; he takes his receiver off the hook in the usual manner and, putting his finger in the hole marked 5, rotates the disc until his finger comes against a stop; he then allows the disc to return to its normal position and repeats the operation with the holes marked 6, 8 and 3 in succession. He is now connected through, and if No. 5683 is engaged, will hear a buzzing in his receiver; if not, he has only to press the ringing-up push and wait until his call is answered. When he puts back his receiver on the hook, all the connections are restored to their original condition. The time taken to get connected through—or to find out that the number you require is engaged—is considerably less than with the ordinary system, even when the exchange girl replies to your call and connects you up immediately, which, as telephone users know, happens but rarely.

The apparatus at the exchange consists of a number of automatic switches known as "first" and "second selectors" and "connecting switches." The construction of all these is very similar, but is too complicated to describe in detail; we can only indicate the principle upon which they work. The switch consists of a semi-cylinder, along the axis of which is the switch-arm. This arm can be raised or lowered in ten steps and also rotated so that its contact can be brought up to any of the contacts on the inside of the semi-cylinder; these are arranged in ten rows of ten contacts each. We may best understand the operation of these switches by following out what happens on ringing up, say, No. 5683. Each subscriber has a "first selector" switch of his own at the exchange, and the first movement of the dial on his instrument operates this switch. As he draws down the hole 5 to the stop, a succession of five current impulses are sent along the line, and these raise the central switch-arm to the fifth row up on his switch. This picks out all the subscribers whose numbers begin with 5000, by connecting the caller to the group of "second selectors" corresponding thereto; there are ten connecting or "trunk" lines leading from the first selectors to the second, and the switch-arm, when it has risen to the fifth row, rotates until it picks out a disengaged trunk, passing over any which are in use by other subscribers. The second movement of the dial operates the second selector in precisely the same way, raising its arm to the sixth row of contacts and causing it to rotate over that row until it picks out a disengaged trunk line leading to the group of subscribers with numbers beginning with 5600. The remaining two movements operate the selector switch and are

slightly different ; the first raises the arm to the eighth row of contacts and the second rotates it to the third contact in that row. The subscriber is now connected to No. 5683 and can ring him up if he is not engaged ; the signal that he is engaged is given through another set of contacts on the connector switch, an interrupted current being sent along the caller's line and causing his receiver to hum. When the conversation is finished and the caller hangs up his receiver, all the switches which he has been using return to their normal position of rest.

The exchange is run on the central-battery system and metallic circuits are used throughout. It will be noticed that the subscriber's connections are duplicated at the exchange, one pair of wires running to the first selector and one to the contacts corresponding to his number on the connectors. It is also obvious that the number of connections in one group of hundreds or thousands which can be made at once is limited by the number of trunk lines ; ten of these per hundred subscribers have been found to be practically sufficient, but the number could, of course, be increased without limit if it was found desirable. Once two subscribers are connected through, their conversation cannot be interrupted, since any attempt to call either up results merely in the caller receiving the busy signal, and any calling up between other subscribers does not affect the lines they are using. This alone is a very great convenience from the user's point of view ; in addition, the gain in time in getting connected up, the impossibility of getting on to a wrong number except by the subscriber's own fault and the secrecy of the system must be reckoned to its advantage. So far as the exchange is concerned, the chief advantage lies in doing away with the exchange girl ; the cost of maintenance is said to be no more than in a manually operated system, the floor space required for connections and switches about the same ; there is, therefore, a slight saving in room, since none of the resting rooms which the strain upon the operators now renders necessary is required. M. S.

INSTANTANEOUS CHEMICAL REACTIONS AND THE THEORY OF ELECTROLYTIC DISSOCIATION.[1]

IT is generally held that instantaneous chemical reaction, if not all chemical action, is dependent upon ions ; in other words, that such reactions take place between electrolytes. In order to test this point, the author has attempted precipitation by double decomposition (like the reaction between silver nitrate and hydrochloric acid) in solutions that are excellent insulators. As a solvent benzene was chosen, though it seems that petroleum ether or toluene would have been equally good. The benzene used was the best that is made by Kahlbaum, free from thiophen. It was allowed to stand for days over phosphorus pentoxide, from which it was distilled, and was finally kept standing over metallic sodium. The conductivity was tested by comparison with that of air. For this purpose an Arrhenius resistance cell, with plates less than a millimetre apart, was placed in series with a sensitive galvanometer, and a dynamo giving a pressure of 110 volts. When the cell contained air a slight movement of the needle could be seen on closing the circuit, and on replacing the air by benzene the deflection was somewhat less. The insulating properties were therefore good.

Some difficulty was found in obtaining suitable solutes owing to the general insolubility of salts in hydrocarbons. Certain oleates, however, are soluble, and those of copper, nickel and cobalt were used. These were prepared by heating pure oleic acid with the calculated quantity of standard solution of sodium hydroxide and then adding to this sodium oleate solution a slight excess of the sulphate of the heavy metal. The precipitate was thoroughly washed with water and finally dried at 110°. The salts so obtained were analysed by reduction in hydrogen.

These oleates are readily soluable in benzene, even in the cold, and give colours similar to those of salts of the corresponding metals in aqueous solutions. On heating the dark red solution of cobalt oleate in toluene it turns blue, and on cooling it again becomes red, in the same way as cobaltous salts change colour in aqueous solutions. It was found that 5 per cent. solutions did not conduct any better than pure benzene. Metallic sodium does not cause any precipitation, and was, in fact, used as a desiccating reagent ; the only change that ever took place was the usual slight pinkish coloration that freshly cut surfaces always assume after a time. Magnesium, aluminium and zinc have been kept in a copper oleate solution for weeks without in the least changing their appearance and lustre. It is therefore abundantly proved that these oleates in benzene are not ionised. Cryoscopic determination of the molecular weight of copper oleate in benzene gave figures about 2400 and the boiling-point method about 2650, whereas the theoretical figure is 625·6, so that, according to the usual idea, the copper oleate would appear to be polymerised.

A solution of dry hydrochloric acid gas in benzene was next prepared. The gas was obtained by dropping the aqueous solution into concentrated sulphuric acid and further drying by sulphuric acid and phosphoric anhydride. The conductivity of this solution was no higher than that of the benzene itself. It does not attack the carbonates of sodium, calcium and barium, or bright magnesium ribbon. Zinc, however, is attacked, whether amalgamated or not, but platinum in contact with it makes no difference, the hydrogen being evolved from the zinc alone. Thus voltaic action is absent. A dilute aqueous solution of the acid seemed to act rather less readily on amalgamated zinc than did the solution in benzene. Similarly, contact with platinum or other metals does not cause magnesium to be acted on by the acid. Iron, nickel, cobalt, copper and cadmium are not attacked ; tin and aluminium are slightly acted upon, and lead very slightly. This is so whether the metals are by themselves or in contact with others. Metallic sodium is fairly rapidly attacked. The chlorides of the metals acted upon are practically insoluble in benzene.

In all the experiments, great precautions were taken against moisture, the generators and other apparatus being connected to suitable drying trains. The flask containing the benzene and substance to be tested was fitted with a doubly perforated rubber stopper, and was connected with the drying train of the hydrochloric acid generator and also to a large tower filled with pumice and phosphoric anhydride. Before introducing the benzene and substance, the flask, stopper and connecting tubes were heated to drive off moisture, and while still hot, the benzene and substance to be tested were quickly introduced and the whole at once connected with the train. The air was then displaced with dry hydrogen, which passed through the hydrochloric acid generator, and finally the acid was slowly evolved until the train was saturated.

When dry hydrochloric acid gas is passed into a solution of copper oleate in benzene, there is formed instantly a heavy brown precipitate which is cupric chloride. We have here, then, a case of instantaneous precipitation by double decomposition which is perfectly comparable with that of the formation of silver chloride in aqueous solutions, when silver nitrate solution is treated with hydrochloric acid. Yet the benzene solutions conduct no better than benzene itself, nor is there the least perceptible increase of conductivity at the instant of the formation of the precipitate. The oleates of nickel and cobalt, when treated in benzene solutions with dry hydrochloric acid, react in a perfectly analogous manner. Analysis showed the precipitation to be complete.

It was found that the conductivity of two samples of anhydrous stannic chloride is no better than that of air. This salt mixes with benzene in all proportions, giving mixtures which are equally non-conductors. Yet when such a solution is poured into a benzene solution of copper oleate, there forms *instantly* a heavy brown precipitate which is principally anhydrous cupric chloride. The precipitate takes down some of the stannic oleate which is formed with it and is difficult to manipulate, but analysis shows that the reaction is in the main a simple double decomposition.

Anhydrous phosphorus trichloride, arsenic trichloride and silicon tetrachloride are miscible in all proportions with benzene and give solutions which are insulators, like the solution of stannic chloride. In each case, when a solution of copper oleate in benzene is treated with a solution of PCl_3, $AsCl_3$ or $SiCl_4$ in the same solvent, copper is precipitated as a dark brown precipitate. This is essentially cupric chloride, but is in each case contaminated with some of the oleate.

We see, then, that HCl, $SnCl_4$, PCl_3, $AsCl_3$ and $SiCl_4$ each precipitate cupric chloride from benzene solutions of copper oleate. There is, then, apparently double decomposition by means of ions, and yet the solutions are non-conductors, showing that ions are not present.

[1] Abstract of a paper in the *Journal of Physical Chemistry*, vol. vi. pp. 1–14, 1902, by L. Kahlenberg.

As in the case of aqueous solutions, the solubility of the precipitate is diminished by adding excess of the precipitant. When dry hydrogen sulphide is passed into benzene solutions of the oleate of copper, nickel or cobalt, the sulphides of the metals are at once thrown down. If these solutions are first saturated with hydrochloric acid so as to precipitate the chlorides and then saturated with dry hydrogen sulphide, the sulphides do not form. Stannic chloride dissolved in benzene was treated with dry hydrogen sulphide in large excess without any visible formation of sulphide; but on standing overnight there was a copious precipitate. Arsenic trichloride in benzene showed a similar reluctance to form sulphide, but when petroleum ether was used as a solvent the formation was almost instantaneous.

Hughes has found that dry hydrochloric acid will not react with dry ammonia, a fact which the author has confirmed. Yet when anhydrous benzene is treated with hydrochloric acid dried over sulphuric acid and phosphorus pentoxide, and then ammonia (evolved by heating lime mixed with ammonium chloride and dried by passing through a tower of lime and one of dry pumice covered with phosphorus pentoxide) is passed into the solution, a white, bulky precipitate of ammonium chloride at once forms; the benzene vapours are enough to cause the reaction to take place. Neither of the solutions, nor the mixture, conduct better than benzene itself, nor is there any change of conductivity at the instant of mixing. Similarly, when anhydrous pyridine is mixed with benzene, the solution is a non-conductor. But when such a solution is mixed with a solution of hydrochloric acid in benzene there is at once formed a heavy precipitate of the hydrochloride.

We must therefore conclude that instantaneous chemical reactions are possible with non-conducting solutions as well as with electrolytes. W. R. C.

A MEDIÆVAL TREATISE ON SURVEYING.

PROF. HAMMER, of Stuttgart, who has from time to time published interesting contributions to the history of geodesy and of surveying instruments, has given in a recent number of the *Zeitschrift für Vermessungswesen* a detailed account of Reinhold's treatise on surveying and mine surveying, a little-known work that enjoyed great popularity in Germany in the Middle Ages. In the bibliography appended to Brough's "Mine Surveying" (ninth edition, 1902, p. 360), Reinhold's book appears as the earliest independent treatise on the subject. In view of the far-reaching influence exercised by the work, a brief analysis of the contents may not be without interest.

The title of the book is "Gründlicher und warer Bericht vom Feldmessen." It was published at Saalfeld in 1574 by his son, Erasmus Reinhold. Reinhold senior was born at Saalfeld in 1511 and died there of the plague in 1553. From 1536 until his death he was professor at Wittenberg. The main contents of the book would appear, therefore, to have been written in the middle of the sixteenth century. The preface, written by Erasmus Reinhold junior, a physician, gives examples of errors made in surveying. Thus, a large forest was measured thrice; the first determination gave an area of 26,000 acres, the second 36,000 acres, and the last 27,000 acres. The author divides his "Bericht" on surveying into five sections. The first deals with the four rules of arithmetic, the extraction of square roots, &c.; the second deals with the calculation of areas; the third with the dividing up of land; the fourth shows how the rules given may be applied in districts where other measures of area are in use; and, lastly, the fifth section enumerates the rules of surveying so as to enable, as the author puts it, a common man of sufficient intelligence to carry out his own measurements without further great ado. The second part of the work is devoted to an account of the quadrants and of the compass, and to a treatise in nineteen chapters on mine surveying.

In the first part of his book Reinhold complains that it is rare to find a town which uses the same names and sizes for field surveying as its neighbours. Morgen, Juchart, Tagwerk, Mannsmahd, Hufe, Hufacker, Artacker, &c., are among the units of area met with. He therefore carefully enumerates his measures of length and area, with the symbols used for them throughout the book. The unit of length is the rod (*Ruthe*) of 16 feet (*Werkschuh*), each of which is again divided into 16 finger-breadths (*Fingerbreit*). The unit of area is the acre (*Acker*) of 150 square rods (*gevierdt Ruthen*). The Werkschuh, on which his whole system of measures is based, is dealt with by Reinhold in a peculiar manner, very characteristic of the period. He says in effect: how long, however, a Werkschuh is, is known to everyone, or can easily be ascertained from any carpenter, mason or cabinet-maker. Later on in the volume he gives a woodcut showing the length of a third of this foot, from which it is evident that the Werkschuh was 281 millimetres long, and consequently the Ruthe was 4·50 metres long, which is in close accord with the old Brunswick rod of 16 feet (4·566 metres). A square rod would represent 20¼ square metres, and the unit of area, the Acker, would contain about 3040 square metres, which is in fair accord with several of the Morgen in use in Germany before the introduction of the metric system. For the measurement of lengths, Reinhold advocates the use of a cord or rods. A wire cord is preferred to a hemp one, as not being affected by weather or by varying tension. For setting out a right angle the author makes use of the right-angled triangle with the sides 3, 4 and 5. He also recommends the numbers 20, 21 and 29, as well as the approximation with the numbers 12, 12 and 17 ($12^2 + 12^2 = 288$, whereas $17^2 = 289$). In reference to the latter method, he reminds the reader that he writes for the common man who does not require everything to be weighed on a gold-balance. Areas are calculated by means of rectangles, trapezoids and triangles, attention being given to the measurement of lakes and woods and other polygonal figures in which diagonals cannot be measured. For the measurement of angles the compass is used. It is graduated into single degrees, each 5 degrees being numbered consecutively from 0 to 360°. The direction of the pointer in the illustration given represents a westerly declination of about 6°. Lastly, the trigonometrical solution of triangles by the aid of a table of natural sines is explained. The next section of the work deals exhaustively with the division of land. Errors, it is pointed out, frequently occur which a good surveyor could easily prevent. Every prince and town, therefore, should, as the author quaintly puts it, have a licensed, but nevertheless competent, surveyor. The second division of the whole work is devoted to mine surveying. The instruments described include the compass, a good quadrant, a water-level and a hanging clinometer. The unit of length in mine measurements was the *Lachter* (fathom) of 6 shoes, and the technical terms then used were much the same as those now in vogue in German mines.

Such in brief are the contents of this remarkable treatise written 350 years ago. Comparing it with some of the most recently published text-books on surveying, it is depressing to find how little is the progress that has been made in the instruction in this important branch of engineering. In a large treatise on the subject published this year the statement is made that a slight knowledge of geometry is necessary, and consequently a chapter is inserted in the middle of the book dealing with geometry, trigonometry and logarithms. The development of the theory of measurements and the mathematical principles on which it is based are neglected, and the author confines himself to enunciating mechanical rules for the testing of surveying instruments and for carrying out surveys. This rule-of-thumb method of education was not enough for Reinhold in 1550, whilst in 1782 Prof. Lempe, in his lectures at the Freiberg School of Mines and in his text-book, went still further by urging the necessity of learning and applying arithmetic, geometry, plane and spherical trigonometry, and even analytical geometry and the elements of the differential and integral calculus, as the surest basis of a successful study of mine surveying. B. H. B.

DYNAMIC INTERPRETATION OF CELL-DIVISION.[1]

THE author came to the study of biology possessing, as a civil engineer, an equipment rare among the disciples of this science. Some years ago he interpreted the phenomena of cell-division and karyokinesis as due to the play of Newtonian forces of equal potential but opposite sign, rather than to the gross actions of pull or push performed by ordinary mechanical forces; and was able to reproduce the spindle-figure and centrosomes by a trough full of spirits of turpentine in which were suspended crystals of sulphate of quinine, and into which were introduced a pair of wires joined to the poles of an electric machine. After continued study under such masters as Giard, he now develops

1. "Interpretacion Dinamica de la division Cellular." By A. Gallardo. Pp. 101. (Buenos Aires, 1902.)

the same conception and extends it in a thesis for the doctorate. The cytoplasm of a dividing cell is differentiated as the site of a field of force; the spindle with its asters is the visible embodiment of the lines of force; the centrosomes occupy the poles, that is the points of maximum potential and of physical equilibrium, though it is not legitimate to say that they are themselves either the sources or the causes of the molecular stresses and strains. Where the centrosome expands into a large zoned astrosphere, as in the eggs of Rhynchelmis or Unio, the zones correspond to equipotential surfaces. It has been objected to such views that they will not explain multipolar figures, such as often occur in nature: but a tripolar figure can be formed in the above *electric* working model by introducing a third terminal put

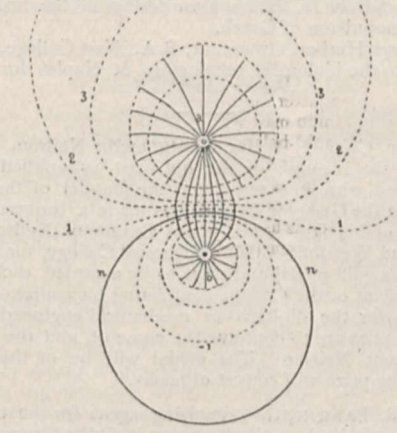

FIG. 1.

to earth; while a quadripolar spindle can be reproduced by a *magnetic* model where iron-filings group themselves under the action of four poles alternately arranged at the consecutive angles of a square. But perhaps the most convincing illustration is supplied by two consecutive figures; the one (Fig. 1) is a geometrical construction to represent the plane section of a field of force passing through the poles, and displaying the system of equipotential zones and lines of force, when the charges at the poles are + 5 and − 3 respectively; and the other (Fig. 2) is the de-

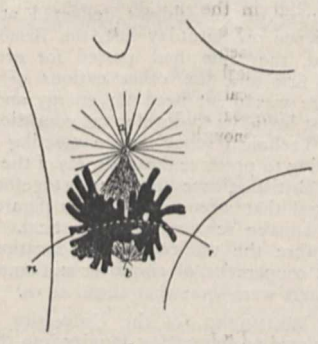

FIG. 2.

lineation of an unequal mitosis in the connective tissue of a salamander-larva copied from F. Reinke.

The splitting of the chromosomes and the repartition of their twin moieties are referred to the same forces, which he terms "karyokinetic" not to prejudge their real nature. He suggests that in direct or amitotic divisions of the cell and nucleus the same forces are at work, although no material presentment of the lines of force is seen.

The whole of this part is admirably worked out: it is quite free from those mathematical short-cuts, which are, indeed, indispensable for the rapid daily work of the physicist, but which Faraday, the great investigator of polar forces, was able to dispense with, and which are for the most part incomprehensible if not revolting to the biologist.

Gallardo regards heredity as the transmission from cell to cell of the power to develop such forces in due course. That these forces are neither electric nor magnetic is certain. It is unlikely that Bütschli's suggestion that they are osmotic is adequate, though doubtless osmosis does play a part in the process. Gallardo is content for the moment to regard them as "vital" forces, avowing that he is so far a vitalist as to admit that the phenomena of living beings present problems and characters not found in inorganic or dead groupings of matter. He does not, however, accept J. Reinke's "dominant" hypothesis.

We ourselves greet this pamphlet the more cordially as embodying ideas that we have held for years—nay, have attempted to work out. The task, however, could only be accomplished by one who possessed a solid grasp of modern physical science as well as of biological fact. We may note that the device we have adopted for modelling in three dimensions the karyokinetic figures—a glass trough of glycerine in which are suspended the finest iron-filings, levigated in alcohol—will be found useful by the physicist; for by moving it from place to place in a magnetic field he can render the courses of the lines of force visible, and map them out in space for himself or his students.

MARCUS HARTOG.

THE RABBIT PEST IN AUSTRALIA.[1]

IT was hoped and expected that the long-continued drought which has prevailed throughout eastern Australia for the last six years would at least have had a good influence in subduing the rabbit pest, but such does not seem to have been the case. The rabbits, like all other living animals, have suffered severely in certain districts, but on the least mitigation of the drought they quickly recover themselves, and become as numerous and as destructive as ever. Large tracts of country formerly able to maintain sheep have been abandoned, we are told, on account of the rabbit pest, and have gone to waste in consequence of the futility of the various schemes that have been tried for the mitigation of this frightful evil.

In these circumstances, Mr. William Rodier, of Tambua Station, Cobar, New South Wales, has done well to reprint the pamphlet on this subject to which we directed attention on a former occasion (NATURE, March 21, 1889), and to explain more fully the very simple and efficacious method by which he proposes to deal with the rabbit pest. Had the scheme put forward by Mr. Rodier been adopted when it was first suggested, we do not doubt that the success which it has met with on his own station would have followed it elsewhere. But, as we all know too well, the prophet has little honour in his own country, and, instead of following Mr. Rodier's excellent advice, the authorities have tried various other schemes that have in many cases only had the effect of augmenting the evil.

Mr. Rodier's plan for combating the rabbit pest is very simple. It is based on the well-known law of nature that polygamy is favourable to the increase of offspring and polyandry is unfavourable. Rabbits usually live in a polygamous state. One male impregnates a number of females and produces a large offspring. Mr. Rodier proposes to convert this polygamy into polyandry by catching the rabbits alive and killing all the females, while all the males are turned out again. If this is done, the male rabbits become more numerous than the females, harass the females by their constant attentions and injure their powers of breeding. Thus the offspring becomes continually less numerous. That this result will follow is illustrated by the case of public women, who seldom bear children and never produce large families, and by other facts well known to science.

The ordinary course pursued in trapping rabbits, in which all that are caught are killed, so far from diminishing the evil is much more likely to increase it. The great majority of the rabbits captured are sure to be males, because the male rabbits have the habit of congregating in certain spots called "buck-heaps." In these spots they are easily caught by the trappers, who are, of course, only anxious to kill as many as possible and to obtain the fees offered for their destruction by the Rabbit Acts. Thus the males become diminished in numbers and the breed becomes increased. Various other modes of combating the rabbit pest have been tried in Australia, but all alike have proved to be failures. Poisons of different descriptions have been much

1 "The Rabbit Pest in Australia, its Cause and its Cure." By W. Rodier. Pp. 16. (Sydney, 1902.)

used. This is done by spreading poisoned grain about the runs of the rabbits or by poisoning the water-tanks. But poison has not turned out successful, and there is besides great objection to the employment of such a dangerous agent in any case.

The introduction of some infectious disease to kill the rabbits has also been advocated, and even tried in certain districts, but it has not succeeded. In this instance, even Pasteur attained no definite result.

In these circumstances, Mr. Rodier's plan, as set forth in his pamphlet, which is certainly theoretically correct, ought to be tried by the authorities on a large scale. It would be easy to fence round a few thousand acres in one of the worst districts and see what effect will be produced by capturing the rabbits alive and killing only the females. Mr. Rodier tells us that his plan has succeeded well at Tambua Station, and there is every reason to suppose that it would succeed elsewhere if it were properly tried.

THE ROYAL HORTICULTURAL SOCIETY.[1]

FEW things have been more gratifying to those "seriously" interested in horticulture than the great improvement that has taken place in the publications of the Royal Horticultural Society during the last few years. The Society has more than recovered from the disasters that befell it at South Kensington. The present year is not yet completed, but already more than one thousand new fellows have been elected. There is every probability that the approaching centenary will be fittingly celebrated by the erection of proper offices, including an exhibition hall and accommodation for the excellent Lindley Library. This latter is the property of certain trustees, but is inseparable from the Society so long as it exists as a corporate body in or near the metropolis.

One potent reason for the phenomenal success which has of late years distinguished the Society is to be found in the zeal, energy and organising faculty of the secretary. In no respect are these qualities more conspicuously illustrated than by the publications of the Society edited by him.

The papers contributed to the *Journal* have almost always been good of their kind, but they were published at irregular, often very long, intervals, so that interest in them flagged or disappeared entirely.

Under the editorship of the present secretary, the quality of the *Journal* has been more than maintained, whilst comparative regularity of publication has been ensured; so that those fellows whose distant residence precludes them from availing themselves to the full of their privileges may yet be assured that in the *Journal*, as now issued, they have a full equivalent for their subscription, and, as far as possible, are kept abreast of the proceedings at headquarters.

The current number shows an improvement on its predecessors in the fact that a larger infusion of original illustrations has been vouchsafed. Among these we may mention the three coloured plates illustrative of several of the more common fungi which attack garden plants. The article on which these plates confer additional value is the production of Dr. M. C. Cooke, and we are glad to see it is marked "to be continued," for a more complete list of this kind than any that has yet appeared is greatly wanted by gardeners. Another paper illustrated by original half-tone blocks is that on "plant communities" by Prof. Carr, of Nottingham; at least we are not so familiar with them as with the numerous cuts which have done duty before in the various horticultural journals.

During the last year or two, a very useful addition has been made to the Society's records in the shape of short abstracts from current horticultural literature relating to the garden and its inhabitants. These are supplied by a goodly number of trained experts, and when experience has taught them a due sense of proportion and a more rigid selection of what is appropriate to a horticultural journal, their value will be even greater than it is now. This portion of the volume will require the greatest care in indexing, as without a comprehensive index reference will be greatly hampered. The contents are so varied that further detailed comment is impracticable. It must suffice to say that all classes of horticulturists, practical, scientific, æsthetic or amateur, will find something to interest them in these pages.

[1] *The Journal of the Royal Horticultural Society* (September, 1902). Edited by the Rev. W. Wilks, M.A., Secretary.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The resolution, "That candidates shall not be required to offer both Greek and Latin in the examination in stated subjects in Responsions," submitted to Congregation on Tuesday, was lost by 189 votes to 166. If the resolution had been carried, a proposal would have been brought forward on November 18, "That all candidates shall be expected to pass in two out of the four following languages:—Greek, Latin, French and German, one of the two being either Greek or Latin." By the decision of Congregation on Tuesday, Greek remains a compulsory subject at Responsions for all candidates; but the subject may be brought up again by a proposal to exempt candidates for honours in certain of the final schools from the compulsion of Greek.

Mr. George Herbert Grosvenor, B.A., New College, has been appointed to the biological scholarship at Naples for the year 1902–3.

THE late Colonel Walter Montgomerie Neilson, who was the son of the inventor of the hot-blast as applied to iron-smelting, and who, in a sense, was the founder of the locomotive trade in the Glasgow district, has made a bequest of 500*l.* in memory of his father, Mr. James Beaumont Neilson, to the Glasgow and West of Scotland Technical College, for the establishment of a gold medal and prize to be awarded each year to the best student of the College completing his course of study of three years for the diploma in mechanical engineering. The medal and prize are to continue the name of, and the invention by, Beaumont Neilson. The medal will be of the value of 10*l.*, and the prize will consist of books.

DR. G. R. PARKIN, the organising agent for the trustees of the Rhodes scholarships, is at present in Oxford to consult with the University and college authorities before proceeding to frame, for the approval of the trustees, a scheme for the election of the scholars. Dr. Parkin states that according to their size, each of the colleges seems prepared to take from two to five of the Rhodes scholars every year. This would give to the smaller colleges six in all for the three years' scholarship, and to the larger colleges about fifteen, when the plan is in full operation. The first year the bequest comes into operation there will be elected probably between seventy and seventy-five scholars, the same number for the second year, for the third year about thirty, and in subsequent years the same proportion will be maintained.

IN the course of an address delivered at the Liverpool School of Science on Saturday last, the Bishop of Liverpool remarked that the time had passed for ever when Great Britain stood first and the other nations of the world nowhere. There was great need for energy and exertion, and great care must be taken to develop on educational lines as fast as possible. Technical schools were meeting a real national need and helping to preserve the greatness of the Empire. They were bringing British science and industry together, and in future they would find that science would transfigure industry, and industry would make science more practical. But what were first needed were the unification of education and the full sympathy and cooperation of employer and employed, in which respect foreigners were somewhat ahead of us.

M. BORIS WEINBERG, of the University of Odessa, has recently completed an interesting inquiry into the provisions for the practical study of science made in 206 laboratories in connection with colleges in Europe, America and Australia. In March, 1900, M. Weinberg sent a circular letter to the directors of all physical, mechanical, electrotechnical and chemico-physical laboratories mentioned in the "Minerva Jahrbuch," asking for information as to the number of demonstrators teaching in the laboratories in 1900 and in previous years so far back as 1865, the number of students in the same years, the smallest number of students working at the same time in the laboratory, the hours devoted to practical work by each student during a week, and many similar points. His results are now published, and deal with typical university colleges, medical schools, technical colleges, &c., of the countries of Europe, of the United States and of Australia. The most valuable part of the information brought together in the pamphlet is the careful

analysis of the courses of study in physics in the different institutions from which data were received. In his circular to laboratory directors, M. Weinberg tabulated some 910 typical practical exercises in physics and requested that those worked in the laboratories might be underlined. It has thus been possible to institute an instructive comparison between the methods of different countries. About four hundred physical laboratories, having five hundred professors and eight hundred demonstrators or assistants, are recorded for the whole of the institutions for higher education in the world. In about one-fifth of these, practical work in physical manipulations is not carried on; in the rest, there are about 25,000 students who pass eight hours a week in the laboratories during three semesters. In these four hundred hours passed in the laboratory a student, on the average, performs sixty different experiments, or about two-thirds of the work for which the laboratory makes provision.

SCIENTIFIC SERIALS.

American Journal of Science, October.—An experimental investigation into the existence of free ions in aqueous solutions of electrolytes, by Julius Olsen. The well-known experiment of Ostwald and Nernst, which has been held to prove experimentally the existence of ions in solution, is criticised, and it is held that the conclusion arrived at does not necessarily follow, and that further proof is needed. Experiments are described which show that an electrolyte which has never been acted upon by a current behaves as if it contained particles charged with electricity which are free to move, and these particles have not been produced by a current. This corresponds to the definition of free ions.—On the solution of problems in crystallography by means of graphical methods, based upon spherical and plane trigonometry, by S. L. Penfield. It is shown that with the addition of certain stereographic scales and protractors to a set of ordinary drawing instruments, the lengthy calculations usual in determining the crystallographic constants can be avoided or, as an alternative, checked. Several illustrated examples of the mode of application of this method are given.—The estimation of bromic acid by the direct action of arsenious acid, by F. A. Gooch and J. C. Blake. It is shown that bromates may be satisfactorily estimated by the direct action of arsenious acid, the few apparent discrepancies which were found being traced to the presence of chlorate as an impurity in the bromate.—Solubilities of some carbon compounds, the densities of their solutions, by Clarence L. Speyers. Seven or eight carbon compounds of different types were examined in various solvents, including water, methyl, ethyl and propyl alcohols, chloroform and toluene. The results are compared with those calculated from Schroeder's formula, but the agreement is not good.

Transactions of the American Mathematical Society.—Vol. iii. No. 3 (July).—L. E. Dickson, on the group defined for any given field by the multiplication table of any given finite group. The subject of this paper is much the same as that of Burnside's in *Proc.* L.M.S. xxix.; the results, however, are obtained by a different method, which does not involve the theory of continuous groups. The paper illustrates the importance of Frobenius's discovery of the group determinant. Two examples are given.—O. Stolz, postscript to a previous article on rectification of curves. A comparison is made with Jordan's treatment of the same theory.—O. Bolza, proof of the sufficiency of Jacobi's condition for a permanent sign of the second variation in the so-called isoperimetric problems.—H. E. Hawkes, on hypercomplex number systems. The author develops the methods of Peirce, and shows that they give an enumeration of all systems in less than six units which have moduli in more than one idempotent unit. The systems for five units with two idempotent units are worked out in detail. A discussion of nilpotent systems follows.—W. B. Fite, on metabelian groups.—L. P. Eisenhart, on conjugate rectilinear congruences.—D. N. Lehmer, constructive theory of the unicursal plane cubic by synthetic methods.—L. E. Dickson, on the groups of Steiner in problems of contact (continued from the January number).

Bulletin of the American Mathematical Society (2) ix., No. 1 (October).—O. Bolza, examples in the calculus of variations.—E. R. Hadrick, on the sufficient conditions in the calculus of variations. A convenient summary, based on lectures by Hilbert.—E. B. Wilson, reviews of recent books on mechanics (Föppl, Volkmann, Picard).—E. V. Huntington, on a new edition of Stolz's "Allgemeine Arithmetik," with an account of Peano's definition of number.—E. J. Wilczynski, an obituary notice of Fuchs.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, October 31.—Prof. S. P. Thompson, president, in the chair.—A paper on the existence of a relationship between the spectra of some elements and the squares of their atomic weights, by Dr. W. M. Watts, was read by Prof. Everett. The author has detected two kinds of relation between the spectra of some allied elements. In the first kind, which is illustrated by comparisons between zinc, cadmium and mercury, and also between gallium and indium, the differences between the oscillation frequencies of certain lines of one element are to the differences between the oscillation frequencies of the corresponding lines of another as the squares of their atomic weights. In the second kind, the relation is not between two, but between three spectra, and is illustrated by the trio potassium, rubidium and cæsium, as well as by the trio calcium, strontium and barium. The element of greater atomic weight has the smaller frequency, and, in comparing corresponding lines, one from each of the three spectra, the differences of frequency are proportional to the differences between the squares of the atomic weights. If each of the spectral lines in question is represented by a point the coordinates of which are "frequency" and "square of atomic weight," the three points which represent three corresponding spectral lines will lie on one straight line in the diagram, and these straight lines will be parallel for all the components of a given set of corresponding groups. When a similar mode of plotting by points is employed to exhibit the first kind of relation, the joins of corresponding points meet in a point which lies on the axis of frequencies, in other words, on the line of zero atomic weight. This relation was indicated by Ramage about a year ago as holding for corresponding doublets and triplets.—A paper on the size of atoms was read by Mr. H. V. Ridout. This investigation deals with the size of dissociated atoms, or ions, and the results obtained refer to a dissociated atom as the smallest quantity of matter which can take part in an electrolytic action. The element chosen is hydrogen, and the author concludes that, in round numbers, 114½ million atoms are necessary to form a line one centimetre long. The method employed consists in finding a pair of spheres which would be charged by the quantity of electricity known to be necessary to electrolyse a given quantity of the body under examination—in this case water—to the known difference of potential of its ions. From this the size of the atoms is deduced, subject to certain assumptions enumerated and discussed in the paper. Lord Kelvin remarked that he had often concerned himself with the size of atoms, and pointed out that the value obtained by the author for the diameter of a hydrogen ion was almost exactly one-half of that which he had obtained for the diameter of a molecule of hydrogen. The fact, however, might be a coincidence. He had dealt with a sphere which would have the same effect as a double atom of hydrogen. While avoiding the assumption that atoms are hard and spherical, it was usual to treat them as such for purposes of calculation. The paper was an important one, but there were many assumptions which required looking into. Lord Kelvin said that, in dealing with the subject of atoms, it was necessary to consider the atoms of electricity. The atomic theory of electricity, now almost universally accepted, had been thought of by Faraday and Clerk-Maxwell and definitely proposed by Helmholtz. The atoms of electricity were very much smaller than the atoms of matter, and permeated freely through the spaces occupied by these greater atoms and also freely through space not occupied by them. An atom of electricity in the interior of an atom of matter experienced electric force towards the centre of the atom. We were forced to conclude that every kind of matter had electricity in it, and Lorenz had named electricity as the moving thing in atomic vibrations. If the electrions, or atoms of electricity, succeeded in getting out of the atoms of matter, they proceeded with the velocity of light and the body was radioactive. It was therefore not surprising that some bodies showed radioactive properties, but rather surprising that such properties were not shown by all forms of matter. Our knowledge of this subject,

which originated with the discovery of the Becquerel rays, had been greatly advanced by the experiments carried out at the Cavendish Laboratory, and he had no doubt that in the next two or three years much light would be thrown upon this important matter.—Prof H. L. Callendar exhibited some vacuum calorimeters. Three of the calorimeters were for the determination of the specific heat of mercury, water and steam respectively by the steady-flow method. The fourth was a vacuum-jacketed Bunsen calorimeter. Prof. Callendar gave some details of the instruments and described the method of using them.—Miss A. Everett exhibited some photographs of cross-sections of hollow pencils formed by oblique transmission through an annulus of a lens. The direct rays of an arc light were allowed to pass through an annulus of a convex lens tilted to an angle of 45° with their direction and placed at a distance of about twice its focal length from the arc. The photographic plate was placed at right angles to the beam, and a series of exposures was made at gradually increasing distances from the lens. Two series of photographs were shown, the first series from a plano-convex lens with one annulus and the second from a double convex lens with two annuli.

Zoological Society, November 4.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—Dr. C. W. Andrews gave an account, illustrated by lantern slides, of the palæontological discoveries made by himself and Mr. H. J. L. Beadnell during their recent visit to the Fayum, Egypt.—A communication was read from Mr. R. Shelford dealing with the mimetic insects and spiders of Borneo and Singapore.—Mr. C. Tate Regan read a paper on the classification of the fishes of the suborder Plectognathi.—A communication from Lieut.-Colonel J. M. Fawcett contained notes on the transformations of the butterfly *Papilio dardanus* and the moth *Philampelus megaera*, and descriptions of two new species of moths under the names *Rabdosia clio* and *Dermaleipa daseia*.—Mr. Oldfield Thomas read a paper on the mammals collected by Mr. Edward Degen during his recent expedition to Lake Tsana, Abyssinia.—A communication was read from the Hon. Walter Rothschild, in which he stated his opinion that the elk described by Mr. Lydekker as *Alces bedfordiae* was, if not a valid species, a distinct subspecies, and not a variety as had been supposed by Mr. H. J. Elwes.

CAMBRIDGE.

Philosophical Society, October 27.—Prof. Macalister, president, in the chair.—A case of extreme visceral dislocation, with remarks on the functional interpretation of the agminated glands of the intestine, by Dr. E. Barclay-Smith.—Notes on the genus Liparis, by Mr. J. J. Lister. Among other points, attention was drawn to the difference between the conspicuous satiny-white colouring of the three species *Porthesia chrysorrhaea*, *P. auriflua* and *Liparis salicis* and the quiet buffs, browns and blacks of the other members of the family, conforming closely with their environment; and it was pointed out that there is a considerable body of evidence showing that the conspicuous species are noxious to other animals, both in the larval and adult state, by reason of the urticating properties of the hairs.—Notes on the anatomy of *Macrozamia heteromera*, by Miss A. Robertson.—Further experiments on radio-activity from rain, by Mr. C. T. R. Wilson. In a paper read before this Society on May 5, experiments were described which showed that a vessel, in which freshly fallen rain has been evaporated to dryness, shows radio-active properties lasting for a few hours only. Many samples of freshly fallen rain have since that date been tested both here and at Peebles, and all have shown this effect. The magnitude of the effect obtained from a given quantity of rain has nearly always been of the same order, whether the rain has consisted of large or small drops, and whether it has been collected by day or by night, at the beginning of a shower or after some hours of continuous heavy rainfall. Once, however, during a thunderstorm an abnormally large effect was obtained. The radio-activity is obtained equally well, whether the rain is boiled down in platinum or porcelain vessels. It is not destroyed by porcelain vessels. It is not destroyed by heating the vessel to dull redness; in this, as in other points, it resembles the induced radio-activity obtained on negatively charged wires. From 190 c.c. of rain a precipitate was obtained sufficiently radio-active to increase the ionisation within the testing vessel to about 100 times its normal value; to enter the vessel the rays had to penetrate aluminium about 0·00032 cm. in thickness. The intensity of the radio-activity falls to about one-fourth of its initial value in an hour, like that obtained by evaporation. Similar precipitates formed in tap-water or in rain-water that has stood for twenty-four hours are quite inactive.

MANCHESTER.

Literary and Philosophical Society, November 4.—Mr. Charles Bailey, president, in the chair.—Mr. Francis Jones read a paper on the action of alkalis on glass and on paraffin, in which he pointed out that, while it is generally acknowledged that alkalis in course of time act on glass, there is considerable difference of opinion among chemists as to whether this action interferes with the well-known test for carbon dioxide in air, generally known as Pettenkofer's, but which was first described by Dalton in a paper read before this Society in 1802. Solutions of lime, strontia and baryta of known strength were left in glass bottles at the ordinary temperature for several months, and the strength of each was ascertained from time to time. It was found that the lime water lost strength more rapidly than the others, and that baryta could be kept in glass bottles for a period of twenty months without suffering any material loss in strength. Similar solutions were left in contact with finely divided silica and with powdered glass, and again it was found that lime water acted on these bodies more rapidly than the other two. The action on glass bottles, however, is not so rapid as to prevent any three of these alkaline solutions being used for Pettenkofer's test. It has been suggested that bottles used for this test should be coated with paraffin wax to prevent the contact of the alkaline liquid with the glass, but the author shows that lime, strontia and baryta lose strength in contact with paraffin, the action of baryta being much more energetic than that of either lime or strontia. Some baryta solution in contact with paraffin for five months was very nearly neutral at the end of that period. Consequently, the storing of standard baryta solutions in paraffined bottles is quite inadmissible.—Sir W. H. Bailey exhibited the working model of the switchback centrifugal railway invented and made by Richard Roberts.—Mr. W. E. Hoyle exhibited some coloured photographic lantern slides prepared by the Sanger Shepherd process.

PARIS.

Academy of Sciences, November 3.—M. Bouquet de la Grye in the chair.—On two Trypanosomes of Transvaal cattle, by M. A. Laveran. Details are given of the mode of growth and multiplication of *Tr. Theileri*, the cause of the cattle disease known as Galziekte. Another Trypanosome, found by M. Theiler in the blood of an ox, is regarded by the author as a new species, to which the name of *Tr. transvaaliense* is given.—On the equality of the velocity of propagation of the X-rays and of light in air, by M. R. Blondlot. On the supposition that the velocities of the X-rays and the Hertzian waves are equal, it can be predicted that the reinforcing effect of an X-ray tube upon a spark discharge ought to pass through a maximum for a certain position of the tube with regard to the spark, and this conclusion has been confirmed by experiment. The same hypothesis allows of the calculation in advance of the displacements that the position of the tube corresponding to this maximum ought to undergo in consequence of changes in the conducting wires or in the detonator. This was also confirmed experimentally, one method giving for the ratio of the velocities 0·97 and the other 0·93. The whole of the experimental facts lead to the conclusion that the velocity of propagation of the X-rays is equal to that of the Hertzian waves or of light in air.—On some recent sunsets, by M. Perrotin. The recent sunset glows are compared with the similar ones in 1883, and the hypothesis of their volcanic origin is considered. It is pointed out that the phenomena occurred in the same month in both years, which would tend to suggest that their origin was rather due to meteorological conditions than to after effects of volcanic eruptions.—The analysis of nine specimens of air collected in the galleries of a coal mine, by M. Nestor Gréhaut. The carbonic acid was found to vary between 1·0 and 1·8 per cent., methane between 3·5 and 7·5 per cent., and oxygen between 16·1 and 18 per cent. Attention is drawn to the high percentage of marsh gas, which in three cases was present in sufficient quantity to form an explosive mixture.—On the monographic resolution of the triangle of position for a given latitude, by M. Maurice d'Ocagne.—On uniform transcendentals defined by differential equations of the second order, by M. R. Liouville.

—On the formation of liquid drops and the law of Tate, by MM. A. Leduc and P. Sacerdote. A reply to the criticisms of MM. P. A. Guye and L. Perrot.—Remarks on a recent note by M. Ponsot on the electromotive force of a thermoelectric couple, by M. H. Pellat.—On the electrical resistance of lead sulphide at very low temperatures, by M. Edmond van Aubel. The resistance of the lead sulphide was found to diminish as the temperature was lowered. The experiments were carried out over a range of temperature between the boiling point of liquid air and the ordinary temperature of the room. The results are not in accord with the previous work of Guinchant and Streintz. —On a chlorosulphate of aluminium, by M. A Recoura. The aluminium compound isolated proved to possess the formula $AlSO_4Cl,6H_2O$, analogous with the similar chromium previously described.—On a general method for the preparation of the metallic nitrides, by M. Guntz By heating various metallic chlorides with lithium nitride, several new nitrides have been obtained; among these are two new nitrides of iron having the composition Fe_3N_2 and FeN; chromic chloride gives CrN. By working with lithium hydride instead of the nitride, metallic hydrides are obtained, but in many cases the reaction is so violent that the hydrides formed are decomposed. The conditions necessary to prevent this decomposition are now being studied.—On barium ammonium and barium amide, by M. Mentrel. Barium ammonium is readily formed by the action of barium on ammonia at $-23°$ C., the dissociation pressures being measured for temperatures between $-63°$ and 28° C. Nitric oxide is absorbed by this substance at low temperatures, barium hyponitrite being formed; carbon monoxide is also absorbed under similar conditions, forming a new compound, barium carbonyl, $Ba(CO)_2$, a yellow, solid body which decomposes without explosion in contact with air, or on heating. Metallic barium, heated at 280° in a current of dry ammonia, gives barium amide.—On some products of the oxidation of aniline by atmospheric oxygen, by M. C. I. Istrati. By the prolonged action of air on boiling aniline, three new crystalline substances of high molecular weight and unknown constitution were obtained.—On a new albuminoid material extracted from maize, by MM. E. Donard and H. Labbé. The new substance, which is present in maize to the extent of about 4 per cent., and which is best extracted by boiling amyl alcohol, is given the name of maisine. It possesses properties which distinguish it from the albuminoid matters obtained from other cereals.—On the estimation of carbon monoxide and carbonic acid in vitiated air, by M. Ferdinand Jean. An application of the minimetric method to the examination of air, requiring no skilled manipulation in its use.—Researches on the budding of *Rhabdopleura Mormanni*, by MM. C. Vaney and A. Conté.—On the fibrillar continuity of the epithelial cells in the Nebalia, by M. Alphonse Labré.—On vital rhythm, by MM. Vaschide and Cl. Vurpas.

NEW SOUTH WALES.

Royal Society, September 3.—Prof. Warren, president, in the chair.—Languages of some native tribes of Queensland, New South Wales and Victoria, by Mr. R. H. Mathews. This paper dealt fully with the grammatical structure of the speech of the native tribes inhabiting the Murray River along the Victorian frontier, and stretching thence northerly through the central and western districts of New South Wales to the 29th parallel of latitude, and continuing onwards far into Queensland.—(1) Current papers, No. 7; (2) Meteorological notes, by Mr. H. C. Russell, C.M.G., F.R.S.—Meteoric dusts, New South Wales, by Prof Liversidge, F.R.S. The term meteoric dust is used because it is commonly applied to the materials forming the subject of this paper; it is not intended to state that the dusts are necessarily of cosmic or extra-terrestrial origin. The specimens described and exhibited were from Moruya (fell on December 15, 1880); from Uralla (fell on December 14, 1882); from near Broken Hill (fell 1896); from Menindie (fell on June 17, 1899); and Pambula (fell on October 5, 1899). Dust from the roof-beams, and mud from a covered cistern at the University and from the roof of the Observatory, Sydney, all three were collected in 1882. All the dusts are of a reddish colour except those from the University and Observatory, which are grey. The red dusts are mainly siliceous and argillaceous, and look as if they had come from dried-up water-holes; they contain a variety of organic and mineral matters such as might be expected from such a source, and in addition magnetite and metallic iron; the latter contains cobalt and nickel, which seems to indicate that the dusts contain some cosmic or extra-terrestrial materials, part of which may have settled down and become mingled with the undoubted superficial terrestrial deposits, and part may have been derived directly from the atmosphere. The University and Observatory dusts also yielded magnetite and metallic iron containing cobalt and nickel, and the University dust yielded particles of gold; the Observatory dust has yet to be tested. The Moruya, Menindie and Barrier red dusts yielded particles of gold; the others have yet to be examined. Fuller information is given in the paper as to the constituents and chemical composition of the dusts, and analyses of volcanic and other dusts for comparison.—A rapid method of estimating lime, by Mr. F. B. Guthrie and Mr. C. R. Barker.

Linnean Society, August 27.—Mr. J. H. Maiden, president, in the chair.—On a new Cryptocarya from Lord Howe Island, by Mr. J. H. Maiden. The "black plum" of Lord Howe Island, the flowers of which have only recently been available, is shown to be new and described under the name *Cryptocarya Gregsoni*. It is also shown that an Elæocarpus occurs on the island, although the material at present available is insufficient to determine the species. Also that the Symplocos on the island, hitherto looked upon as *S. Stawelli*, is in reality new to science, and has been named *S. candelabrum* by Brand. Carl Mez, the monographer of the order Myrsinaceæ, has shown that there is no true Myrsine on the island, but that the genus Rapanea is represented by two species, *R. platystigma*, Mez (*Myrsine platystigma*, F.v.M.) and *R. myrtillina*, Mez, sp.n.—Life-histories of, and notes on, Australian Neuroptera, by Mr. W. W. Froggatt. One species of the family Panorpidæ (*Bitticus australis*, Klug) and twelve of the family Hemerobiidæ are treated of.—Some records of New South Wales mosses, by Mr. W. Forsyth. Eighty-one species or forms are noted. Of these, six forms are new, thirty-nine are additions to the known flora of the State, one is new for Australia, while the remainder are recorded from new or additional localities. The paper concludes with a list of thirty-three species collected in the neighbourhood of the Jenolan caves. — Census Muscorum Australiensium: a classified catalogue of the frondose mosses of Australia and Tasmania, collated from available publications and herbaria, by the Rev. Walter W. Watts and Thomas Whitelegge. Part i., comprising about 530 species.—The ulcer disease (black ophthalmia?) of rainbow trout, by Mr. R. Greig Smith. The ulcer disease of rainbow trout appears to be identical with the brook trout disease of American writers. The disease called black ophthalmia recently occurred at the same time as the ulcer disease in a tank of rainbow trout, but there is reason to believe that these two are not the same disease. From the ulcers, *Micrococcus pyogenes* was isolated. This produces somewhat similar lesions in mammals. The action of the micrococcus in trout appeared to be influenced by the unhealthy conditions to which the fishes had been subjected.

September 24.—Mr. J. H. Maiden, president, in the chair. — Australian fungi, new or unrecorded. Decades i.-ii., by Mr. D. McAlpine.—On a new species of Ardisia from New South Wales, by Mr. R. T. Baker.—Notes on Prosobranchiata. Part i. Lotorium, by Mr. H. Leighton Kesteven. The first portion of the paper is a discussion of the synonymy of the genus and family. The conclusions are in favour of the adoption of Montfort's name Lotorium for the genus, and Harris's Lotoriidæ for the family. The second part deals with the arrangement of the species of the genus.—The bacterial origin of the gums of the arabin group, by Mr. R. Greig Smith. (i) The soluble (arabin) wattle gums. A bacterium (*Bact. acaciae*, n. sp.) was found in pure culture in the tissues of *Acacia binervata* from which gum was exuding. In the laboratory it produced a gum which behaved to reagents, gave the same oxidation products and contained the same constituents, viz. arabinan and galactan, as the natural gum. This soluble gum, and probably all others of a similar nature, are therefore of bacterial origin, a circumstance which had been suggested by the irregular distribution of gum-bearing trees. (ii) The insoluble (metarabin) wattle gums. In company with *Bact. acaciae*, a bacterium (*Bact. metarabinum*, n. sp.) was separated from the bast of *Acacia penninervis* affected with gumming. In artificial culture it formed a gum which swelled with water like the metarabin gums. The gum gives the same reactions and contains the same arabinan-galactan complex as the natural gum. The metarabin is, therefore, the product of this organism.—Revision of the

Australian Curculionidæ belonging to the subfamily Cryptorhynchides, by Mr. Arthur M. Lea.—Descriptions of some new Araneidæ of New South Wales, No. 10, by Mr. W. J. Rainbow. Three new species, referable to the genera Storena, Araneus and Stephanopsis, are described and figured.—Notes on some New South Wales hepatics, by the Rev. W. Walter Watts. Twenty-three species are recorded, the majority of them collected on the Richmond and Brunswick rivers.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part v. for 1902, contains the following memoirs communicated to the Society :—

July 12 :—W. Voigt : Further contributions to the explanation of the properties of pleochroic crystals. H. Vöchting : On experimental anatomy (of plants).

July 26 :—F. Schmidt : The body-musculature of *Branchiobdella parasita*. W. Kaufmann : The electromagnetic mass of the electron. O. Wallach : Researches (xi.) from the University Chemical Laboratory of Göttingen—(1) on the isomerisation of cyclic hydrocarbons and ketones ; (2) on the transformation of cyclic ketones into bases of nitrogenous ring-systems. W. Voigt : New observations on magneto-optic phenomena in absorption bands.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 13.

MATHEMATICAL SOCIETY, at 5.30.—Address on the Infinite and the Infinitesimal in Mathematical Analysis : Dr. E. W. Hobson.—Ueber den Satz der Gleichheit der Basiswinkel im gleichschenkligen Dreieck : Dr. D. Hilbert.—The Summation of a Certain Series : Prof. A. C. Dixon.—Expansion by Means of Lamé's Functions : Prof. A. C. Dixon.—Sets of Intervals : W. H. Young.—Note on Unclosed Sets of Points defined as the Limits of a Sequence of Closed Sets of Points : W. H. Young.—Wave Propagation in Two Dimensions : Prof. H. Lamb.—The Continuation of Certain Fundamental Powers Series : Prof. M. J. M. Hill.—A Geodesic on a Spheroid and an Associated Ellipse : L. Crawford.—The Propagation of Light in a Uniaxal Crystal : Prof. A. W. Conway.—A New Connection between Legendre Functions and Bessel Functions : E. T. Whittaker.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Presidential Address by Mr. James Swinburne.

FRIDAY, NOVEMBER 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Another Form of Micrometer for Measuring Star Positions : H. C. Russell.—Ephemeris for Physical Observations of the Moon for 1903 : A. C. D. Crommelin.—Stereoscopic Pictures of Comet Perrine : Max Wolf.—On the Images Formed by a Parabolic Mirror, second paper—Influence on the Measurement and Reduction of a Photograph : H. C. Plummer.—Sur la Précision des Mesures Photographiques : M. Lœwy.—Herschel's Nebulous Regions compared with Photographs taken with the 20-inch Reflector and 5-inch Cooke Lens : Isaac Roberts.—*Possible papers :* On the Proper Motion of Bright Stars Relatively to Faint in the Zones near 30° North Declinations : H. H. Turner.—On a Standard Scale of "Seeing" : Percival Lowell.

PHYSICAL SOCIETY, at 5.—The Theory of the Aluminium Electrode : Dr. W. W. Tayler and J. K. H. Inglis.—A Determination of the Ratio of the Specific Heats at Constant Pressure and at Constant Volume for Air and Steam : W. Makower.

TUESDAY, NOVEMBER 18.

ROYAL STATISTICAL SOCIETY, at 5.30.—Annual Address by the President, Major P. G. Craigie, C.B.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Paper to be further discussed :* Electric Tramways : C. Hopkinson, B. Hopkinson and E. Talbot.

MINERALOGICAL SOCIETY, at 8.—On some Swiss Minerals : Prof. Lewis.—On Proustite : Mr. Lamplugh.—On Seligmannite and Baumhauerite : Mr. Solly.

ZOOLOGICAL SOCIETY, at 8.30.—On some Pliocene Mammalian Remains from Concud, near Teruel, Spain : Dr. A. Smith Woodward, F.R.S.—On the Birth of an Indian Elephant in the Society's Menagerie : F. E. Beddard, F.R.S.—Note on the Cabul Markhor : R. Lydekker, F.R.S.

WEDNESDAY, NOVEMBER 19.

CHEMICAL SOCIETY, at 5.30.—The Dynamic Isomerism of Thiourea and Ammonium Thiocyanate : J. E. Reynolds and E. A. Werner.—Isomeric partially Racemic Salts containing Quinquevalent Nitrogen ; (1) Part VIII. : Resolution of the Hydrindamine Bromocamphor Sulphonates ; (2) Isomeric Compounds of the Type $NR_1R_2H_3$: F. S. Kipping.—The Synthesis of *aa*-Dimethylglutaric Acid, of *β*-Hydroxy-*aa*-di-methylglutaric Acid, and of the Cis- and Trans- Modifications of *aa*-Dimethylglutaconic Acid : W. H. Perkin, jun., and Miss E. Smith.—A Reaction of some Phenolic Colouring Matters. Part II. : A. G. Perkin and C. R. Wilson.—The Vapour Pressures and Boiling Points of Mixed Liquids. Part II. : S. Young and Miss E. C. Fortey.—(1) The Vapour Pressures and Boiling Points of Mixed Liquids. Part III. ; (2) Note on Mixtures of Constant Boiling Point : S. Young.—Note on the Condensation Points of the Thorium and Radium Emanations : E. Rutherford and F. Soddy.—The Oxime of Mesoxamide and some Allied Compounds. Part II. Disubstituted Derivatives : Miss M. A. Whiteley.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—English Climatology, 1881–1900 : F. Campbell Bayard.—The Rainfall of Dominica : C. V. Bellamy.

GEOLOGICAL SOCIETY, at 8.—The Semna Cataract or Rapid of the Nile ; a Study in River-erosion : John Ball.—Geological Notes on the North-West Provinces (Himalayan) of India : Francis J. Stephens.—Tin and Tourmaline : Donald A. MacAlister.

ROYAL MICROSCOPICAL SOCIETY, at 8.—An Electrical Method of taking Microscope Measurements : Dr. Philip E. Shaw.—Demonstration on the Microscope in Fossil Botany : Dr. D. H. Scott, F.R.S.—Demonstration on an Apparatus for obtaining Monochromatic Light with the Mixed Jet : Dr. Edmund J. Spitta.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 20.

ROYAL SOCIETY, at 4.30.—*Probable papers :*—Report on the Recent Eruption of the Soufrière in St. Vincent and on a Visit to Mont Pelée in Martinique : Dr. Tempest Anderson and Dr. J. S. Flett.—Contributions to a Theory of the Capillary Electrometer. II. On an Improved Form of Instrument : G. J. Burch, F.R.S.—On the Correlation of the Mental and Physical Characters in Man. Part II. : Dr. Alice Lee, Miss M. A. Lewenz and Prof. K. Pearson, F.R.S.

LINNEAN SOCIETY, at 8.—Digestion in Plants : Prof. Sydney H. Vines, F.R.S.—Relation of Histogenesis to Tissue-Morphology : A. G. Tansley.—Stelar Structure of Schizæa and other Ferns : L. A. Boodle.

FRIDAY, NOVEMBER 21.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Adjourned Discussion upon Captain C. C. Longridge's Paper on Oil Motor Cars of 1902.—And, *time permitting*, Recent Practice in the Design, Construction and Operation of Raw Cane Sugar Factories in the Hawaiian Islands : J. N. S. Williams.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—What is Climatic Disease : Lieut.-Col. A. M. Davies.

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