THURSDAY, FEBRUARY 8, 1900.

FARADAY AND SCHÖNBEIN.

The Letters of Faraday and Schönbein, 1836–1862; *with Notes, Comments and References to Contemporary Letters.* Edited by Georg W. A. Kahlbaum and Francis V. Darbishire. Pp. xvi + 376. With two frontispiece portraits. (Bâle: Benno Schwabe. London: Williams and Norgate, 1899.)

THE correspondence which has passed between the great pioneers of modern science must always be of interest to the present generation of workers. The interest is enhanced for us in the present case through the circumstance that one of the correspondents was our eminent countryman, Michael Faraday. The custom which has grown up of late years of allowing our illustrious dead to speak for themselves through their own letters is in every way a good one—particularly when the correspondence enables us to trace the history and follow the development of discoveries which have now become incorporated in the general stock of scientific knowledge. There is a living reality about a man's description of his own work, which inspires the reader to a degree quite incapable of being produced by any bald text-book statement or formal lecture-room utterance. Such correspondence is even as valuable in some cases as the original memoirs in which the final results are set forth, because we are enabled to follow the actual working out of the various lines of thought, and to stand at the elbow of the investigator as he gropes his way towards the truths which he finally gives to the world.

The present volume contains 155 letters, of which eighty-one are by Schönbein; the whole correspondence covers a period of over a quarter of a century. Some of Faraday's letters have been published in Bence Jones's life of that philosopher, but the majority have never been made public before. Much of Schönbein's correspondence also has been published, because Faraday was in the habit of communicating to the *Philosophical Magazine* results of scientific importance announced by Schönbein in his letters. But the value of the present work is in no way impaired by this circumstance, because we have now the whole correspondence brought together chronologically, the letters being left intact as originally written, and made more valuable by a most complete series of explanatory notes giving references to the papers alluded to, as well as short biographical notices of people mentioned in the correspondence. The care and trouble which has been bestowed upon this most essential adjunct to a set of letters containing references to memoirs which for us represent the scientific literature of a former generation, has thus resulted in a distinct contribution to the history of science, and the editors have laid all workers in the domains of physics and chemistry under a debt of obligation.

The human side of Faraday's nature has been so thoroughly dealt with by his biographers, Bence Jones, Tyndall and Gladstone, and, more recently, by S. P. Thompson, that very little new light is thrown upon his character by these letters. It is painful to be reminded so frequently of his failure of memory, and of his bad health leading to periodical removals from London and temporary cessation from all work. As in the case of another of our illustrious countrymen, Charles Darwin, one can only marvel at the magnitude of the labours achieved under such disadvantageous conditions.

On comparing the letters of the two correspondents, it will be found that from the social point of view both Faraday and Schönbein are equally communicative; but while the Swabian chemist gives his scientific thoughts and results in such fulness that they are in many cases capable of being published as written, Faraday, on the other hand, does not give much detailed information about his work, but only alludes incidentally to his discoveries when these appear to him to be of sufficient interest to mention to his correspondent.

We are thus enabled to follow Schönbein's work in a very systematic manner, and the development of the leading discoveries with which his name will always be associated can be traced from year to year as he unfolds them to the English philosopher. Speaking generally, it may be said that the three main lines of work which engaged his attention were the "passive" state of iron, ozone and hydrogen peroxide, and gun-cotton. Incidentally, many interesting side issues are raised, and passages can be gleaned here and there from his letters which show the wide grasp of, and philosophical insight into, the principles raised by his experimental skill. The first communication refers to "passive" iron (1836), and this subject is brought forward again and again for over six years. The explanation of the phenomenon was obscure to its discoverer, and led to his bringing the subject under the notice of Faraday and other contemporary men of science. Even if Schönbein did not find the true explanation, there can be no doubt that his work in this field had a great influence in directing his thoughts towards the action of the voltaic current and electrolysis in general, as he frequently refers to his speculations on these subjects. With regard to the explanation it may be said, as Kahlbaum points out in the introduction:—

"Even at the present day we have not succeeded in gaining clear insight into the cause from which this phenomenon proceeds."

The first reference to ozone is contained in a long letter dated April 4, 1840, in which Schönbein tells Faraday:—

"The phosphorus smell which is developed when electricity (to speak the profane language) is passing from the points of a conductor into air, or when lightning happens to fall upon some terrestrial object, or when water is electrolysed, has been engaging my attention the last couple of years, and induced me to make many attempts at clearing up that mysterious phenomenon. Though baffled for a long time, at last, I think, I have succeeded so far as to have got the clue which will lead to the discovery of the true cause of the smell in question."

This letter was communicated to the Royal Society on May 7, and an abstract published in the *Philosophical Magazine*. From that time ozone is frequently referred to, and the vicissitudes through which the new "odoriferous principle" passed can be followed with interest throughout the correspondence. At one period Schönbein thought that it was a derivative of nitrogen, viz. that the latter was "a compound consisting of ozone and hydrogen" (letter of April 19, 1844). In 1853 he tells Faraday that the nature of ozone appeared to have been settled in Bunsen's laboratory: "that there is one sort of ozone containing nothing but oxygen, and another that contains some hydrogen" (p. 213). By 1854 he had fully recognised that oxygen could exist in two different states, and this leads him to some further speculations on electrolysis, thermolysis and photolysis, which are well worthy of consideration even at the present time.

Students of the history of chemistry are, of course, familiar with all the points raised in the course of Schönbein's labours on ozone; but the personal recital of the discoverer's views, hopes, experimental results, and his refutation of the criticisms of other chemists will be found most instructive reading. He unbosoms himself freely to Faraday, in whom he found that sympathetic spirit which is so powerful an aid to scientific progress when exercised between co-workers whose greatness of mind and disposition exalts them above the level of all professional rivalry or petty jealousy.

The discovery of gun-cotton is heralded in 1846, when nitrated cellulose is introduced to Faraday with the statement :—

"To give you an idea of what may be made out of vegetable fibre, I send you a specimen of a transparent substance which I have prepared out of common paper. This matter is capable of being shaped out into all sorts of things and forms, and I have made from it a number of beautiful vessels." . . .

"There is another point about which I take the liberty to ask your kind advice. I am enabled to prepare in any quantity a matter which, next gunpowder, must be regarded as the most combustible substance known. So inflammable is that matter, that on being brought in contact with the slightest spark it will instantly be set on fire, leaving hardly any trace of ashes; and if the combustion be caused within closed vessels, a violent explosion takes place. . . .

"A substance of that description seems to be applicable to many purposes of daily life, and I should think that it might advantageously be used as a powerful means of defence and attack. Indeed, the congrevian rockets can hardly be more combustible than my prepared cotton is. What shall I do with that matter? Shall I offer it to your Government? I have enclosed a little bit of that really frightful body, and you may easily convince yourself of the correctness of my statements regarding its properties."

Human nature in 1846 appears to have been pretty much the same as it is now when a "utilitarian" scientific discovery is made; and in another letter of the same year he confides to Faraday, that while his knowledge of the world has been vastly increased by his experience, his "esteem for mankind has not grown in the same ratio." He adds :—

"I could tell you a great many things of an incredible description, but I will not trouble you with detailing facts which I should like never to have become acquainted with myself. So much, however, I must say, that by the occurrences alluded to, my temper, which is usually not much liable to be ruffled, and the placidity of my mind have been suffering these many months" (p. 165).

But apart from these capital discoveries with which Schönbein's name will be always linked, and which are now part and parcel of our modern science, some of the bye-products of that active mind are perfect marvels of scientific intuitiveness. A few of these collateral suggestions have been noted in reading through the correspondence, and readers of NATURE will be interested in having their attention called to some of the more striking passages. Compare, for instance, the present views on the nature of electricity with the statement written to Faraday in 1839 :—

"It appears to me that what we call static electricity is only a state of tendency of something to move in certain direction, and that current-electricity is the actual motion of that something. That motion must not be considered as one of weighty particles, but as a motion of something that is not affected by gravity; as a peculiar motion of the ether, if you like. According to these hypothetical views, we can easily conceive how a vibratory motion might be propagated through a space, or medium, empty of weighty particles, but filled up with some imponderable matter which is capable of being brought into a moving state. The only thing difficult to conceive is the relation of that imponderable agency to the weighty particles in their natural and excited condition; that is to say, the way in which both are acting upon each other. It is possible that a state of tendency to motion may be brought about in ether only by a peculiar action of ponderable particles upon that fluid, and that consequently such a state cannot exist in it without the presence or agency of matter, whilst moving ether of itself has the power to impart motion to ether being at rest" (p. 71).

The question of the colour of oxy-compounds appears to have directed Schönbein's attention towards the subject of colour in general. In 1852 he penned this most significant statement :—

"I cannot help thinking that the colours of substances, which up to this present moment have been very slightly treated (in a chemical point of view), will one day become highly important to chemical science, and be rendered the means to discover the most delicate and interesting changes taking place in the chemical condition of bodies. In more than one respect the colour of bodies may be considered the most obvious *signatura rerum*, as the revealer of the most wonderful actions going on in the innermost recesses of substances, as the indicator of the most elementary functions of what we call ponderable matter."

The letter from which the above passage is quoted contains remarks which—to put the case with the least disparagement to the memory of their writer—show that the then newly developing science of organic chemistry found very little to commend it to Schönbein's mind. Faraday echoes his sentiments in his reply to this letter, in which he says :—

"You are very amusing with your criticisms on organic chemistry. I hope that in due time the chemists will justify their proceedings by some large generalisations deduced from the infinity of results which they have collected. For me, I am left hopelessly behind; and I will acknowledge to you that, through my bad memory, organic chemistry is to me a sealed book."

Again and again does Schönbein declare his attitude towards this branch of science, not only in his letters to Faraday, but also to other contemporary men of science. In a letter to Faraday, written in 1854, he speaks of "cook-like chymists, who are brewing on and on their liquors and puddings without paying much attention to the conditions of the primary matters they are continually mixing together." Even the editor of the present volume finds it desirable to append a sort of apologetic note (p. 225) concerning this "harsh verdict," and pointing out that, although concerned with the chemistry of only one element, this branch of the science has had "great practical value and importance." It is not to be wondered at that Schönbein should have felt some trepidation in meeting his great compeer Liebig, the father of modern organic chemistry, which event is graphically described in a letter written to Faraday in 1853 (p. 216) :—

"Of course, I met Liebig at Munich, whom I knew before little more than by sight, but within the first five minutes we had found out the footing upon which both of us could move comfortably enough. You will laugh when I tell you Liebig asked me to deliver a lecture before a very large audience in his stead, and Mr. Schönbein, though reluctantly, yielded to that strange demand. The subject treated was that queer thing called 'Ozone,' which ten or twelve years ago, as you are perhaps aware, was declared by a countryman of yours and pupil of Liebig's to be a 'nonens.'"

Could the shade of Schönbein revisit the laboratory of a modern worker in organic chemistry, he would find that the latest "Handbook" consisted of four large volumes, containing altogether some 6000 pages of closely printed matter, all compiled by one man (Beilstein). But nature, which endowed the "mighty atom" of carbon with such marvellous potentialities, had her revenge upon the illustrious Swabian during his lifetime, for she placed in his way a discovery which, curiously enough, is just now exciting the greatest interest, viz. the oxygen-carrying power of certain enzymes known at the present time as "oxydases." His first allusion to this is in 1855, when he wrote to Faraday :—

"You know that I entertain a sort of innate dislike to touch anything being in the slightest way connected with organic chemistry, knowing too well the difficulty of the subject, and the weakness of my powers to grapple with it; but, in spite of this well-grounded disinclination, I have of late, and as it were by mere chance, been carried in the midst of that field, upon the intricacies and depths of which I have been used all my life to look with feelings of unbounded respect and even awe. The picking up of a mushroom has led to that strange aberration of mine, and you will ask how such a trifling occurrence could do that. The matter stands thus: What the botanists tell me to be called *Boletus luridus*, with some other sorts of mushroom, has the remarkable property of turning rapidly blue, when their hat and stem happen to be broken and exposed to the action of atm[ospheric] air. On one of my ramblings I found a specimen of the said *Boletus*, perceived the change of colour alluded to, and being struck with the curious phenomenon, took the bold resolution to ascertain, if possible, its proximate cause."

He then describes his experiments in some detail, and comes to the conclusion that this and other Fungi contain an "organic matter" which is "a true carrier of active oxygen." This letter was communicated to the *Philosophical Magazine*, and published in vol. ii. 1855.

As another example of Schönbein's power of grasping and dealing with scientific problems, we may refer to his treatment of "polarisation," which term he used in at least two senses, viz. the electrical sense in which it is now used as indicating the reversal of current by charged electrodes (1838), and later (1859) to indicate "two active kinds of oxygen standing to each other in the relation of + to −." This association of ideas in the philosopher's mind is a good instance of pre-vision, and his remarkable comparison of the opposite states of the two kinds of oxygen to Pasteur's racemic combination of the two tartaric acids (p. 288) is a bold analogy which may even yet find justification. This explanation of voltaic polarisation, given as far back as 1839, is substantially the same as that adopted at the present day. So also his views on the course of chemical change, expressed in a letter to Faraday in 1856, are so much in harmony with modern notions that they are worth emphasising by quotation :—

"Another fact, not quite void of scientific interest, is this, that in some instances I can show, as it were, steps which the oxidation of certain matter passes; . . . it is not impossible that any oxidation is a sort of chemical drama, consisting of different acts, the last of which is real oxidation. . . . Schönbein maintaining that between the moment on which two isolated elementary bodies meet, and that of their chemical associating being finished, there lies a whole world of phenomena, and is very much of which the chemists of the present day have as yet not the slightest notion. There is even within inorganic chemistry something which I might call physiology, and the most interesting and truly scientific object of chemical research lies, to [in?] my opinion, within the short interval of time alluded to, and hence the great difficulty of such an investigation" (p. 271).

The next paragraph in this letter mentions, by the way, a synthesis of formic acid by the oxidation of olefiant gas by ozonised oxygen.

Among the other numerous subjects discussed in the course of the correspondence, "contact action" may be mentioned. In sending a pamphlet to Faraday, published in 1844 by Schönbein, the latter says :—

"There is also a paper in the book treating of chemical effects produced by contact, on which I should like very much to have your opinion. Having these many years entertained strong doubts about the correctness of the atomic theory, and been inclined to consider what is called a 'molecule' of a body *as a centre of physical forces* (italics ours), I have tried to make that view bear upon the chemical actions being produced by contact."

So that we have here the Boscovich notion very clearly set forth. The same letter also contains a paragraph which will go to the heart of many and many a worker in science who reads this notice :—

"Having had no less than nineteen hours to lecture a week in the course of this winter, you may easily imagine that I had no time for making researches: I grow, indeed, impatient of that everlasting schoolmastering, and am longing for being placed under circumstances more favourable to scientific pursuits."

In selecting specimens of the correspondence from the volume before us, we have necessarily given Schönbein the greater prominence. Faraday, as already explained, was not so communicative of his scientific results. The latter, moreover, may be assumed to be more familiar in this country than the original papers and memoirs of the Swabian chemist. But scanty as are the English philosopher's references to his work, the chronological sequence of his main discoveries can be traced, and these appear to have been eagerly followed by his correspondent. Of particular interest at the present time is Faraday's statement, in 1845, that he had failed to liquefy oxygen at $-140°$ F. under a pressure of 60 atmospheres; and in 1852 he asks Schönbein :—"Have you condensed oxygen?—I wish you could tell me what liquid or solid oxygen is like. I have often tried to coerce it, and long to know."

In November 1845 he mentions one of his fundamental discoveries to Schönbein in these words :—

"I happen to have discovered a direct relation between magnetism and light, and also electricity and light, and the field it opens is so large and I think rich, that I naturally wish to look at it first" (p. 148).

Another little list of scientific gossip concerning Crosse's supposed production of insects by an electric current (p. 33) will be found of interest, as also the reference to table-turning (p. 214), concerning which he says :—

"I have not been at work except in turning the tables upon table turners—nor should I have done that, but that so many inquiries poured in upon me that I thought it better to stop the inpouring flood by letting all know at once what my views and thoughts were. What a weak, credulous, incredulous, unbelieving, superstitious, bold, frightened, what a ridiculous world ours is, as far as concerns the mind of man. How full of inconsistencies, contradictions and absurdities it is" (p. 215).

The above and other passages in this letter come as near to misanthropy as anything to be found in Faraday's correspondence. It is obvious from the context that the letter (July 1853) was written during one of his periods of prostration, for he says: "Consider my age and weariness, and the rapid manner in which I am becoming more and more inert."

The extraordinary pertinacity displayed by Schönbein in following up his ideas concerning the "polarisation" of oxygen, and in searching for the hypothetical "antozone," is well brought out in the course of the correspondence. In 1860 he thought he had obtained "antozone" from fluor-spar, and he described his experiments to Faraday, who in his reply raises a question concerning nitrogen in a very remarkable passage :—

"But surely these wonderful conditions of existence cannot be confined to oxygen alone. I am waiting to hear that you have discovered like parallel states with iodine or bromine, or hydrogen and nitrogen. What of nitrogen? Is not its apparent quiet simplicity of action a sham?—not a show, indeed, but still not the only state in which it can exist. If the compounds which a body can form show something of the state and powers it may have when isolated (as in your ⊖○⊕), then what should nitrogen be in its separate state?"

The extracts which have been given are sufficient to show that the editors of this volume have made a most valuable contribution to the literature of science. It is out of such materials as Dr. Kahlbaum and his colleague have now provided that the history of the science of the nineteenth century must be built up; and we are glad to have received from this same author other volumes giving the correspondence of Liebig and Schönbein, and a monograph on Schönbein's work, which we hope to notice in due course. Certainly this period of six-and-twenty years during which the intimacy between Faraday and Schönbein began and ripened into the warm friendship which was terminated only by the death of one of the correspondents was one of extraordinary activity and productiveness. The names of the contemporary workers referred to comprise, not only those already mentioned, but also Arago, Berzelius, Becquerel, St. Clair Deville, Frémy, Houzeau, Marignac, De la Rive, Hofmann, Magnus, Nobili, Pasteur, Pélouze, Pettenkofer, Plücker, Poggendorff, Rose, Wiedemann and Wöhler on the Continent; Draper in America; and in this country Airy, Andrews, Brodie, Daniell, Grove, Herschel, Noad, Stokes and Whewell. It is interesting to read that in 1856 Faraday sent a volume of his researches to Schönbein through "Mr. Roscoe, a student under Professor Bunsen at Heidelberg"; while in 1843 he refers to "a magnificent steam electric apparatus" made by Mr. (now Lord) Armstrong.

With respect to the manner in which the editors have performed their task, there are some points to which attention may be called. Dr. Kahlbaum lays down the principle in the preface that in publishing historical documents these

"should be set forth in exact agreement with the original, and in the next place provided with as many suitable comments as possible to explain their meaning."

Regarding the latter statement, we have already pointed out how admirably the editors have done their work. In accordance with the first statement, the letters have been printed, on the whole, exactly as written, and thus any "editing" which was done for the *Philosophical Magazine*, or for the Royal Society, can now be compared by the curious with the original documents. In no case, as far as we have ascertained, has Schönbein's meaning been altered by the editorial process. It must be remembered that Schönbein thought in German and wrote in English, and the letters generally show that his English was excellent. Only in matters of spelling and the use of capitals is there any laxity to be found, and it is perhaps to be regretted that the editors did not leave every word of Schönbein's intact or else have adopted a uniform system of correction throughout. Thus, where they alter the spelling it is generally by interpolating some trivial correction, such as "favorite" to "favo[u]rite," "Alps" to "Alp[e]s," "color" to "colo[u]r," and so forth, while "oxigen," "sulfate," "british," "french," "german," "You," &c., are allowed to pass. The whole result leaves an impression of straining at gnats and swallowing camels; particularly when such spelling as "oxigen" and "german" appears also occasionally in Faraday's letters, possibly through misprints. The volume, we may add, has been printed at Bâle. Faraday's writing also was in some cases so illegible that the editors have been obliged to leave gaps or to suggest interpolations. The portrait of Faraday is the well-known one prefacing Bence Jones's "Life," and that of Schönbein is drawn from a statuette of 1855 and contemporary photographs. The original letters are now, though the generosity of Faraday's niece, Miss Barnard, and Schönbein's daughters, deposited in the University Library at Bâle. R. MELDOLA.

THE ANIMALS OF BRITAIN AND THEIR ORIGIN.

The History of the European Fauna. By R. F. Scharff, B.Sc., Ph.D., F.Z.S. Pp. vii + 364; illustrated. (London: Walter Scott, Ltd., 1899.)

THE title that we have chosen for this review of Dr. Scharff's volume is really rather more expressive of the scope of the book than is his own title. For he deals at greater length with the fauna of our own country than with that of Europe in general. This is by no means a defect to be urged in considering his statements and arguments; on the contrary, we think that it will add to the interest of the book; and besides Great Britain has a fauna which practically only differs from that of adjacent parts of Europe in its poverty. The reduction of the number of individuals and of species of indigenous creatures was set down by Mr. Wallace to the recent glaciation of these islands, which, occurring, as it was supposed to do, after the land connection with Europe had been broken through, destroyed many forms coming originally from more southern regions. The severance of the land connections hindered a repopulation when more favourable climatic conditions were re-established. Dr. Scharff is one of those who do not believe in great possibilities of migration over stretches of sea for purely terrestrial animals. There are of course such cases on record; but they are really not numerous. Dr. Scharff mentions several that are of recent occurrence. He tells us that Colonel Fielden, when in the Barbadoes, witnessed, or heard of, the arrival of an alligator which must have traversed a tract of ocean of 250 miles. There are also well-known experiments which show that animals *might* be imported in a natural way from distant and transpontine countries. The resistance of certain snails and other molluscs to the effects of sea-water when guarded by their diaphragm has been proved by the classical experiments of Darwin. It is, however, disappointing to learn from Dr. Scharff how dangerous it is to argue from experiments which can so readily be made to the actual phenomena of nature.

Concerning one of these protected and—as it was thought—adventurous molluscs, the author writes as follows:—

"The fact that *Cyclostoma elegans* does not live in Ireland is of particular interest in connection with the floating-theory just quoted, as on all sides of Ireland dead specimens have been picked up on the shore, showing that marine currents carry specimens, and have thus transported them for countless centuries. Nevertheless, the species has not established itself in Ireland."

Equally strong arguments can be derived from the study of other islands, from which a species, that ought to be there, as it were, is unaccountably absent. It has always appeared to the present writer that in deducing results from the faunas of oceanic islands which must have been stocked *de novo* from adjacent mainlands too little weight has been given to involuntary introduction by man. There is no doubt whatever that emigrating man has been a most fell agent in the destruction of faunas by the deliberate introduction of domestic and other animals; it is also probable that much has been done in the way of accidental introduction. There is, however, another possibility—urged by Dr. Scharff himself elsewhere in his volume—that may account for a given species not succeeding in establishing itself in a country which appears to be ideal for its needs. There may be no room for it; the ground may be taken up by an allied form or a creature of similar needs and habits. Here again the problem is indefinitely complicated by human occupation and tillage—in the case of the countries which form the subject of Dr. Scharff's remarks. Another matter of wide zoo-geographical interest, as well as vital to the development of his argument, is dealt with by Dr. Scharff. The peopling of these islands has, he thinks, mainly at least occurred along land routes; but how is it to be decided whence a given animal started in its wanderings towards the British Islands?

The author gives an example where a fair guess may be made as to the original home of the genus.

"The badger," he observes, "inhabits Europe and Northern Asia. It is absent apparently from many parts of Central Asia, but it appears again further south in Palestine, Syria, Persia, Turkestan, and Thibet. West Central Asia would be about the centre of its range. That this corresponds to its place of origin is indicated by the fact that the only three other species of badgers known, viz., *M. anakuma*, *M. leucurus*, and *M. albogularis*, are confined to Asia. If we examine the fossil history of the genus, we find that the two most ancient instances of the existence of badgers have been discovered in Persia, where *M. Polaki* and *M. maraghanus* occur in Miocene deposits."

Failing future discoveries of fossil badgers, this method of argument seems to be valid. But it is not so clear to us that Dr. Scharff is justified in stating that the centre of distribution, *i.e.* the original home of the genus, is to be sought for where the number of species of the genus is at a maximum. There are more species of the Tapir (*Tapirus*) in America than in Asia, where there is only one. But it is doubtful as to whether the genus is of American origin; it is much more probably European. So, too, with the cat tribe; the species of *Felis* abound in Asia and the East generally, and are fairly numerous in America, but Europe again would seem to be the place of dispersal.

From these general considerations, which are put forward with clearness and supported by a proper treatment, so far as we can judge, of the geological evidence, the author proceeds to discuss in detail the actual homes of our British animals, laying most stress upon, or at least dealing more at length with, the mammalia. Naturally this is the most important group in attacking the problem, since our acquaintance with fossil invertebrates, and even of other vertebrates, is less extensive. The fauna of this country, as everybody knows, is a mixture of various and apparently incongruous elements.

The facts brought forward by Dr. Scharff show incidentally how very little influence temperature seems to have, and to have had, in the limiting or encouraging the migrations of mammalia. The tiger barred and the leopard are at home in tropical forests and in the colder regions of Asia. The polar bear, *par excellence* an Arctic animal, endures with comfort the temperature of London in the summer—and, indeed, more than endures it—as is shown by the fact that an individual lived for thirty-seven years in the Zoological Society's gardens. Dr.

Scharff distinguishes three main lines of migration to these islands—the Siberian, the Arctic (which he carefully separates), and finally the Oriental. Besides these three trunk routes, so to speak, a considerable quota of our fauna has arrived here from such centres of dispersal as the Lusitanian area. It is often put forward that the fauna of Europe show more likenesses to that of Africa than to that of Asia—"Oriental" Asia, that is to say. Dr. Scharff does not omit to notice this view, but will not allow an African origin for any part of our fauna. On the contrary, he is disposed to think that the spreading of animals has been in a exactly opposite direction, and that Africa has been partly peopled from Europe.

We can distinctly commend this book, which is agreeable reading as well as a repertory of important facts. Its value is considerably increased by a short summary at the end of each chapter of the line of argument pursued and the results arrived at. Numerous engravings and maps, all of them in the text, add to its usefulness; while a selected bibliography will enable the non-expert reader to pursue his inquiries further into any particular matter not treated at length in Dr. Scharff's book.

F. E. B.

OUR BOOK SHELF.

Le Cidre. Par X. Rocques. Pp. 171. (Paris: Gauthier-Villars, 1899.)

IN a country where the technical difficulties of the wine-grower and the brewer have been considered worthy of the attention of such a man as Pasteur, it is not surprising that the cider-maker should receive help from science. That this is so, is rendered very evident by M. Rocques in the small volume before us, where we find in a condensed, but very readable form, an account of the valuable aid French men of science are giving to the cider industry. In England we are, of course, behindhand in such a matter, but there is, perhaps, some excuse in this case, as cider has not the economic importance here that it possesses in France. In that country, where the mean annual consumption of cider is twelve million hectolitres, representing one-fifth of the alcoholic beverages consumed, economic considerations affecting its production are naturally very great, and the importance of scientific help proportionately large.

But, according to the author, one point in connection with the cider industry tends to hinder somewhat the adoption of scientific methods by the manufacturers, and this is the remarkable fluctuations in the apple crop compared with the fluctuations in the other leading agricultural crops of France. The proportion of the minimum wheat crop to the maximum is 1 to 1½, and of wine, 1 to 2; but in the case of cider there is the very great difference of 1 to 8½. It appears, in fact, on taking the average of the last twenty-five years as a guide, that a good apple crop can only be expected one year in two. Such uncertainty in the crop, no doubt, tends to hinder rapid progress in the art of cider-making; but, on the other hand, progress is assisted by the growing custom of establishing well equipped breweries, which are supplied with apples from the smaller growers who previously made their own cider on a small scale with poor appliances, and in the old rule of thumb style.

About 40 per cent. of the total production of cider in France is now made in these breweries, much to the comfort and advantage of the consumer, who is not provided by nature with a stomach equal to the action of the acid liquid so often produced by the small farmer.

In the cider breweries working on a sufficiently large scale to permit the adoption of suitable plant and skilled supervision, scientific methods appear to be adopted freely. The diffusion method, employed so largely in the beet-sugar industry, is utilised for the extraction of apple-juice for the production of certain classes of cider, but the old method of extraction by pressure is still found desirable for full-flavoured, sweet ciders, the diffusion process producing a beverage of a drier character.

Hansen's well-known researches on the pure culture and selection of yeasts, which influence so largely the zymo-technical processes of to-day, are also made use of by the advanced cider-maker for the purpose of improving his produce. A composite yeast of the well-known organism, *Saccharomyces apiculatus*, together with another selected yeast derived from the apple, *S. Mali*, is found to give good results. As apple-juice, unlike a beer wort, cannot be sterilised by heat in order to provide a clear field for the development of a selected yeast culture, the plan adopted is to nurse the selected yeast growth to such a vigorous state that when used it is capable of crowding out the undesirable saccharomyces naturally present in the apple-juice.

For the purpose of improving and increasing the flavour of cider, an interesting use is also made of Jacquemin's researches, by which he showed that various parts of certain plants, including the apple, contain glucosides capable of being split up by fermentative action into sugar, and principles possessing the characteristic bouquet of the fruit used.

We recommend M. Rocques' little volume to all interested in technical cider-making, and also to those interested generally in zymo-technical literature.

A. J. B.

Liverpool School of Tropical Diseases. Memoir I. "Instructions for the Prevention of Malarial Fever." (Liverpool: University Press, 1900.)

THIS booklet is the first of a series of memoirs to be issued by the Liverpool School of Tropical Medicine, and is the outcome of the malaria expedition sent out by that body to Sierra Leone. It deals with measures of prevention suggested by observations made on the spot in a malarious country and with the light of modern theory as to the cause of the disease. There are two drawings of the innocent and noxious mosquito which cannot help but impress the imagination of the reader. The idea of alertness and viciousness suggested by the attitude of the latter should make the most careless observer interested in noting which genus of mosquito it is that infects his neighbourhood.

The memoir, which is clearly and concisely written, contains most valuable information for any one living in the tropics. It is artistically got up, and reflects credit on the school and on the University Press of Liverpool, of which it is one of the first productions.

Our Insect Friends and Foes: how to Collect, Preserve and Study them. By Belle S. Cragin, A.M. Pp. vi + 377. With 255 illustrations. (New York and London: G. P. Putnam's Sons, Knickerbocker Press, 1899.)

THE title of the work is likely to give the impression that it is devoted to economic entomology, whereas it is professedly a text-book on general entomology and "relations of insects," spiders, scorpions, &c., dealing with the common species of all orders found in "the States east of the Rocky Mountains and north of the Gulf States," including useful instructions on collecting, rearing and preserving insects, their anatomy, &c. The book is written almost expressly for young people, who will find it interesting and instructive in many ways. Unfortunately, many of the illustrations are very poor indeed, and this particularly applies to the *Hymenoptera*.

LETTERS TO THE EDITOR.

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

The Effects of Lightning upon Electric Lamps.

THE accompanying effects were obtained when attempting photographs of lightning, and were rather the result of accident than design; an impending thunderstorm, with a somewhat limited horizon, prevented the camera from being pointed in the direction whence the most numerous of the lightning flashes occurred, without including in the field one or more of the electric arc lamps (Brush) which are the illuminating power of our town. Upon developing the few exposures made, it was noticed that whether or not the picture *took in* the flash, and in many cases this did not appear at all, there was exhibited upon the films the light of the permanent lamps, and that from them a flow of electricity proceeded towards the ground in an irregular line. Ground or summer lightning, as it is frequently called, produced the same effect upon the lamps, but when neither was present an exposed film only showed a sequence of white dots or perpendicular short strokes in the places occupied by the lamps, as seen by the naked eye at night. The result was sufficiently curious to invite further experiments in the same direction, but this could not be done upon the same lines as before, for the electric system varies with the months upon the sea front at Dover. In autumn, winter and spring the usual lighting is considered sufficient for all purposes, but during the visitors' season an additional illumination is provided by festoons of smaller glow lights from standard to standard, with occasional cross festoons over the roadway, the whole producing a charming effect at night; but, as will be seen in No. 6, the detail as to these becomes confused to any one not acquainted with the relative position of the lamps.

The first impression these photographs gave me was that the electric discharge in the heavens produced an instantaneous one also from the lamps, and that in this way the circuit was completed; but other causes beyond these must have been in action from the disjointed and irregular display from the lamps as opposed to that of the lightning.

Sir George Stokes, who has kindly interested himself in the matter, appends his views, and I need only add that I hope when a thunderstorm visits a town illuminated by electricity, photographers will, both in daylight and after dark, expose a few plates for the elucidation of the thoughts suggested to us. I say in daylight, for the camera will often record impressions that our eyes cannot see by reason of other external surroundings, as instanced by my noticing upon one occasion with the unaided eye a stream of electricity descending from an arc lamp towards the earth which I should assuredly have never seen had I not learnt from these photographs that such a phenomenon did exist.

SYDNEY WEBB.

Dover, October 1899.

I WISH to add a few remarks to Mr. Webb's description of the way in which his remarkable photographs were obtained, my object being to point out certain features which seem likely to lead towards an explanation of the discharges which take place, simultaneously with lightning flashes in the sky, in the neighbourhood of the electric lamps.

Fig. 1 represents a photograph which was taken looking westwards before the installation from the ornamental glow lamps was set up for the season. The three roundish luminosities represent the normal illumination due to four arc lamps. If these, taken in order along the street, be called Nos. 1, 2, 3, 4, their order in the picture, from left to right, will be 1, 2, 4, 3, but Nos. 3, 4 are so nearly in the same line of sight that the images of their normal luminosities are blended into one. The lamps are twenty-one feet above the ground, and the distance from lamp to lamp is about ninety-two yards. Towards the upper left is seen a flash of lightning in the sky. Simultaneously with the flash, electric discharges took place between the lamps and the ground, which are recorded on the photograph.

It is to be noted that though the lamp-posts were of iron the discharge did not take that course to the earth, but went in a curved path which must have been thirty feet or so in length. Its course led towards the high-tension cable, which ran underground along the esplanade; but whether the cable had anything to do with it, there is not sufficient evidence to show. The different paths are remarkably similar, almost identical in form. A striking feature of the discharge is its beaded or stratified character. The intensity of the discharge and the closeness of the stratification are both greatest near the lamp, and decrease as we approach the ground.

Another photograph (2*a*), not here reproduced, was taken under the same circumstances, but with a different flash. The general features are the same, but the form of the curves is

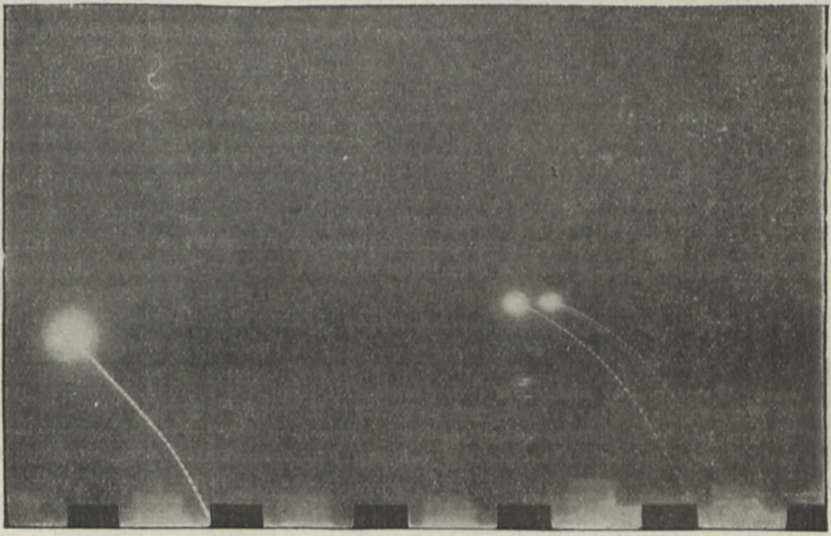


FIG. 1.

different. Instead of a curve convex outward, as in Fig. 1, we have curves first convex, then concave, then convex again, and as in the former case similar to one another. The negatives of these show a feature which does not appear in the reproduction (Fig. 1), nor even in positives taken with sufficient exposure to show the fainter portions of the discharge. In the negative of 2*a*, the images of lamps 2, 3, 4 show each a pair of short straight dark lines, indicating special luminosity, like two "I's" parallel to one another and nearly vertical, the base of the right being nearly on a level with the top of the left. No. 1, which is much nearer, has too much darkened the negative to show more than a trace of one of the I's. The discharge in 2*a*, which shows the stratification, is seen issuing from the top of the right-hand upper I in a nearly horizontal direction. The negative of Fig. 1 shows a similar strong luminosity, only here the I's, if they are distinct, are nearly horizontal, and run one into the other. In this feature, again, we observe as before similarity from lamp to lamp, difference from flash to flash.

Four photographs were taken looking east along the shore. Three of these are here reproduced (Figs. 2, 3, 4). In one only of these is the flash, which gave rise to the discharges, seen in the field (Fig. 2).[1]

The three figures all show one arc lamp which is tolerably

[1] It should be mentioned that in this case, and in this case only, the flash was strengthened by hand on the back of the negative to make it print better, so that the picture of the flash cannot be altogether trusted as to minute details.

near, with the discharges connected with it, and the discharges belonging to several very distant arc lamps, of which five are seen to the right and a few to the left of the former. Fig. 3, which points a little more to the north, takes in an arc lamp at an intermediate distance. These figures, as before, point out very strikingly the similarity of the discharge from lamp to lamp, and the difference from flash to flash.

Thus, in Fig. 2, we have a nearly vertical discharge from the near lamp, and also from the distant lamps, whereas in Fig. 3 we have the corresponding discharges nearly horizontal, somewhat resembling parabolas in a horizontal plane. In these cases, unlike that of Fig. 1, there is a discharge of curious form which is more conspicuous than the discharge between the lamp and the ground.

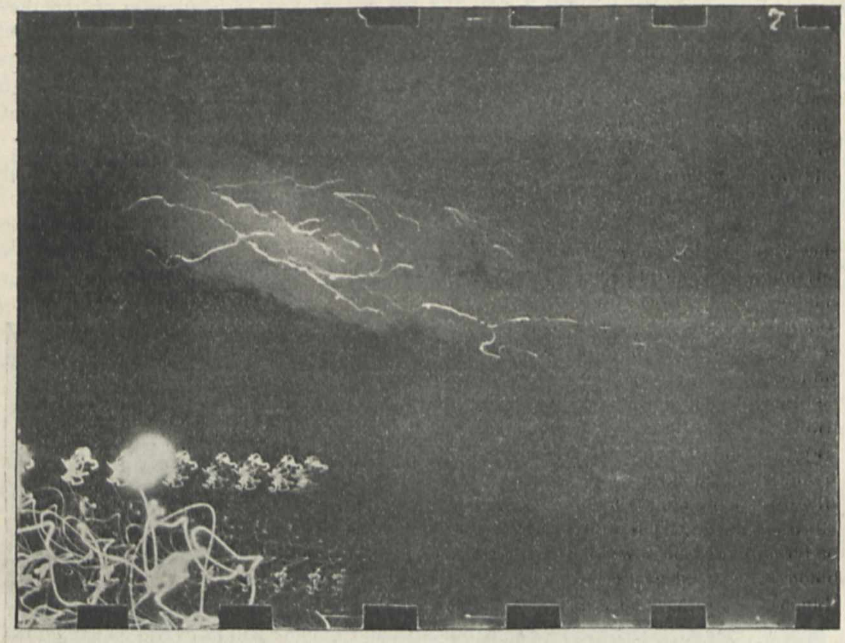


FIG. 2.

The finer beading naturally cannot be shown in the reproduction, though it appears in very many cases in the positive copies, and still better in the original negatives. After an examination of the actual photographs, one is disposed to regard the beading as a normal feature of this kind of discharge, though for different reasons it cannot always be traced.

Fig. 5 was taken towards the sea, facing the installation for ornamental incandescent lamps just opposite to Mr. Webb's house. The flash which occasioned the local discharges is seen in the field. Some luminosity is seen at the top connected with the mounting of the ornamental lamps, and delicate discharges going obliquely downwards. But the chief luminosity would seem to have relation to the high-tension cable below, and it may be also to one or both of the horizontal wires above, across which the lamps are hung, and which are charged through transformers to a much lower tension.

The complicated Fig. 6 represents five flashes, all apparently in the field, and the local effects due to them. At the risk of a digression, I would point out the character of one of the flashes —that shown in the middle of the field—though what I am about to say can hardly be gathered from the reproduction, but appears in a positive photograph, or, better still, in the original negative. The actual photographs give strongly the idea of a spark-discharge, the path of which is the right-hand boundary in the picture, followed by a transverse flow, or arc-discharge, from right to left, all over the path of the spark; then a second spark-discharge, parallel to and less strong than the former, followed by a second transverse flow. Previous photographs taken with a moving camera had shown a duration of luminosity after the spark-discharge, which would naturally be interpreted to indicate either a sort of phosphorescence of the air, produced by the spark-discharge, or else an arc-discharge proceeding along the path opened up for it by the spark. But Mr. Webb's photograph, the original of Fig. 6, seems to indicate pretty plainly an arc-discharge proceeding, with a variable intensity, from the different points of the path of the spark, but flowing in a direction *transverse* to that path.

The local effects, which form by far the greater part of the luminosity represented in Fig. 6, are naturally very complicated, on account of the number of flashes; too much so to be convenient for individual discussion. We may notice, however, in a general way, the repetitions of the same form and the beading. A prominent object is the very formidable-looking discharge shown in the left half of the picture, traces of the beading of which may be seen even in the reproduction.

In several cases the photographs indicate pretty plainly a local discharge of the form of tape striped across. The tape in its course is liable to be bent or twisted, or both. In places where the plane of an element of the tape is in the line of sight, the striping is not usually seen, as the bright and dark stripes would overlap unless the axis of the tape happened to be roughly perpendicular to the line of sight.

In connection with the phenomena presented by the electric lamps in a thunderstorm, as revealed by the photographs, several theoretical questions present themselves. Do the lamps act merely in consequence of the tall iron lamp-posts, so that the effect would be the same if the dynamos at the works were not in action, or is the artificial electricity concerned in the production of the effects? What is the nature of the action of the flash of lightning in bringing about the discharges? What determines the course of the discharge, and why is it so different from flash to flash, while for a given flash it is nearly the same for lamps ranging over a space of some hundreds of yards? What is the nature of the beading or striation?

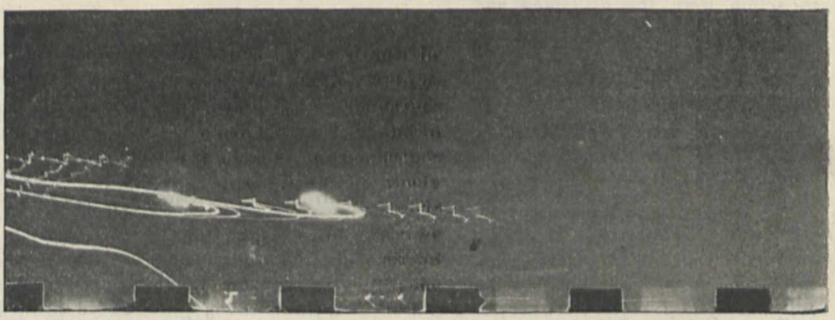


FIG. 3.

As the lamps are wanted for public lighting, the experiment could not well be made of disconnecting one from the works when a thunderstorm was impending in the evening, and seeing whether the one disconnected would give a discharge like the others. In default of experiment I can only say that from my theoretical notions I think that the electrical action of the lamps is required.

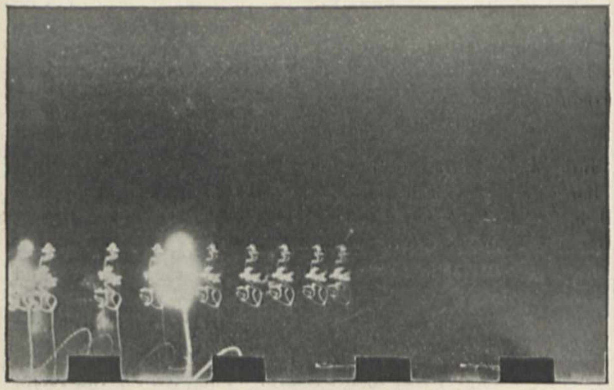


FIG. 4.

When the lamps are in use there is a very steep gradient of electric potential about them. I am informed that there is a difference of about 50 volts between the carbons of the Dover arc lamps, and this entails steep gradients in the air about them. If, then, there were something to cause a sudden change of potential-gradient irrespective of the lamp, this, when compounded with the normal gradient due to the working of the lamp, would give a gradient in some places greater and in some less than the normal. A path might thus be opened for a discharge different from the normal one from pole to pole, and this might pass away from the lamp altogether, and even go to the ground, provided there were a sufficient gradient to continue it when it had got to a distance from the lamp; and such a gradient might naturally exist in thundery weather. Or, again, if there were something to cause a sudden diminution in the resistance of the air, a similar effect might be produced.

The striking of a flash would no doubt be accompanied by a sudden change in the atmospheric electric potential. But I rather incline to the other view, and to regard the phenomenon as what I may call a case of Nature's wireless telegraphy. This view would make it depend on electromagnetic waves propagated from the flash. The flash would take the place of the sending instrument, the resisting air that of the coherer, the gradient of potential, whether artificial (that due to the electric works) or natural (that existing in thundery weather), would take the place of the electromotive force of the battery or cell which tends to send a current through the coherer, while the electromagnetic waves would open a path for the current in the air as in the coherer.

The close similarity of the discharges from lamps three hundred yards or more apart points to a distant cause, or at least one which is much the same at places 100 or 200 yards apart in a horizontal direction. This is not incompatible with the supposition that the path, when the discharge is fairly launched from the lamp, depends on the atmospheric variation of the atmospheric electric potential, which may very well be on an extensive scale; and such a similarity of path is what might have been expected beforehand if the paths depend on electomagnetic waves coming from the flash; and it may well depend on a combination of these two conditions. The difference from flash to flash would seem to be in this way most easily accounted for. For not only might different flashes, though close together in time, come from different parts of the sky, but even if they came from nearly the same quarter the mode of the transverse ethereal vibrations would be pretty sure to be different. Now the facility for the passage of a current afforded by an electromagnetic disturbance would naturally depend jointly on the direction of vibration and the direction in which the current tended to pass, that is, on two independent vector quantities, the pre-existing potential gradient and the ethereal vibration; and further, the vibration might very well resemble that in common rather than that in plane polarised light; so that there is abundant room for complexity, and for variation from flash to flash, as regards the path of the local discharge.

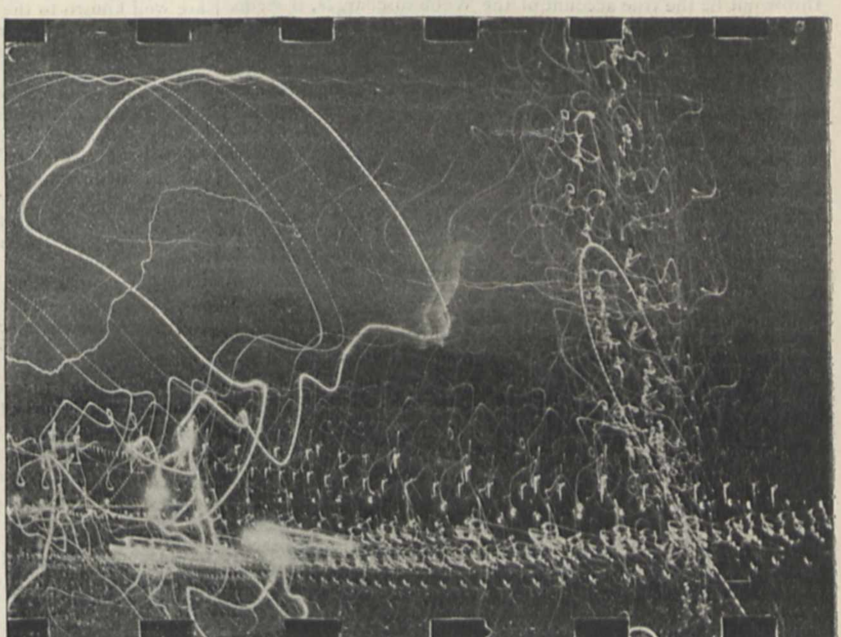


FIG. 6

The striation or beading of the discharges remains to be considered. The Dover lamps are worked on the alternate current system, and it might at first sight be supposed that perhaps the beading may have something to do with the alternation. But, as was pointed out to me at the Dover electric office, this could not be. For the period of the current is about the hundredth of a second, and if we counted the beads we should arrive at a duration of discharge much too great

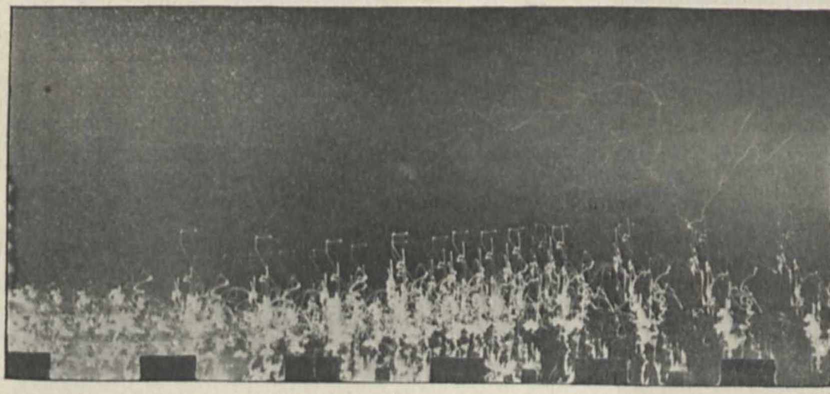


FIG. 5.

to be allowed. Two ideas presented themselves to my mind as to the possible origin of the beading. One was that it might have something to do with the way in which the path crossed a series of electromagnetic waves, like those of light, except as to the scale of wave-length. Another, which seems more probable, is that they are of the nature of the stratified discharge in exhausted tubes. This supposition indeed is not free from difficulty, though I do not think the difficulty fatal. In an ordinary tube it requires a very good exhaustion to get strata as much as an inch thick. But here, at full atmospheric pressure, we have strata a foot or more in thickness. However, in a Geissler tube the strata are closer in the capillary part, where the current is concentrated, than in the broad part. It may be that in the discharges, for example, represented in Fig. 1, which are unconfined laterally, these wide strata are possible, and if so, the density of the current is small. It has already been remarked that the intensity decreases as we go from the lamp to the ground. It seems that the current is gradually spent in electrifying the air. If this explanation be correct, the local discharges represented in Mr. Webb's photographs may not be so dangerous as some of them look. Still, until we know more about the subject, it might be prudent in a thunderstorm to keep a little away from arc lamps in a street.

If the wireless telegraphy theory which I have ventured to throw out be the true account of the Webb discharges, it seems that by imitating with any necessary modification the receiving apparatus, and introducing a telephone, as has been done with great advantage by M. Turpain in his researches, it might be possible simultaneously to see and to hear a flash of lightning.

Cambridge, January. G. G. STOKES.

The Mathematical Tripos.

ON February 15 the recommendations of the Special Board for Mathematics on the Mathematical Tripos will be voted on by the Senate of the University of Cambridge. With regard to the changes proposed in the general arrangement of the examinations there can be scarcely any difference of opinion. About twenty years ago the advances in mathematical science had reached such a pitch that it was impossible to cover the whole range of mathematics in a single examination, and many a promising mathematician found himself seriously fettered by the necessity of having to confine himself to those parts of the subject which would best enable him to obtain a high place in the examination, and to spend his time in attaining proficiency in rapidly solving certain classes of problems rather than devote himself to specialising in the higher branches of mathematics. It was under these conditions that the Tripos was divided into two parts, the first covering the less advanced subjects, and the second enabling a candidate to specialise in those portions of higher mathematics for which his enthusiasm and ability best qualified him. The further developments of the last twenty years have necessitated an extensive reconstruction of the schemes, and the framers of the present regulations have been at great pains to bring the Mathematical Tripos into line with modern requirements. At the same time it is becoming daily more and more evident to those competent to judge that a sound training in mathematical methods is of paramount importance in the study of applied science, and the regulation allowing candidates to take Part i. in their fifth term should prove of great value to those who wish to study mathematics as a preparation for the subsequent study of physics or mechanical science or even, nowadays, chemistry.

The abolition of order of merit in Part i. is a logical outcome of the fact that this part does not represent the highest knowledge of mathematics. In late years the title of Senior Wrangler, which is often regarded in the outside world as the highest honour which Cambridge can confer, has often been bestowed on men who have proved unequal to the task of securing the highest place in Part ii. The announcement that a lady had been placed "above the Senior Wrangler" caused the greatest excitement throughout the country; but the fact that on another occasion the only candidate who secured a first division in Part ii. was a lady passed almost unnoticed. Still, it cannot but be regretted that because the Senior Wrangler has not always subsequently proved himself the best man of his year, the University should contemplate altogether abolishing the old title of Senior Wrangler, and that even "wranglers," "senior optimes" and "junior optimes," may soon be a thing of the past. When the Tripos was first divided into two parts, one of the mathematical authorities best qualified to judge considered it desirable that the title of Senior Wrangler should be given to the best candidate in Part ii. This was not done, and hence the position of Senior Wrangler has for many years been an anomalous one, and we have been irresistibly drifting in the direction of abolishing the title altogether. But why should not the first division in Part ii. be called "Senior Wranglers?" The number who obtain a first division in any year is very small, often not more than two, and these are surely no unworthy successors to the senior wranglers of the past. Moreover, by this means the competition for place would be avoided, each candidate being judged on his merits irrespective of whether he was in a strong year or a weak one, and the present anomaly of the second or third or even lower wranglers in a strong year being better than the senior in a weak one would be obviated.

Such a proposal is not inconsistent with the changes in the examinations proposed by the Board. The plea for the retention of the old titles is no question of sentiment. The mathematical school of Cambridge has, under the "coaching" system, taken a unique position in the educational system of the country, and it is but right that Cambridge honour-men should retain the marks of distinction which at present distinguish them from graduates of modern Universities. These marks of distinction are well known to the world at large, and may enable their possessors to carry greater weight in insisting on the importance of providing efficient mathematical teaching in our schools, and adequate endowments for the mathematical schools of our provincial University Colleges. Too often these schools and colleges are controlled by councils and governors consisting of business men, with whom the name "Senior Wrangler" carries weight, but who only look to the "main chance," and who see no use in encouraging mathematics because they do not understand it and think it "unpractical." In encouraging the purely experimental side of science there is a danger of neglecting that training which is needed to enable logical conclusions and practical applications to be deduced from experiments. It is, therefore, important that the old titles should be retained, not only to enable their bearers to point out that they have been trained in the same school which has produced so many of our best physicists, including a Maxwell and a Kelvin, and has thus contributed so greatly to the advancement of Applied Science, but also to encourage others to submit to that rigorous mathematical training without the fruits of which even the most practical of "practical men" would soon come to a standstill.

G. H. BRYAN.

Floating Stones.

THE correspondence on "Floating Stones" brings to my mind a phenomenon I often noticed about ten years ago, when my work caused me to spend a good deal of time on the upper reaches of the River Mersey, of patches of earth floating down the river on the surface of the water. This occurred during the early part of the ebb tide and on water obviously contributed by the river. I concluded that this earth was detached from the banks during the quiescent period of high water, and that the surface tension of the water was so increased by the strength of the effluents from the manufactories and other sources, that lumps of earth, often several inches in area and of appreciable thickness, were enabled to float. Unless the conditions have since changed, no doubt the same thing may still be observed.

Coopers Hill, February 3. A. W. BRIGHTMORE.

ENGINEERING AT CAMBRIDGE.

ON Friday, February 2, a large and important addition to the Engineering Department of the University of Cambridge was inaugurated by Lord Kelvin, as a memorial to the late Dr. John Hopkinson, and his son, John Gustave Hopkinson. In August 1898, only a few days before the terrible accident by which he lost his life, Dr. Hopkinson had discussed with Prof. Ewing the rapid growth of this department, and the urgent need for its extension, and had expressed his intention of starting a fresh movement among engineers to secure the necessary funds. In October of the same year, Mrs. Hopkinson communicated to the Vice-Chancellor of the University the desire of herself and her son and daughter to give

5000*l.* towards the extension of the laboratory, regarding this as a "peculiarly fitting memorial" to one who from the first had been warmly interested in the school, and who had so lately expressed a strong desire to assist in furthering its development.

A site was at once available, as a plot adjoining the existing laboratory had previously been assigned to the department. The design of the new buildings was entrusted to Mr. W. C. Marshall, of Messrs. Marshall and Vickers, and on November 29, 1898, the Senate of the University authorised a syndicate to proceed with the erection of the new wing at a cost not exceeding 5000*l.*, and decreed "that the gift of Mrs. Hopkinson and her family be applied to this purpose, and that the wing be called the Hopkinson Memorial Wing." It was at the same time agreed that 500*l.* should be provided by the University to cover the cost of certain structural alterations to the existing laboratory and other subsidiary works. It is understood that the whole of the work now completed has, if at all, only slightly exceeded the estimate of 5500*l.*

The Hopkinson wing is a block about 92 feet long and 40 feet wide. On the ground floor is a large laboratory, which has been assigned to elasticity and hydraulics, and a smaller room, which will be used as a dynamo room. On the first floor is the new lecture theatre, with preparation room adjoining, and a large room, which at present is occupied partly as an additional lecture room and partly as a supplementary drawing office. On the third floor, three smaller rooms, adapted to purposes of research, have been provided. A wedge-shaped space between the old building and the new has been roofed over with glass, and forms a very useful addition to the large elasticity laboratory.

The opening ceremony on Friday last was presided over by the Vice-Chancellor (the Master of Emmanuel), and was attended by a large number of residents, by a considerable gathering of well-known engineers, and other friends of the late Dr. Hopkinson, and by many present and former students of the department. The Vice-Chancellor, in opening the proceedings, referred to Dr. Hopkinson's distinguished career at Cambridge, and conveyed to Mrs. Hopkinson, on behalf of the University, "the assurance of their sympathy and of their gratitude to her and to her children for the noble benefaction with which they have enriched the University in the name of husband and father."

Lord Kelvin, in his address, spoke of Dr. Hopkinson's rare power of grasping a scientific truth and of applying it practically to mechanical art for the use of mankind. He illustrated this power by reference to his work on dynamo-electric machines and on methods of distribution of electric light and power, to his discoveries in nickel and steel alloys, and to his group-flashing light, "a splendid application of scientific optics now in use in lighthouses and light-ships all over the world." Touching on the growth, at Cambridge, of the study of physical science, both on its theoretical and its practical side, he mentioned that when Dr. Hopkinson was an undergraduate, less than thirty years ago, the only experiments he had an opportunity of seeing were those with which Sir G. Stokes illustrated his lectures. Since then matters had progressed, and we had seen, on the one hand, the development of the Cavendish laboratory, founded by the late Duke of Devonshire, and conducted by Clerk Maxwell, by Lord Rayleigh, and now by Prof. J. J. Thomson; and, on the other hand, the establishment of the engineering workshops by Prof. James Stuart, and their development under Prof. Ewing into an organised school for the study of scientific engineering and of engineering laboratory practice.

Lord Kelvin further made reference to the great value of Prof. Ewing's work, to his researches in magnetism and electricity, and in many other branches of science, to his admirable text-books on steam, on strength of materials and on magnetism, to his untiring energy in developing the work and resources of the engineering department, and to the excellent research work now being done in it under his direction. In conclusion, Lord Kelvin announced that he was commissioned by the directors of the Linotype Company to offer, for the acceptance of the University, a bust of Dr. Hopkinson.

In proposing a vote of thanks to Lord Kelvin, Prof. Ewing expressed his sense of obligation to the many friends, both in the University and without, who, by gifts of money, had made it possible for a laboratory to exist, and by gifts of apparatus that assisted so much in its development and growth. He announced that he had received by telegram the promise of a valuable set of polyphase plant from the British Westinghouse Company. The vote of thanks was seconded by Principal Hopkinson, of Owens College, Manchester.

The Master of Trinity then unveiled an excellent portrait of Dr. Hopkinson, painted by Mr. T. B. Kennington, and presented to the laboratory by subscribers. This has been hung in the principal room of the new wing, and a replica has been presented to Mrs. Hopkinson. For this, thanks were returned to the subscribers by Mr. Bertram Hopkinson. A vote of thanks to the Master of Trinity, proposed by Sir Douglas Fox, President of the Institution of Civil Engineers, closed the formal proceedings. Prof. and Mrs. Ewing afterwards held a reception in the laboratory, and the guests were enabled to examine at leisure the large collection of apparatus with which both the old and the new parts of the building are furnished.

A short account of the growth of the Engineering School in Cambridge may not be out of place. A professorship of mechanism and applied mechanics was founded in 1875, and the first holder of the chair, Prof. James Stuart, established workshops, which afterwards became the property of the University. In these, practical instruction was given in pattern-making, forging, turning and fitting. About the same time an examination in mechanism and applied science was established as one of the special avenues to the ordinary B.A. degree.

Prof. Ewing was appointed to succeed Prof. Stuart in 1890, and at once took up the task of forming an engineering laboratory, and of organising a more complete school of applied science. A site was granted by the University; a sum of 5000*l.* was raised, largely by the efforts of a strong committee of prominent engineers; and this, with an additional 1000*l.* granted by the University, was applied to adapting and extending the buildings of the old Perse School. At the same time a great impetus was given to the work of the department when the University sanctioned the granting of honour degrees by the establishment of the Mechanical Sciences Tripos. The new laboratory, which was opened by Lord Kelvin in 1894, though sufficient for the seventy students then in attendance, soon became overcrowded, until, during the last few years, a considerable proportion of the lectures have been delivered in rooms borrowed from other departments. The growth of the department may be seen at a glance at the following table:—

Year.	Number of Students.	Amount paid in fees. £
1892	39	546
1893	71	1269
1894	73	1541
1895	84	1706
1896	88	2043
1897	103	2338
1898	112	2534
1899	123	2915
1900	150 now in attendance.	

The work of the department has been carried on mainly on the lines of the syllabus for the Mechanical

Sciences Tripos Examination as established in 1893. Regular courses of lectures are given in mathematics, mechanics, principles of mechanism and machine dynamics, strength of materials and theory of structures, heat and heat engines, and applied electricity. Instruction is also given in geometrical and mechanical drawing, and in graphic statics. In the laboratory there are regular courses in mechanics, elasticity, heat, the testing of steam, gas and other heat engines, applied electricity, and hydraulics. In the summer term there are lectures and field-work in surveying. Practice in the use of tools for wood-work and metal-work forms a regular part of the course, and at the same time the workshops, in which a considerable staff is employed, constitute a very useful adjunct to the laboratory.

During the past few years research has been taking a more and more prominent place in the work of the department, and with the larger space and special rooms now available further development in this direction may be looked for. At present a number of research students are at work in the elasticity, the electrical, and the steam laboratories. Evidence of the value of this work may be found in the current volume of the Royal Society's *Transactions*, where two papers, one, by Prof. Ewing and Mr. Rosenhain, on "The Microscopic Structure of Metals" (the Bakerian Lecture), the other, by Mr. J. Muir, on "The Recovery of Metals from Overstrain," deal with work which has been entirely carried on in the department.

The University grants an annual sum of between 1200*l.* and 1300*l.*, from which are paid the salaries of the Professor and the two University Demonstrators (1000*l.* in all), part of the wages of the workshop staff, and some other expenses. From the students' fees, which form the main source of revenue, are paid the salaries of four or five assistant demonstrators and lecturers, as well as the greater part of the wages of the workmen and laboratory attendants.

Many valuable gifts of apparatus have been made to the department during the past six years, and many pieces of heavy machinery have been supplied by engineering firms on specially favourable terms. A high speed compound combined engine and dynamo set, on which regular tests are made, was presented by Messrs. Mather and Platt in 1894. Recently a coupled set of two dynamos arranged for the Hopkinson test has been given by Messrs. Siemens Brothers and Company, and a gas engine of about ten horse-power by the Forward Engineering Company of Birmingham. A very valuable microscope, specially designed for the microscopic study of metals, was lately presented by Mr. Thomas Andrews, F.R.S. Among other recent additions are a five-ton testing machine by Messrs. Buckton and Co., presented by past and present pupils; and a set, comprising turbine, motor and pump, supplied by Messrs. Mather and Platt. Towards the further equipment of the laboratory a sum of 1200*l.* has recently been subscribed, and there is now on order from Messrs. Robey and Co. a compound horizontal engine of about fifty horse-power, specially arranged for testing purposes. This will form a very useful addition to the steam laboratory.

There can be no doubt that the Engineering Department has established for itself, under Prof. Ewing, a firm foothold among the scientific schools of the University. At the same time, if it is to take, as it may reasonably aspire to do, a foremost place among British Schools of Engineering, it must look to provide a wider curriculum. The laboratories necessary for the proper teaching of such subjects as mining, metallurgy and naval architecture, as well as for keeping abreast of the latest developments of the subjects already represented, cannot be founded or maintained without an endowment of an amount far exceeding the sums already so generously contributed.

While it is admitted that the establishment of the department was looked upon by some with misgiving, as an encroachment on the more purely academic studies of the University, it is certainly true now, as the Vice-Chancellor said on Friday last, that the great majority of resident members welcome the establishment of the department, and rejoice in its flourishing and successful state; and it is also true that the growth of this cordial recognition is due in no small degree to the support which has been so freely given by the engineering world outside the University. This view of the matter is supported by the *Times* when it says, in reviewing the inauguration we have just described, that "it is pleasant to see one of our old Universities, while remaining faithful to all the traditions of its venerable past, at the same time displaying an intelligent appreciation of the wants of the future, and affording to the most modern forms of learning the nurture and support which for many centuries it has afforded to those forms with which alone our forefathers were familiar."

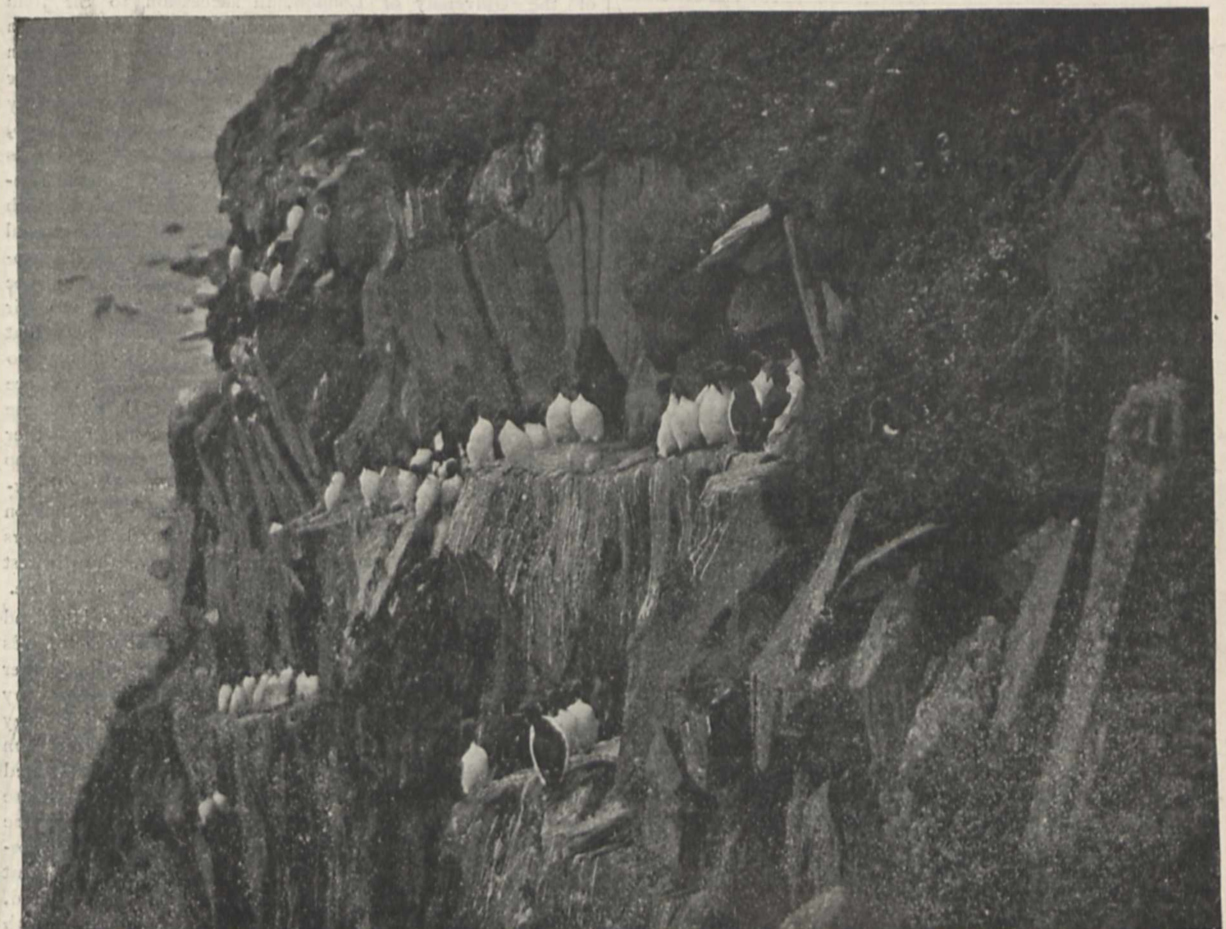
THE NATURAL HISTORY OF THE SHORES OF BARENTS SEA.[1]

IN the summer of 1895 Mr. H. J. Pearson and a party of fellow naturalists visited the Barents Sea to study the birds that nest upon its shores. The party landed on Kolguev and Novaya Zemlya, and at one of the promontories on the Murman Coast. Many interesting observations were made on the natural history of the region, but work was hampered by the small size and limited coal capacity of their yacht, the *Saxon*. Two years later Mr. Pearson returned in a larger and more powerful vessel. The main object of the second journey was the investigation of the avifauna of the coastlands of north-eastern Russia, between the Pechora and the Urals, an area which the author describes as "ornithologically unknown." In the summer this country is accessible only from the sea, owing to the vast extent of flood and swamp. Mr. Pearson accordingly chartered the *Laura*, and, accompanied by Colonel Feilden and Mr. F. Curtis, left Tromso for the Pechora coastlands in June, 1897. The scheme was to land near the mouth of the Karataikha River. But the *Laura* could not approach nearer than twenty miles from the mouth of the river, and it was not considered safe to leave the steamer in the open bay for eight hours while the entrance was reconnoitred in the launch. Mr. Pearson was therefore reluctantly compelled "to abandon the chief object of the expedition as impracticable from the sea." The steamer was turned northward, and the rest of the season was spent in visits to Dolgoi Island, "Waigatch" and Novaya Zemlya.

"Beyond Pechora Northward" would therefore have been a more accurate title for the book, as except at the port of Habarova, the expedition did not alight on the mainland east of the Pechora. But in the islands of the Barents Sea, Mr. Pearson and his colleagues did excellent work, some of the results of which have been published in the *Ibis* and the *Journal* of the Geological Society. Mr. Pearson's book gives a detailed narrative of the two cruises, with appendices on the botanical and geological results by Colonel Feilden, Prof. Bonney and Messrs. E. T. Newton and A. C. Seward. It is no disparagement of Mr. Pearson's work to say that the appendices contain the greater amount of new information, as this is one of the indications of the more advanced state of ornithological knowledge. Owing to the wide range of the Palæarctic fauna, the discovery of new birds was not to be expected. There was even

[1] "Beyond Petsora Eastward: Two Summer Voyages to Novaya Zemlya and the Islands of Barents Sea." By H. J. Pearson. With Appendices on the Botany and Geology by Colonel H. W. Feilden. Pp. xiv + 335. (London: R. H. Porter, 1899.)

little scope for collecting hitherto unknown eggs, as Mr. Popham had in the same season already found the nest of the curlew sandpiper, thus, according to Mr. Pearson, gaining the "blue ribbon of the oological world." The main zoological object was the observation of new facts relating to the habits and nesting plumage of the birds that breed round the Barents Sea. The results are illustrated by a valuable series of photographs, including those of nests of the dotterel, red-throated diver, little stint, peregrine falcon and purple sandpiper, and the young of the rough-legged buzzard. The first young Bewick swans brought to England were collected during the expedition, which also obtained many eggs of the little stint. The finding of the first nest of this bird



Brünnich's Guillemots. (Nameless Bay.)

Mr. Pearson describes as one of those "few joyful moments that stand out clear and sharp in the memory, and will never be forgotten while life lasts." The largest egg collection made was of Brünnich's guillemot; 440 specimens were obtained from one small cliff. The series showed extreme colour-variation, and as the birds were feeding on the same food and the eggs were laid under identical conditions, Mr. Pearson thinks that "it is scarcely possible these abnormal variations can serve any useful purpose." He commends this problem to other naturalists, as "this subject of the coloration of eggs is truly one of which we may be said to know nothing yet." Unfortunately no material contribution to such problems is made in this book, as short dashes on shore from a steamer do not offer much opportunity for their study.

The same conditions have limited Colonel Feilden's work on botany and geology. An extensive series of plants was collected, enabling Mr. Burkill to make some collections and additions to the floral lists of this region. The physiological problems of the Arctic flora, such as those discussed in Ekstam's paper on the flora of Novaya Zemlya, require careful study on a small area, rather than rapid collecting during a lengthy cruise. Geological progress in this region also now requires continuous work on shore. The general outlines have been long well known. Thus, the mapping of the eastern side of Dolgaya Bay, where Colonel Feilden corrects the Russian Index Map (1892), was correctly represented in Keyserling's map of 1846. Rapid reconnaissances from the sea cannot now yield such important results as zonal collecting in the palæozoic rocks, accurate mapping of small areas of the Archæan series, and careful analyses of the glacial gravels. The only point in the book open to serious criticism is the lack of system in the spelling of the proper names. As so much of the literature on this region is in Russian, it is a pity to add uncertainty regarding names to the existing difficulties. Some words, such as Habarova, are rendered phonetically; others, such as Waïgatch (Pearson) or Waigats (Feilden) may be concessions to convention; but others, such as Petsora and Matyushin, appear inexplicable. The two authors use different renderings of the same name, and one at least of them has no consistent system. Thus, one island appears as Meshdoshapsk in the map and text, and as Meshdusharsky in the appendix; the name of a well-known Russian geologist appears as Chernysheff and Tscherneyschew (p. 288); the letters, which are translitered (p. 266) as "aya" in the case of Novaya, are abridged to "a" in the name Dolgaya, which therefore appears as Dolga. Belootchia and Belushja are no doubt renderings of the same word. But nomenclature is after all a matter of detail, and Mr. Pearson and Colonel Feilden are to be congratulated on a valuable contribution to the natural history of one of the least known regions of Europe.

J. W. G.

INTERNATIONAL COMMITTEE OF WEIGHTS AND MEASURES.[1]

THE International Committee of Weights and Measures at Paris issue from time to time "Travaux et Mémoires" with reference to the investigations and comparisons undertaken at their Bureau during certain periods. Ten such volumes have been published since 1881—Tome i. to Tome xi.—and during last year a further volume, Tome ix., was distributed. This latter volume contains the final account by Dr. J. René Benoit and Dr. Max Thiesen of the comparisons made at the Bureau of forty standard kilograms, "Prototypes nationaux" with the "Prototype International K," which is kept at the Bureau. These national standard kilograms have long since been forwarded by the Committee to the several High Contracting States who (including Great Britain) have joined the Metric Convention of 1875; and the introductory account of the comparisons of these standards was given in Tome viii. (1893), the final account having only now been issued, although it deals with comparisons made so far back as 1884.

The unit of mass of the kilogram is determined by a solid piece of metal, iridio-platinum, in the form of a cylinder (of the height and diameter of 30 millimetres), and the comparisons of the forty cylinders included weighings in air and in water; the numerous observations made by Dr. Thiesen being stated in detail in Tome ix., the observations and reductions of the hydrostatic weighings alone occupying 229 pages of this large volume. The balances used were made by M. Bunge, of Hamburg (1879), and more recently by Messrs. A. Ruprecht and H. Schoss, of Vienna. Of the Bunge Balance an illustrated description is given in Tome ix., and of the original Ruprecht Balance in Tome i. of "Le Travaux et Mémoires." The balances were so designed that any two kilograms under comparison could be automatically interchanged from one side of the balance to the other without disturbing the balance-case, and any minute weights could be added to either pan by the observer without approaching the case. The results appear to have been highly satisfactory, the probable error of a final comparison of two kilograms not exceeding 0·002 mg. Such comparisons are inexhaustible, and therefore it is not surprising to find that no two of the kilograms were found to be absolutely alike.

The final density of the standard kilogram, No. 18, forwarded to Great Britain, appears to have been 21·5454, corresponding to a volume 0° C of 46·414 millilitres. The actual difference of No. 18 from the true kilogram was found to be :—No. 18 = K + 0·070 mg.

By the Weights and Measures (Metric System) Act, 1897, it is provided that "No. 18" is to be the legal standard of this country, from which all other metric weights and all measures having reference to weight are ascertained; and its precise equivalent in terms of the pound avoirdupois has been found to be 2·20462234 lb., or the pound equals 0·45359243 kg.

The investigations of this Bureau as to modes of weighing and methods of reduction, have attracted the attention of all engaged in exact metrological inquiry, the results of the investigations being referred to in modern text-books on physical science; and in the present volume the several corrections and reductions found to be necessary in the precise weighings made by Dr. Thiesen during the years 1884-8 are fully stated in his excellent account.

1 "Travaux et Mémoires du Bureau International des poids et mesures." (Paris, 1898.)

NOTES.

THE poll for the election of a Parliamentary representative of the University of London, in succession to Sir John Lubbock, opened on Tuesday morning, and will close on Saturday. The result will be declared at the University on Monday next, at noon. On Tuesday evening the number of votes recorded for each of the candidates was officially declared to be: Sir Michael Foster 255, Dr. Collins 156, and Mr. Busk 119, and we trust that when the poll is declared next Monday the numbers will be of the same relative order of magnitude. Graduates of a University which promises to become in the near future an even more powerful means of promoting scientific interests and encouraging intellectual activities than it has been in the past, should see for themselves that the return of any other candidate than Sir Michael Foster would be disastrous. It is unfortunate that sharp electioneering practice induced a number of the graduates to give their names as supporters of Mr. Busk and Dr. Collins before Sir Michael Foster entered the lists; but if they have the courage of their convictions they will seriously consider whether a promise made without a knowledge of the candidates who would contest the seat should not be withdrawn. Petty differences of opinion and individual grievances ought to be put on one side upon an occasion like the present, and the electors should vote for the candidate who would have the greatest influence upon the advancement of the University as a whole.

SOME weeks ago we expressed surprise that the Highland Agricultural Society of Scotland had not contributed towards the cost of Prof. Ewart's experiments on telegony and other subjects of special interest to breeders. From a contemporary we learn that the Society last week voted 200*l*. in aid of the very costly investigations, and that the former chairman (Sir John Gilmour), in a letter urging the secretary to make a grant, stated that he intended sending a donation of 50*l*., and expressed the hope that others would follow his example. As there was some danger of the work collapsing for want of funds, this is altogether satisfactory. Though science in the past, to the great loss of the nation, has too often been systematically ignored, better times may be coming, for the new century may bring with it a higher appreciation of scientific methods, and thus keep us abreast with the spirit of the age.

IN his lecture at the Royal Institution on Friday last, Mr. Marconi made a statement as to the use of his system of wireless telegraphy in connection with the war. He is reported by the *Times* to have said that six of his assistants have been sent out to South Africa. The War Office intended that the wireless telegraph should only be used at the base and on the railways; but the officers on the spot, realising it could only be of practical use at the front, asked if the assistants were willing to go to the front, and accordingly on December 11 they moved up to De Aar. The results at first were not altogether satisfactory, owing to the want of poles, kites, or balloons, which are needed to elevate the vertical wires; but the difficulty was overcome by the manufacture of kites, in which work Major Baden-Powell and Captain Kennedy, R.E., took part. It has been reported that the difficulty was due to the iron in the hills, but, as a matter of fact, iron has no more destructive effect on these Hertzian waves than any other metal, and Mr. Marconi has been able to transmit messages across the high buildings of New York, the upper stories of which are iron. However, when kites were provided, it was easy to communicate from De Aar to Orange River—some 70 miles—and now there are stations at Modder River, Enslin, Belmont, Orange River, and De Aar. Two of the assistants volunteered to take instruments through the Boer lines to Kimberley, but the military authorities would not grant them permission, as probably too great risk was involved. It seemed to Mr. Marconi regrettable that installations were not established in Ladysmith, Mafeking, and Kimberley before the commencement of hostilities, but he found it hard to believe that the Boers had any workable instruments. Some intended for them, which were seized at Cape Town, were of German manufacture, and not workable, and Mr. Marconi said that as he had supplied no apparatus to any one, the Boers could not possibly have any of his instruments. In conclusion, he said he did not like to dwell on what might be done in the immediate or distant future. But he was sure that the progress made this year would greatly surpass what had been accomplished during the last twelve months, and, speaking what he believed to be sober sense, he said that by means of wireless telegraphy telegrams would become as common and as much in daily use on the sea as they are at present on the land.

THE Government have placed a number of commissions in the army at the disposal of the Chancellors of all the British and Irish Universities, and some of the Colleges of University rank.

THE Turin Academy of Sciences has awarded the Bressa prize of 10,000 lire (400*l.*), for the best scientific work published during the past four years, to Prof. Ernst Haeckel, of Jena.

PROF. MITTAG-LEFFLER has been elected a correspondant of the Paris Academy of Sciences in the section of geometry, and M. Bienaymé has been elected a correspondant in the section of geography and navigation.

THE two candidates whose names have been submitted to the Minister of Public Instruction by the Paris Academy of Sciences for the chair of comparative embryology at the College de France, are M. Henneguy and M. Roule, the former occupying the first place.

PROF. RÖNTGEN, who has accepted the call to the University of Munich, has been appointed director of the State institute of physics and metrology.

ANNOUNCEMENT is made in the *London Gazette* that, after the expiration of forty days from February 6, it is proposed to submit to Her Majesty in Council the draft of an Order in Council providing that acetylene, when in admixture with atmospheric air or with oxygen, shall be deemed to be an explosive within the meaning of the Explosives Act, 1875, and that it shall not be manufactured, imported, kept, conveyed, or sold.

THE New York correspondent of the *Times* announces that the British Ambassador and the Secretary of State signed the new Nicaragua Canal Convention on Monday, and it will be sent to the Senate at once for ratification. In connection with the Convention, England asks for nothing for her concession of the right of objection to the canal. Both nations treat the matter as of deep importance to the whole world. The canal is to be neutral. The United States will build and manage it, but their position will be much the same as that of England in reference to the Suez Canal.

THE sixty-eighth annual meeting of the British Medical Association will be held at Ipswich on July 31–August 3. The president-elect is Dr. W. A. Elliston. An address in medicine will be delivered by Dr. P. H. Pye-Smith, F.R.S., and one in surgery by Mr. F. Treves. The scientific business of the meeting will be conducted in thirteen sections as usual.

THE *British Medical Journal* states that the sum of 98,000 dollars left by Mrs. C. B. Croft for the furtherance of the systematic study of cancer has now been paid to the Harvard University, and will be administered by the Department of Surgery of the Medical School of that University. Dr. E. H. Nichols has been appointed to an office under the trust, and will shortly visit English and continental laboratories for the purpose of investigating the work now being done in them.

THROUGH the enterprise of Prof. Conway M'Millan, a Botanical Art Gallery has been commenced during the past season in connection with the University of Minnesota. It consists of a collection of photographs from nature intended to illustrate the flora of the State, and is at present limited to portraits of the plants themselves in their habitats, and ecological groups.

LARGELY through the exertions of Mr. Thomas Meehan, we learn from the *Botanical Gazette*, the City of Philadelphia has acquired the dwelling and a part of the grounds which belonged to James Logan, one of the founders, along with William Penn, of the State of Pennsylvania. Logan was a distinguished botanist, the genus *Logania* (and natural order Loganiaceæ) having been named after him. The property will be known as Stenton Park.

THE Herbarium of the New York Botanic Gardens has acquired a collection of plants made in the Yukon Territory by Mr. R. S. Williams, which is believed to be the first made in the Klondike region.

FOUR botanical organisations will meet in New York during the last week in June:—the Botanical Society of America, the Botanical Section of the American Association for the advancement of Science, the Botanical Club of the same Association, and the Society for Plant Physiology and Morphology.

ON Friday last Mr. William Whitaker, F.R.S., President of the Geological Society, was elected President of the Geologists' Association. Never before have the two presidential chairs been occupied by the same individual. It is announced also that the ex-President of the Geologists' Association, Mr. J. J. H. Teall, F.R.S., is the President-elect of the Geological Society.

THE replies which the Duke of Devonshire and Mr. Ritchie gave to the deputation which waited upon them on Monday, to present a memorial asking for the continued maintenance of the Buckland Museum of Economic Fish Culture, were as satisfactory as could be expected. The deputation had two main objects; first, to ask that the museum should be permitted to remain where it is now, in the Victoria and Albert Museum at South Kensington; and next, that it should be placed under the Fishery Department of the Board of Trade. With regard to the first point, the Committee appointed by the Treasury, and the more recent Select Committee of the House of Commons, reported against the retention of the museum in its present position. There is no question as to the value of the collection—the only doubt is whether it is rightly situated; and in replying to the deputation, the Duke of Devonshire expressed the opinion that a change of position would be desirable. The place in which the museum is situated is, however, not such an important consideration as the means for keeping it in good condition, adding to it from time to time, and making it a scientific laboratory in which experimental pisciculture can be systematically carried on. At present no such funds are available; for, as the Duke of Devonshire frankly remarked, "It has not been thought necessary for the Government to do so much for the fishing industry of England as is done by a great many foreign countries, notably by the United States, or even as much as is done for Irish and Scotch Fisheries." If the Treasury will provide the means by which the museum may be properly housed at South Kensington or elsewhere, Mr. Ritchie said the Board of Trade would undertake the working of it. The interests of science will be served if, in whatever changes are made, it is borne in mind that "the museum is not for the purpose of exhibiting models, or attracting the attention of the curious, but a means to an end, the end being proper investigation and research into the habits of fish, and other matters, with a view to developing the industry in the way it ought to be developed."

WE learn from the *Lancet* that the president of the Board of Agriculture has appointed a departmental committee to inquire and report as to what regulations may be made by the Board in regard to the standards of quality of milk and cream. The difficulty in connection with proceedings taken under the Sale of Food and Drugs Act has been to differentiate exactly between abnormal milk, or milk which has been watered or from which cream has been abstracted. It is to be hoped that the long-vexed question of what is and what is not genuine milk or cream may be decided by this committee by recommending a system of fair standards. The committee will consist of the following gentlemen:—Lord Wenlock (chairman), Mr. George Barham, Mr. George Cowan, Major Patrick George Craigie, Mr. S. W. Farmer, Mr. Shirley Murphy, Prof. Thorpe, and Mr. J. Augustus Voelcker. Mr. R. H. Rew (of the Board of Agriculture) will serve as secretary to the committee.

WE regret to learn that Sir Thomas Grainger Stewart, the well-known Edinburgh physician, died last Saturday. He will be missed by a large circle of friends and pupils, who will find it difficult to replace their loss. Sir Thomas received his education, both scholastic and collegiate, in Edinburgh; at the completion of his medical curriculum he travelled abroad, and studied in Berlin, Prague, and Vienna. He gave during this time especial attention to medical pathology, and was fortunate to be in this branch of learning a pupil of Virchow and the veteran Rokitansky. The late professor's most important contribution to medical literature was the book published by him in 1868 on "Bright's Disease of the Kidneys" The book is a thorough and extensive description of the various renal affections comprehended under this term, with many plates illustrating, from cases under the author's observation, the pathological anatomy of this malady. Chemistry and physics, since the publication of this work, have shed considerable light upon the subject. The book also contains supplementary chapters upon other renal affections. In 1884 Prof. Stewart published a small work, entitled "An Introduction to the Study of the Diseases of the Nervous System," being the subject-matter of a course of lectures delivered by him. In 1888 Fasciculus II. of his clinical lectures on important symptoms, entitled "Albuminuria," appeared. This is a carefully written and instructive monograph, comprising several lectures, upon the varieties of albuminuria, the cause and clinical significance of this symptom. In 1893 an important clinical paper on "Grave's Disease" was published by Sir Thomas in the Edinburgh Hospital Reports. In 1882 Dr. Stewart was appointed Physician to the Queen in Scotland, and in 1894 received the honour of Knighthood, being nominated by Lord Rosebery. In addition, he received many honorary degrees from English and foreign universities and learned societies. He was frequently to be seen in an official capacity at congresses and medical reunions, and invariably shone in their environment. His private practice was large, and he will be greatly missed by many who owe to his care and skill their health and happiness. In Edinburgh he was active in connection with medical mission work, and this organisation will find it difficult to replace him.

THE death of M. Marion, professor in the faculty of sciences in Marseilles University, and director of the natural history museum there, was recently announced. M. Marion was a correspondant of the Paris Academy, in the section of anatomy of zoology. At Marseilles he gathered round him numerous students, and created interest in zoological researches. In the Endoume marine laboratory he investigated the organisms of the Gulf of Lions, and questions relating to pisciculture. He took part in all the dredging trips of the *Travailleur* and the *Talisman*, and collected much valuable material for study. The investigations made by his pupils and himself are described in the *Annales du Museum de Marseille*.

THE annual meeting of the Anthropological Institute was held on Tuesday, January 30. The treasurer's report showed an improved financial position, and an increased membership. The President, Mr. C. H. Read, delivered an address, in which he discussed the progress of anthropological studies during the year, with special reference to the problems which have been more especially subjects of discussion. He explained the prospects, and mode of working, of the proposed bureau of ethnology, and indicated the directions in which increased activity is to be expected or encouraged in the near future, concluding with an eloquent tribute to the memory of the late Sir W. H. Flower, one of the most valued supporters of the Institute, and a past president. The election of officers for 1900 resulted in the appointment of Mr. Read as president, Mr. A. L. Lewis as treasurer, and Mr. J. L. Myers as secretary.

THE Berlin correspondent of the *Standard* announces that the Royal Prussian Meteorological Institute in Berlin is about to make arrangements for the systematic examination of the higher strata of the atmosphere by means of special apparatus. In the grounds of the Aeronautical Observatory at Tegel—a suburb of Berlin where Alexander and William von Humboldt were buried—registrations of the atmospheric conditions at a height of three to five thousand metres will be carried on, if possible, day and night, with kites and kite-balloons. The registering apparatus, which automatically records the pressure, temperature, humidity, and wind velocity, at these heights, is taken up by a kite-balloon connected with the earth by piano wire. An elevation of four thousand five hundred metres has been attained by a train of kites even without balloons, when there was sufficient wind.

MR. W. H. MALLOCK has versified parts of Lucretius—the Roman poet of science—in the metre employed by FitzGerald in Omar Khayyám's "Rubaiyat." The following two stanzas, which we quote from the *Academy*, bring to mind Tennyson's inspired lines on the same themes:—

Globed from the atoms falling slow or swift
I see the suns, I see the systems lift
Their forms; and even the systems and the suns
Shall go back slowly to the eternal drift.

Those blue and shining seas in delicate haze
Shall go; and yonder sands forsake their place;
And where they are, shall other seas in turn
Mow with their scythes of whiteness other bays.

THE *Photogram* directs attention to the fact that February 11 is the centenary of the birth of William Henry Fox Talbot,—the father of photography. To obtain for Talbot's work fuller recognition than is usually given, the *Photogram* has commenced the publication of a series of articles on the early history of photography. Our readers may remember that a proposal has been made, and has received some support, to restore the chancel of Lacock Church, Wiltshire, as a memorial to Fox Talbot. There is, at present, no other monumental record of him than a short inscription on his gravestone in the Lacock cemetery. Subscriptions in aid of the proposed memorial, the cost of which is estimated at 1000*l*, should be sent to Mr. C. H. Talbot, The Abbey, Lacock, Chippenham, or to the Fox Talbot Memorial Fund, Capital and Counties Bank, Chippenham.

THE proposal to generate electricity on the Canadian side of the Niagara and to sell electric power on the American side, has caused a flutter of excitement among American electricians. The New York *Electrical Review* states that the question has been raised whether foreign-made electricity is not subject to a duty of ten per cent *ad valorem* as an "unenumerated manufactured article." This question has produced a flood of debate, and while it is purely hypothetical as yet, the Merchants' Exchange of Buffalo and the Niagara Falls Power Company, have gone so far as to pass resolutions opposing such taxation. Those who desire discrimination in favour of home-made electricity argue that electric power is a vendable and valuable product of manufacture; that it can be measured easily and accurately, and that foreign-made electricity should pay duty equally with foreign-made cloth or wine. Those who believe in free trade in electricity point out that it is not an article, that it is not valuable or sold or saleable, that it has no power to do work, but only serves as a means of transmitting power, and that it is utterly impossible to import it because it instantly returns to its source.

AN address which Dr. H. R. Mill delivered before the Royal Geographical Society on Monday last, and which will no doubt appear in due course in the *Geographical Journal*, should be brought before the attention of every local scientific society. The subject was the geography of south-west Sussex, and the object was to show how the geological and topographical structures, the meteorological conditions, agricultural products, industries, and distribution of population are related to one another. With the Ordnance Survey maps as a basis, the district was subjected to minute geographical analysis, and many interesting connections were brought out. Geologically, the area examined is made up of the low-lying Tertiary clays, marls, sands, and pebble-beds on the coast, the chalk forming the South Downs a few miles behind, and the Greensand and Weald Clay north of it. As an example of the different characteristics and productive capacities of these three divisions, the following tabular statement is instructive:—

	Plain.	Hill.	Valley,
Average elevation	30 ft.	400	150
Formation	Tertiary	Chalk	Greensands
Rainfall	27 in.	36 in.	34 in.
Woodlands	4%	30%	20%
Pastures	26%	50%	48%
Arable land	60%	20%	32%
Wheat (bushels per acre)	40	35	36
Density of population (per square mile)...	400	10	200

The numbers are only approximate, but they serve to exhibit the chief differences between the three areas. The comparison suggests that, in this case at all events, the geology of the district is the controlling influence, but Dr. Mill pointed out that just as striking differences could be found in areas of a single geological formation, and that it was the function of geography to discover the causes, geological or otherwise, which produced them. His survey was a model which should inspire others to inquire into the causes of the relations between the natural and economic conditions of their own districts, and thus provide material with which to construct a geography of the British Isles on scientific lines.

A MEMOIR on the Geology of Belford, Holy Island, and the Farne Islands, by Mr. William Gunn, has just been issued by the Geological Survey. The region is one with which the late George Tate, of Alnwick, for long was intimately associated, until his death in 1871. The work of the Geological Survey was for the most part carried on subsequently, but there has unfortunately been considerable delay in the publication of the memoir. It deals mainly with rocks of Lower Carboniferous age, and contains a full account of the various coal-seams which have been worked in that series. Lists of Carboniferous fossils are given, and there are notes on the Whin Sill and on the Glacial and post-Glacial deposits.

ONE of the most gigantic sanitary works of the day was brought into operation at the beginning of January, when the water was turned into the great drainage canal through which in future the sewage of Chicago is to flow instead of into Lake Michigan, the source from which the city's water supply is drawn. This canal has been seven years in construction, and has cost about 6,000,000*l*. It is 29 miles in length, and has been excavated through glacial drift and solid rock, the width at the bottom through the rock being 160 feet and the depth 22 feet. The flow of water through the canal is to be regulated to 300,000 cubic feet a minute, and the volume of sewage will be 4,200 feet a minute. The constant depth of water in the canal is to be 22 feet, and the rate of flow is to be regulated so as not to exceed one mile an hour, and it has been constructed with the intention that it shall hereafter be used as a ship canal, rendering navigation possible from Lake Michigan, by way of the Illinois and Mississippi rivers, to the Gulf of Mexico. The watershed of this part of America is situated at the head of Lake Michigan, the water from which ultimately flows down the Saint Lawrence, and that to the south of the Lake by the Mississippi to the Gulf of Mexico. This diversion of the water and the question as to what effect it may have in lowering the level of the lake and so affecting the navigation and other water rights have been the subject of considerable discussion and investigation. The general opinion arrived at is that the quantity of water flowing down the canal cannot lower the water in Lake Michigan more than three inches.

THE passage of electricity through rarefied gases forms the subject of a paper by M. E. Bouty in the *Journal de Physique* for January. The author differs from Prof. J. J. Thomson's view (1893) that rarefied gases behave like electrolytes, and in this connection arrives by a different method at conclusions agreeing with those of E. Wiedemann. According to M. Bouty the conductivity of the gas is related in some manner to its luminosity. In studying the electrical properties of gases, we have to consider (1) the dielectric equilibrium in the case of fields of force of less than a certain critical intensity; (2) the modifications produced by electric discharges due to a field exceeding the critical intensity; (3) the determination of the limits separating the two phenomena. The last of these points forms the subject of M. Bouty's present investigations.

THE Summary of the *Weekly Weather Report*, showing the rainfall and mean temperature for the year 1899, and for thirty-four years, 1866 to 1899, has recently been published by the Meteorological Council. The principal features during last year have been the small amount of rain in the summer months, and the high temperature that has persistently prevailed in most districts throughout the year. Over the British Isles generally, the deficiency of rainfall, compared with the mean of thirty-four years, only amounted to 0·6 inch; the greatest deficiencies were England E., 2·8 inches, Midland Counties, 2·6 inches, England S., 2·4 inches, England N.W., 2·9 inches, England S.W., 3·8 inches. In Scotland N., there was an excess of 6·9 inches, Scotland W., 6·3 inches, and in the east of Scotland and south of Ireland there was also an excess of 2¾ inches. In the south of England the rainfall has been below the average during the last five years. The excess of temperature was greatest over the southern portion of the kingdom, although in the northern districts it was also considerable; in the neighbourhood of London the temperature was nearly 2° above the average of fifty years (1841–90). For the British Isles generally, it has been above the mean during the last seven years, with the exception of 1895, in which, it will be remembered, the prolonged frosts of January and February occurred. There was an excess of sunshine over the whole country; in the south of England it amounted to about 350 hours.

WE have received the Report of the Northumberland Sea Fisheries Committee for 1899, in which two points seem worthy of special notice. In regard to flat-fish, the Report shows the gratifying state of affairs that an increase took place during the first five years that trawling excursions were instituted, and that the numbers of fish has since remained fairly constant. It is quite true that the increase has not been as large as was expected. But what has been learnt in regard to the spawning migrations affords the required explanation; and there is no doubt that the protection extended to the immature fish, as well as to their adult brethren which spend a portion of their lives in-shore, justifies the closure of the territorial waters to trawling. If such were again permitted, the destruction of immature fish in off-shore waters would be intensified, while the in-shore fish would be practically exterminated. The second point is the advisability of establishing on different parts of the coast beds of mussels for use as bait.

THE anatomy and development of Reptiles receive a large share of attention in part i. vol. xxviii. of the *Morphologisches Jahrbuch*; Dr. E. Göppert, of Heidelberg, contributing a paper on the larynx, while Herr H. K. Corning writes on development of the muscles of the head and limbs. Both papers are of a highly technical nature.

THE *Morphologisches Jahrbuch* also contains the first instalment of an important memoir by Dr. S. Paulli on the pneumaticity of the mammalian skull, as developed in the olfactory region, this part dealing only with Monotremes and Marsupials. It is shown that whereas in the Australian Duckbill the porous (ethmoid) bones in the nasal chamber are so slightly developed that there is not even a division between the olfactory and the respiratory portions, in the Echidna the same structures attain an extraordinary degree of complexity and specialisation. The difference is doubtless due to the aquatic habits of the one animal as compared with the terrestrial mode of life of the other.

THE greater portion of the first part of vol. lxvii. of the *Zeitschrift für Wissenschaftliche Zoologie* is taken up by an elaborate memoir on the structure and development of the crystalline lens of the eye in Mammals, by Herr C. Rabl, of Prague.

APPENDIX IV. for 1899 of the *Kew Bulletin of Miscellaneous Information* consists of a classified catalogue of the additions to the library received during the year 1898, covering fourteen pages.

A SERIES of articles on "Present-Day Leaders of Science" is running through *Good Words*. The January number contained an appreciation of Lord Kelvin, by his successor at Glasgow, Prof. A. Gray; and in the February number, Prof. Ramsay's scientific investigations—especially those referring to argon, helium, and other gases recently isolated—are described by Prof. Dobbie.

MR. C. L. WRAGGE writes to us with reference to the weather charts of Australasia issued by him, and mentioned in a note in our issue of November 9, 1899 (p. 40). He informs us that "the charts are regularly published daily, Sundays and holidays excepted, and are thus kept up to date. They are afterwards lithographed for general circulation within three days of the original issue. . . . Although the isobars are extended seawards, and the dotted lines over north-western Australia, where, except along the north-western coast, or data are limited, long series of observations over the land in connection with data from the Northern Territory, Tasmania, New Zealand and New Caledonia, prove that they closely approximate to the truth, and ship's logs repeatedly confirm the oceanic contouring of the isobaric lines."

Science Abstracts has become indispensable to all who wish to keep in touch with the progress of work and thought in any branch of physical science, whether pure or applied. The number for January, with which is issued the index to last year's volume, excels all previous ones both in the extent and interest of the information given as to recent advances of knowledge. It consists of 168 pages of abstracts of scientific papers, concisely written and well arranged. The scope of the journal has been considerably extended, more especially in the direction of steam plant, gas engines, oil engines, and motor cars. The practical man, as well as the student and investigator, cannot afford to neglect such a serviceable publication. The publishers are Messrs. E. and F. N. Spon, Ltd.

THE development of the practical teaching of physics has led to the production of simple apparatus and cheap materials by several scientific instrument makers. Messrs. J. J. Griffin and Sons have just published a catalogue, which shows they have adapted themselves to the new conditions. The catalogue contains classified price-lists of apparatus and materials described in several text-books of general elementary science and practical physics, and also required for the teaching of physiography, and for the complete equipment of a physical laboratory and lecture-room in a School of Science or other institution in which a systematic course of instruction in science is given. The catalogue should secure the attention of teachers who already possess laboratories, as well as of those making arrangements for experimental work by students.

SOME years ago Bernthsen published experiments to show that hyposulphurous (or hydrosulphurous) acid had the formula $H_2S_2O_4$ and not H_2SO_2. Though the evidence on which this conclusion was based has never been contradicted, the formula has not obtained general currency, and some doubt has lately been thrown upon it. Bernthsen has, therefore, returned to the subject, and, in conjunction with M. Bazlen, publishes, in the current number of the *Berichte*, an account of the preparation of crystallised sodium hyposulphite. The salt was prepared by taking sodium bisulphite, zinc dust, and sulphur dioxide in quantities corresponding to the following equation:—

$$2NaHSO_3 + Zn + SO_2 = (Na_2S_2O_4 + ZnSO_3) + H_2O.$$

Milk of lime is added to the solution to precipitate the zinc and the sulphites, and on adding common salt to the solution, sodium hyposulphite is salted out. Analysis and other evidence show the crystallised salt to have the formula $Na_2S_2O_4 + 2H_2O$. The original view of Bernthsen is thus established, and hyposulphurous acid must be held to correspond in its stage of oxidation to the oxide S_2O_3.

ALTHOUGH but a short time has elapsed since the discovery of the elements radium and polonium by M. and Mme. Curie, a considerable amount of work has already been done upon the properties of the rays emitted by these substances. M. Henri Becquerel has already shown that there is a fundamental difference between the rays emitted by polonium and radium, in so far as a portion of the radium rays are deviated by a magnet. In the current number of the *Comptes rendus* is a further contribution by M. Becquerel on this same subject, in which, after showing that the deviation is the same in air and *in vacuo*, by an ingenious arrangement it is shown that the rays given off by different preparations are similar in nature, differing only in intensity. The salts were placed in small leaden cups upon a sensitised plate wrapped in black paper, and isolated from each other by screens, no effect being produced upon the plate until the magnetic field was excited. In a strong field the radiation is bent down on to the plate, which, when developed, showed that the deviations were equal, although of different intensity.

THE exact value for the atomic weight of nitrogen, in spite of its importance, is still liable to some uncertainty. The mean value derived from the researches of Stas, Penny, Marignac, Pelouze and Hibbs, by methods exclusively chemical, is 14·034 (oxygen = 16); whilst the value calculated from the practically identical densities of Lord Rayleigh and Leduc is 14·006. The February number of the *Journal* of the Chemical Society contains further work on this subject by Mr. G. Dean. Silver cyanide was obtained in a state of great purity, and the ratio Ag : AgCN determined, from which the value 14·031 is deduced for the atomic weight of nitrogen, a number practically identical with the mean above quoted, 14·034. Further work is clearly necessary to explain this considerable discrepancy, nearly 0·2 per cent., between the results obtained by physical and chemical methods.

THE additions to the Zoological Society's Gardens during the past week include two Common Marmosets (*Hapale jacchus*) from South-east Brazil, presented by Mrs. Nigel Cohen; a Black-eared Marmoset (*Hapale penicillata*) from South-east Brazil, presented by Mr. Hamilton Coffey; a Rhesus Monkey (*Macacus rhesus*) from India, presented by Dr. R. Cox; a Small Hill-Mynah (*Gracula religiosa*) from Southern India, presented by Mr. W. Brindley; two Dwarf Chameleons (*Chamaeleon pumilus*) from South Africa, presented by Mr. H. Way; a Lesser White-nosed Monkey (*Cercopithecus petaurista*, ♂) from West Africa, an American Bison (*Bison americanus*, ♂) from North America, two Great Anteaters (*Myrmecophaga jubata*, ♂ ♀), a Blue-fronted Amazon (*Chrysotis aestiva*) from South America, deposited; a Hog Deer (*Cervus porcinus*, ♂) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET GIACOBINI (1900*a*).—A telegram, received February 3, from the Centralstelle at Kiel, announces the observation of this comet by M. Javelle, at the Nice Observatory, in the following position:—

R.A. 2h. 57·7m. } 1900 January 31d. 7h. 3m.
Decl. −7° 55′ } Nice Mean Time.

A later telegram, received February 4, gives the following position:—

R.A. 2h. 49m. 51s. } 1900 February 3d. 7h. 25·8m.
Decl. −6° 40′ 10″ } Nice Mean Time.

Daily motion in R.A = −2·6s.
„ „ „ Decl. = −25″.

The comet, when discovered, was about 2° north-east of the 4th magnitude star η Eridani, and according to its observed motion is at present following a north-westerly path through Cetus.

SECOND NEW ALGOL VARIABLE IN CYGNUS.—It is announced, in the *Astronomische Nachrichten*, No. 3614, that Madam Ceraski, of the Moscow Observatory, has detected another variable during the examination of plates taken at the Observatory by M. Blajko. From the light variation observed, it is considered to be of the Algol type. Its position is the following:—

	R.A. h. m. s.	Decl. ° ′ ″
1855·0 ...	19 40 59·7 ...	+32 21 6
1900·0 ...	19 42 43·4 ...	+32 27 34

The period is calculated to be

6d. 0h. 9·4m.;

an epoch of minimum being

1899 December 15d. 23·3h. Greenwich Mean Time.

The normal magnitude of the variable is 10, its value at the minimum being about 12.

A small chart of the neighbouring stars is given in the paper to facilitate its recognition. The star makes almost an equilateral triangle with the stars B.D. 32°·3559, and B.D. 32°·3560.

THE COMPUTATION OF OCCULTATIONS.—There is a considerable number of methods for calculating the times of occultations, and until quite recently that of Bessel was the most generally employed. In these computations, in order to obtain results accurate to some seconds of time, the values resulting from the first calculations were only taken as a first approximation and used as a basis for a second computation, which latter gave the times with greater precision. In the year 1896 Dr. Carl Stechert published a new method (*Tafeln für die Vorausberechnung der Sternbedeckungen*) which dealt directly with the apparent and not the true time of conjunction, and at the same time allowed of certain simplifications being made. Curiously enough we have received from the Director of the Observatory of Rio de Janeiro, Mr. L. Cruls, a description of a method which results in an equation similar to that obtained by Dr. Stechert, but obtained by a line of reasoning essentially different. This method, which only involves one computation, and is based on the exact knowledge of the instant of the apparent conjunction of two stars, is fully described in the publication referred to, the text being arranged in parallel columns in the Spanish and French languages. The accuracy of this method may be gauged from the results of ten computations compared with the observed values. The mean error of a single isolated observation was found to be ± 11s·5 while that of the whole of the sixteen observations (including immersions and emersions) was ± 3s. The method is accompanied by numerous tables and diagrams for facilitating the reductions of equations involved.

LIGHT CURVE OF CERASKI'S FIRST ALGOL VARIABLE.—In the *Astronomical Journal*, No. 475, Mr. J. A. Parkhurst gives the results of forty-five observations of this variable during the period 1899 June 15 to September 12. Comparisons with four neighbouring stars give the normal magnitude as 8·75, and the minimum as 11·4. Forming the light curve from the observed times and magnitudes, the epoch of an August minimum was found to agree more closely with Prof. E. C. Pickering's value (*Harv. Coll. Obs. Circular*, No. 44) than with that of Prof. Ceraski, so that the author supports Prof. Pickering's extension of the period to 4d. 13h. 45m. 2s.

REDUCTION OF STAR PHOTOGRAPHS.—Mr. A. R. Hinks, who has recently undertaken the work of stellar photography with the new photographic equatorial refractor at the Cambridge Observatory, discusses, in the *Astronomical Journal*, No. 475, the method he proposes to adopt in the reduction of the plates. The telescope is to be devoted to determinations of stellar parallax, measures of star clusters, &c., and it is important for the ultimate value of the work that the measures as published should be comparable with others obtained elsewhere. Of the many possible methods of reduction, the author considers it most advisable to adopt a system based upon that devised for the work of the Astrographic Catalogue by Prof. H. H. Turner (*Monthly Notices*, *R.A.S.*, 1894, vol. liv. p. 489). In thus publishing the measures in the rectangular co-ordinates from the plates themselves, there may be some doubt as to their being comparable with older work published in the usual spherical co-ordinates of right ascension and declination. This the author proceeds to investigate by applying the new method of reduction to Dr. Frank Schlesinger's measures of the Rutherford photographs of the Praesepe cluster. In working out the equations of condition, both the rigid least square solution and the simplification devised by Mr. Dyson are given. From the values of the residuals it appears that determinations of parallax, &c., from photographs, may with advantage be carried out entirely in rectangular co-ordinates, and the results thus published. In addition, the approximate method of solution of the equations of condition is but little inferior to the rigid least square solution. A great advantage of the adoption of this plan would be the tendency to equalise the time of obtaining and reducing the photographs.

TECHNICAL INSTRUCTION IN RELATION TO INDUSTRIAL PROGRESS.[1]

What are the new industrial conditions which we now have to meet?

WE have long known of the enormous progress being made in Germany, especially in those branches of manufacture of the more scientific kinds. Thus, most of the electric plants installed throughout the continent have been made in Germany, and German firms are building practically all the large lighting and traction plants in South America. In steam engineering and in shipbuilding we know how efficient Germany has become. The phrase "made in Germany" was intended to imply that the goods so marked were not equal in quality to British made goods, but the phrase no longer carries this meaning, and it will be remembered that when the *Kaiser Wilhelm der Grosse* made a record passage from New York to Southampton, having beaten the best English record, she sailed into port with large white letters painted on her side, "MADE IN GERMANY." I was in Germany myself just as this happened, and heard the story passed round, to the great amusement of the Germans.

In South Africa the same progress has been made by the Americans, who have supplied most of the machinery used in the South African mines, and the engineers engaged there are nearly all young Americans who have received a good technical training as engineers and electricians. Again, many of the principal electric light and power plants in our own country are equipped throughout by American firms in competition with the best home companies, and erected at our very doors, notwithstanding that the American plant has to be carried so many thousand miles before it reaches its destination.

It is frequently stated that this is owing to our own firms being so full of work that they have orders two years ahead, but the question is whether England has more work than she can do, or whether the rate of production of that work is what it might be if the plant employed in our various manufactories were of a more up-to-date type. In any case it is clear that the higher grades of the metalworking trades are no longer a speciality of this country, but, on the contrary, both America and Germany can compete with us on our own ground.

But there is another direction in which, quietly but surely, a revolution is being effected in methods of manufacture, not only in engineering works of all kinds, but in many industries which have never until recently used machinery, and this revolution is being brought about by the introduction of the American Machine Tool. The characteristics of this machine tool are its high quality, its adaptability to all kinds of special work requiring automatic appliances, and the method of working the tool so as to produce with great accuracy an indefinitely large number of interchangeable parts by working to standard gauges.

To give an illustration of the way in which these changes are being brought about by the introduction of the American machine tool: A few weeks ago I visited the newly-erected machine tool factory of the Ludwig Loewe Co. in Berlin, one of the largest factories of the kind in the world, having cost, I believe, nine million marks to build and equip. The firm was founded in the first place about thirty years ago for the purpose of making sewing machines, but before it could make sewing machines it had to buy American tools with which to make them. Then after a time the American machines required to be repaired, and they had to start a small engineers' shop for the purpose of repairs, and more American tools were purchased to equip the engineers' shop. But this small engineers' shop proved so serviceable and so successful that the sewing machine trade was stopped, and the machine tool instead began to be manufactured. From this beginning a great machine tool business was gradually built up. The tools made were of the newest and most approved American patterns. The head engineer and works' foremen employed were Americans. This business has now reached such enormous dimensions that it includes not only the machine tool works above mentioned, but also Arms and Ammunition works and Electrical Appliance works, the whole employing, I am told, something like twelve thousand men.

From these works are passing out from time to time skilled men with practical experience of up-to-date machine tools, who become foremen in the various works and manufactories, and the result is that, wherever they go, they soon introduce the highest class of machine tools, and rapidly a great change takes place in the amount of business done by the firms. America, as is well-known in engineering circles, is doing an enormous trade on the continent of Europe and with England also in improved machine tools of the highest class.

We have, of course, good machine tool makers in this country, but few, if any, who have made a speciality of one single type of machine tool, as is the case in America, which tool they claim to be the most perfect of its kind, while they leave other types to other manufacturers. By thus confining themselves to one class of tool they greatly reduce the working costs of manufacture as compared with firms who make any and every class and size of tool.

A London Daily recently said, "there is no question that the commercial interests of the United States are growing by leaps and bounds. Europe is beginning to be inundated with American goods, and American firms are getting contracts at the expense of European rivals all the world over. This would not be accomplished except for the fact that American manufacturing plants are maintained by the universal use of high-class machine tools, operated by well-paid workmen, while by far the greater number of shops in this country are equipped with tools many of which are of the most antiquated type."

It is probable the German workshops, generally speaking, are in no sense better equipped than our own. In fact, we have in this country, especially in connection with our great Railway Companies, shops which are probably superior to anything else of the kind in the world, also our textile machinery is superior to that of any other country, but the Germans are waking up to the fact of their deficiencies as compared with the machine tool equipment of the general American manufacturer. They recognise that trade follows the machine tool, and the financiers of Germany appear to be encouraging the rapid introduction of a better class of machines for general works' practice. A similar tendency is at work in this country, and the result is that the industrial conditions are rapidly changing, and a new and more efficient class of men to carry on our mechanical industries is becoming more and more an absolute necessity.

What we require in order to meet these conditions successfully and to maintain our industrial position as a community of metalworkers in competition with our rivals.

It is clear from what has been already said that we need the means of securing a steady supply of skilled machinists and tool makers, with a competent knowledge of up-to-date methods of turning work out, and of the best types of machine tools; men, in fact, who are competent to become, in course of time, leading men and works' foremen.

There are, of course, works' foremen in England second to none in the world, but every one knows, who has any knowledge of works, that such men are singularly scarce, and when a vacancy occurs, extremely difficult to replace. These men are the brain of the workshop, and upon their skill depends very much of the true success of any manufacturing concern. Almost any man in the works could be more easily replaced than the skilled works' foreman.

Incompetent foremen are not only incapable of improving methods of production, but they will not encourage the introduction of new machines, which they themselves have not the ability to understand and use. Such men initiate little, and they continue to demand the same kind of tool and methods that their forefathers used. But the deficiency in the supply of

[1] Abridged from a paper on "Metal Work as a Form of Manual Instruction in Schools," read at a conference of science teachers on January 11, by Prof. W. Ripper, University College, Sheffield.

men of the more competent type is becoming more serious every day, because the demand for skilled mechanicians increases with the introduction of improved machine tools, and the problem is, in what way can we hope to insure a supply of thoroughly well-trained competent machinists.

It will of course be said by a certain class of critics that the workshop is the only place in which such a training must be obtained, but this is not the opinion of some of the best-informed American engineers.

A movement is on foot in America for securing a special training, by the founding of schools for the purpose of training machinists thoroughly from the earliest stages upwards. On this point a most valuable paper has recently been contributed to the American Society of Mechanical Engineers on "The Education of Machinists, Foremen, and Mechanical Engineers," by Prof. M. P. Higgins, of Worcester, Mass., U.S.A., in which, after recommending the formation of workshop schools, he says, "America has made a strong beginning as an export nation of high grade machines. There are many evidences of keen interest amounting to surprise and alarm on the part of our European rivals. It is interesting to note their efforts to discover the cause of this sudden uprising of a new and evidently powerful rival in a field heretofore all their own.

"The cause of our supremacy," he says, "has not been altogether the superiority of our high-class engineers, for they also have highly educated engineers. But it has largely resulted from the superior character and make-up of our *mechanics*, which has come from the chance which America gives the workmen, and in the liberal and wise provisions to train American boys, giving each a fair field and open path to rise from one plane to a higher one, as his abilities and circumstances may warrant.

"We must not allow ourselves to rest secure in the belief that our Old World competitors will be slow to discern this cause or slow to profit by the example. Therefore, what more potent steps can we take for our protection than to keep this path open from the bottom, and to better our methods all the way up through the successive stages?"

In what way may the schools help to more effectually prepare our youths for the task which lies before them?

The Elementary School.—I begin at the elementary school because the problem before us is one which can only be solved by laying a good foundation at the very beginning, and proceeding upwards by a properly organised system of training towards the result which we desire to obtain.

Our British system of elementary school training is probably equal to that of any country in the world, but we have to regret the very early age at which the majority of boys pass away from the influences of the school. This is in part due no doubt to the feeling on the part of parents, especially of the lower classes, that after having passed the ordinary standards there is no necessity for any further stay at school, as the subjects taught are assumed to have little or nothing to do with the immediate requirements of life outside the school.

The opening in many large centres of Higher Grade Schools, in which pupils who have reached the higher standards may receive instruction at low fees, in science and in manual work, has been generally productive of much good, by retaining in the school pupils who would otherwise have left at an earlier age; and in these Higher Grade Schools pupils of exceptional ability, as tested by the ordinary system of examinations, have been selected, and in many cases specially trained, for scholarships or for examinations admitting them to the universities. But an idea is beginning to dawn upon us that perhaps, after all, there may be, among the very large majority of boys who are never among those selected to receive any special training to pass university examinations, and who have no special aptitude in the direction of acquiring book knowledge, much real ability in other directions, in fact, that they may be, as it were, a kind of unworked mine of possibilities and resources.

Hitherto they have been looked upon as the wasters of the school, but it is almost certain that the great inventors and mechanicians of our time have not usually come from the class of boys who are looked upon as the most successful students. Usually the "clever boy" is the one who, by his ability, in the particular direction by which the schools measure ability, succeeds in escaping from the workshop and in doing, as he would consider, better for himself by obtaining other employment.

Every Higher Grade School in which work is carried to the extent of providing school laboratories for, say, chemistry and physics, which, by the way, is a very good and necessary provision, should provide also an alternative course in a school workshop for the type of boy well known to teachers whose tendencies are more mechanical than scientific, who would be likely to make much more progress if trained in a workshop than in a chemical laboratory; and who would certainly pay for such training.

Every teacher who has had experience with the teaching of science to boys knows that the class consists of two distinct types; first, those who are fitted by careful training to become successful students, and to take a more or less high position in public examinations, who in fact are aiming at passing some examination as a means to their future progress; and secondly, those who have no prospect of such success, and whose future success will depend, if they succeed at all, upon other qualifications.

Now this latter class includes the majority of the pupils. They contain also the class from which will be drawn in the future the workers, and in some cases the leaders, in our industries, and these boys have, equally with the other boys, a reasonable claim upon all that the school can do for them to prepare them for their future. To meet then the case of these boys the workshop course should be an altogether different course from that hitherto provided. It should be equipped with as much care and as much completeness, in its way, for the purpose of training this type of boy, as is the chemical or physical laboratory, and the educational value of such training need be in no sense inferior to that of any other course of study.

It is assumed that boys in such a school have already done a woodwork course, and if so they would here receive an iron-work course in a workshop supplied with a good selection of tools, including some small but good types of machine tools driven by a gas engine or electric motor. The effect of providing such a course of instruction would be to select, by a natural system, the type of boy likely to profit by the training received, and to retain these boys for a much longer period than would otherwise be possible. But the success of such school workshops would depend largely upon the course of instruction given, and upon the quality of the teacher giving it. The course should include practical work in the shops, the arithmetic of machines, geometry, machine drawing and design, and elementary applied mechanics. Each of these subjects is capable of indefinite extension, but it is of great importance that the early teaching should lay a good foundation upon which the future may be built, and that nothing should be learned which will afterwards require to be unlearned.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

It is announced that a copy of the charter and statutes which are to govern the new University of Birmingham, has been laid on the table of the House of Commons. This contains a list of honorary and other officers covered by the terms of the charter, but only three persons are mentioned who have been definitely appointed to positions in the new University. The first Chancellor will be Mr. Chamberlain. No name is associated with the office of Principal, which is to be a Crown appointment, made through the Lord President of the Council, but the Vice-Principal nominated is Dr. R. S. Heath, who has been acting Principal of Mason University College. The appointment of the first Dean of the Faculty of Medicine has been conferred on Dr. B. C. A. Windle, F.R.S.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 7, 1899.—"Gold Aluminium Alloys." By C. T. Heycock, F.R.S., and F. H. Neville, F.R.S.

The freezing point curve for mixtures of gold and aluminium consists of seven branches, each branch corresponding to equilibrium between liquid and the first solid which forms as the system cools. Seven substances can also be detected by a microscopic examination of the solid alloys. They are gold, Au_4Al, Au_5Al_2 or perhaps Au_8Al_3, Au_2Al, a body which is probably AuAl, Roberts-Austen's purple $AuAl_2$, and aluminium. With the exception of $AuAl_2$ the compounds are white in colour. The bodies Au_2Al and $AuAl_2$ are indicated by well-marked summits in the curve, their freezing points being 625° C. and 1062° C. respectively, the latter identical with the freezing point of gold. The lowest melting point is that of an alloy containing only 3·6 per cent. by weight of aluminium; this alloy melts at 527° C.

The photomicrographs accompanying the paper show that the minute structure of the alloys repeats itself at corresponding points of each branch of the curve. For example, near the summit of the branch corresponding to the pure alloy, Au_2Al, the photograph shows us more or less hexagonal polygons of this substance almost entirely filling the field, and only separated from each other by very fine lines of impurity. If we take a section of an alloy a little way below the summit, we see the polygons of Au_2Al surrounded by a ribbon-like network of mother substance. Still further down, the crystals of Au_2Al are scanty, and arranged in such regular patterns, generally in lines at right angles to each other, as to render it certain that they crystallised freely while surrounded by liquid. Finally, at the bottom of the branch, that is at the eutectic point, the large crystals of Au_2Al are absent, and the whole field is full of the

mother substance, which is sometimes, but, as we explain in the paper, not always a eutectic mixture.

If, leaving the eutectic point, we ascend the next branch, these phenomena repeat themselves, but the primary crystallisation (that is the matter which solidified first) is now of a different substance.

The photograph reproduced is of an alloy which, taken as a whole, would have the formula $Au_{70}Al_{30}$. The darker part consists of Au_2Al, which crystallised first. The lighter ground, or mother substance, is in this case the pure body Au_5Al_2, and is not a eutectic mixture. The pattern is typical of a point on the curve situated a little way above a eutectic angle. (Magnification 45 diameters.)

Royal Microscopical Society, January 17.—Annual meeting.—Mr. E. M. Nelson, the President, in the chair.—The President announced with deep regret the death of the Treasurer, Mr. W. T. Suffolk. He was an old member of the Society, having joined it in 1863. In addition to acting as Treasurer for some years, he had examined and catalogued the slides, about 7700 in number, in the Society's cabinet, and had remounted a great number of them, which had been found to be leaking or otherwise imperfect.—A resolution expressing the great sympathy of the Council with Miss Suffolk, and also acknowledging her gift to the Society of her uncle's cabinet of slides, was read to the meeting, and at the request of the President the Fellows present endorsed the action of the Council by show of hands.—After the report of the Council for the past year and the statement of accounts had been read and adopted, the President announced that the following had been elected as officers and Council for the ensuing year:—President: Wm. Carruthers; Vice-Presidents: A. W. Bennett, G. C. Karop, A. D. Michael, E. M. Nelson; Treasurer: J. J. Vezey; Secretaries: Rev. Dr. W. H. Dallinger, Dr. R. G. Hebb; Ordinary Members of Council: J. M. Allen, Conrad Beck, Dr. R. Braithwaite, E. T. Browne, Rev. E. Carr, E. Dadswell, Sir Ford North, H. G. Plimmer, T. H. Powell, C. F. Rousselet, Dr. J. Tatham, G. Western; Curator: C. F. Rousselet.—The President then delivered the annual address on the work done during the past year in connection with the Society, including the standardisation of the substage and eye-pieces, and concluded by reading a paper, which was a continuation of the optical subjects dealt with in his previous addresses, and had special reference to the aplanatic oil immersion front and the construction of the Huyghenian eye-piece.—Mr. Michael proposed a vote of thanks to the President, not only for the address, but also for his eminent services to the Society during the time he had occupied the chair.—In this period he had given a series of addresses which will form an admirable record of the practical application of the principles upon which the optical part of the microscope was constructed.—Dr. Braithwaite having seconded the vote of thanks to the President, it was put to the meeting, and carried unanimously.—The President then introduced his successor, Mr. Wm. Carruthers, who, having taken the chair, gave a short address to the meeting.—Mr. Rousselet exhibited a mounted specimen of *Stephanoceros eichhorni*, a rotifer which is very difficult to kill with its cilia fully extended; but after many trials, Mr. Rousselet has succeeded in overcoming the difficulty, and the specimen exhibited presented a very life-like appearance.

Linnean Society, January 18.—Dr. A. Günther, F.R.S., President, in the chair.—Mr. J. C. Hill, of Sydney University, exhibited some photographs of specimens and drawings of Monotreme and Marsupial embryos, obtained by him in Australia. Of special interest were those of a newly-hatched *Ornithorhynchus*, showing a nasal caruncle and the presence of a medium maxillary tooth, the function of which is at present undetermined. Chief among the Marsupial series were photographs of *Dasyurus* embryos *in situ* and showing the free condition of the allantois. The Zoological secretary gave an account of a paper by Mr. H. M. Kyle, incident to an extended investigation of the flat-fishes now progressing. The author records in these and certain other Teleosteans the existence of "Nasal Sacs," originally observed by Owen, and more recently by Solger in the stickleback. He shows them to be secretory in the less specialised Pleuronectidæ, paired and non-secretory among the soles. Mr. George Massee read a paper on the origin of the Basidiomycetes. He remarked that Juel, a Danish mycologist, had recently demonstrated that *Stilbum vulgare*, hitherto regarded as a typical Hyphomycete, is a true Protobasidiomycete. Following up this hint, the majority of the species of *Stilbum*, some of which are the known conidial phase of species of *Sphaerostilbe*, and others existing without any known higher form, were examined, with the result that the conidial condition of *Sphaerostilbe microspora* and *S. gracilipes* proved to be identical in structure with *Stilbum vulgare*, in other words, true Protobasidiomycetes. This discovery reveals the fact that the conidial condition of an ascigerous fungus may be a true Protobasidiomycete. Similar discoveries had been made with forms of *Tubercularia* and *Isaria* known to be the conidial stages of ascigerous fungi.

MANCHESTER.

Literary and Philosophical Society, January 23.—Prof. Horace Lamb, F.R.S., President, in the chair.—Mr. C. E. Stromeyer read a paper on the origin of granite, in which he suggested that, as the melting temperatures of solids are either raised or lowered by pressure, and as the melting temperatures of felspar and hornblende are certainly raised by pressure, it may be found that the melting temperature of quartz is lowered under such conditions; if that were seen to be the case, a satisfactory explanation would be afforded why the order of crystallisation of granite-forming minerals is the reverse of the order of their melting temperatures, because at the depths below the earth's surface where these melting temperatures are reached the pressures are sufficiently great to account for variations of melting temperatures of several hundred degrees. Clerk Maxwell even assumed that the melting temperature of these minerals would be so materially raised that the earth's centre must necessarily be solid. No experiments having as yet been made on quartz, the author suggested that, if sufficiently small specimens of this mineral were experimented upon in Prof. Joly's meldometer, the molecular pressure—which for water is said to be 5000 atmospheres—would affect the melting temperature very materially, and by this means the question as to the origin of granite would be advanced one step.—A paper, entitled "Notes on some Jurassic plants in the Manchester Museum," by A. C. Seward, F.R.S., was communicated by Prof. F. E. Weiss. The late Prof. W. C. Williamson collected from the inferior oolite rocks exposed in the cliff sections south of Scarborough a number of fossil plants, of which he sent drawings and descriptive notes to Prof. Lindley, who figured a number of them in the classic "Fossil Flora." Some of these plant-remains, now in the Manchester Museum—to which they were presented by Prof. Williamson—Mr. Seward has subjected to a renewed critical examination, with the result that he finds many of them identical with fossil plants described previously under other names by Brongniart. Thus, *Sphenopteris arguta*, Lindley and Hutton = *Coniopteris hymenophylloides*, Brongniart; *Pecopteris dentata*, L. and H. = *Todites williamsoni*, Brong.; *Otopteris cuneata*, L. and H. = *Sagenopteris phillipsi*, Brong. Some other specimens figured by Lindley and Hutton under one name are, according to the author, identical with other plant-remains which had been differently identified. Thus, *Thuites expansus*, figured on Pl. 167, is specifically identical with *Brachyphyllum manillare*, figured on Pls. 188 and 219. Other Jurassic plant-remains in the Manchester Museum were also described by Mr. Seward, and their systematic position critically discussed.

CAMBRIDGE.

Philosophical Society, January 22.—Mr. Larmor, President, in the chair.—Experiments on the periodic movement of plants, Miss D. F. M. Pertz and Francis Darwin. The first part of the paper is practically a continuation of the authors' research on the artificial production of rhythm in plants, published in the *Annals of Botany*, 1891. The second part deals with a new example of periodic movement. If a "sleeping" plant is placed in a dark room after its leaves have assumed the nocturnal position, it will "awake" next morning, *i.e.* its leaves will return to the diurnal position, in spite of the darkness. In the experiment described, the procedure was varied by exposing the plants to one-sided illumination; in these circumstances the leaves are well known to assume certain characteristic oblique positions. The point of the experiment is that if a plant is darkened after having responded in the above manner to one-sided illumination, it returns to the oblique position on "awaking" next day in complete darkness.—Wealden plants from Bernissart, A. C. Seward. A brief account was given of a collection of plants in the Natural History Museum of Brussels which was obtained from argillaceous rocks at Bernissart, a locality rendered famous by the discovery in 1877 of more than twenty complete skeletons of *Iguanodon*. The beds containing the Iguanodons and plants occupy a gorge, 250 m. deep, bounded on either side by carboniferous strata. A short list of species of Bernissart plants was published in 1878 by M. Dupont (*Bull. Ac. R. Belg.*, vol. xxvi. [2] 1878, p. 387), the identifications being made by the late Marquis of Saporta. Through the courtesy of M. Dupont, the Director of the Brussels Museum, the writer has recently examined the collection, which consists of numerous small fragments of typical Wealden species. The flora is represented by fragmentary samples which appear to have been transported for a considerable distance, and finally deposited in a fine freshwater argillaceous sediment. A striking feature of the flora is the scarcity of Gymnosperms; nearly the whole of the material consists of fragments of fern fronds, *Weichselia Mantelli* being by far the commonest species. The evidence afforded by the plants points unmistakably to a Wealden age, nearly all the species being identical with those described from the Wealden rocks of the Sussex coast, the north German area and elsewhere.—On the biology of Bulgaria polymorpha, R. H. Biffen. The life-history of this fungus has been studied in detail by means of cultures grown on blocks of sterilised oak-wood.

EDINBURGH.

Royal Society, January 22.—Prof. Copeland in the chair.—Dr. Peddie, in a communication on the torsional constants of iron and steel, stated that he obtained for steel results similar to those already obtained for iron. A linear relation was found to hold between log b and n, where x and n are the parameters in the oscillation equation $yn(x+a)=b$, in which x is the number of oscillations reckoning from the commencement of any experiment, and y is the amplitude of oscillation. The line representing this linear relation varies in inclination with the state of fatigue of the wire; but, for the same wire, these lines all pass through one point. This gave a quantity which might be regarded as measuring a definite elastic quality of the metal. The results showed that iron was, as regards elastic properties, about six times worse than steel.—Prof. Kuenen gave a simple proof of Gibbs' phase rule, that a system of n independent substances existing in r phases in equilibrium is capable of $(n-r+2)$ independent variations. It was first shown that the total number of variables was $(n-1)r+2$. Then, by a simple application of the second law of thermodynamics to the conditions of equilibrium, it was shown that these conditions were $(r-1)n$. The difference of these two expressions gives the phase rule.—Prof. Kuenen also read a paper on the change with temperature of the coefficient of absorption of a gas in a liquid. Several experimenters had obtained evidence that in some cases the coefficient of absorption passes through a minimum as the temperature rises. Having been asked by Prof. Ramsay if the phenomenon might not be connected with the approach to the critical point, he had looked into the question, and by a comparison of the vapour-pressure curve for a mixture with the curve for the solvent in the case of hydrogen and carbon dioxide he found that the coefficient must increase as the critical temperature is approached. Then, the coefficient of absorption being in the vast majority of cases high at low temperatures, it follows that it must pass through a minimum as the temperature rises.—Mr. W. B. Blaikie exhibited his "Cosmosphere," which consists of a terrestrial globe surrounded by a concentric celestial sphere of celluloid. The instrument is useful for demonstrating a great variety of problems in astronomy and navigation. From the cosmosphere in its complete form had been evolved a slide-rule, which solved by inspection many of these problems. It consisted of two celluloid sheets inscribed with projections of the hemisphere with longitude and latitude lines. The hemispheres were accurately superposed, and the upper one could be rotated and clamped in any position relatively to the under. Mr. Blaikie demonstrated the value of the slide-rule by solving with great ease problems requiring, as usually treated in books, a considerable amount of intricate mathematics. The solutions were correct to about a quarter of a degree.

PARIS.

Academy of Sciences, January 29.—M. Maurice Lévy in the chair.—Contribution to the study of the radium radiations, by M. Henri Becquerel. Different preparations of radium salts emit rays which are equally deviated in the magnetic fields, differing only in intensity. The results are independent of the presence of air.—Note on the crystalline and volcanic rocks of Southern China, by MM. Michel Levy, A. Lacroix and Leclère. The results of an examination of the specimens collected by M. Leclère on his recent expedition in China. From Hien-Bai to Tali-Fou the rocks are chiefly felspathic and micaceous schists. In the stanniferous region of Ko-Tiou the granitic schists are traversed by tourmaline pegmatites, whilst the line of fracture of Khin-Gan is marked by the appearance of a coarsely crystalline granite containing biotite.—The Gard coal basin, by M. Marcel Bertrand. The author combats the generally accepted view that the break between the upper and lower coal-measures (Stephanian and Westphalian) is the chief fact dominating the history of the chain, and puts forward a view co-ordinating and explaining in a simple manner all the anomalies of the basin.—On the molecular volumes of some camphor derivatives, by MM. A. Haller and P. Th. Muller. The results of the densities of eighteen camphor derivatives, partly pure, and partly taken in toluene solution, are tabulated and the results compared with those calculated by Traube's formula.—Materials of topological study for Algeria and Tunis, by M. Bassot. Remarks on the tenth volume of the "Cahiers du Service géographique de l'Armée."—M. Mittag-Leffler was elected a Correspondent for the Section of Geometry, and M. Bienaymé for the Section of Geography and Navigation.—The President announced to the Academy the loss by death of M. Marion, Correspondent for the Section of Anatomy and Zoology, and of Mr. D. E. Hughes.—Remarks by M. Milne-Edwards on the work of M. Marion.—Observation of the Leonids of 1899 in Russia, by M. S. de Glasenapp. Although the conditions were unfavourable, owing to the state of the sky, observations of 745 Leonids were made, 394 of which were seen during the night of November 14.—On the proper motion of stars near the sun, by M. Duponchel.—On some partial differential equations, by M. H. Duport.—On the existence of second differentials of potential, by M. Henrik Petrini.—On the law of the resistance of the air to the motion of projectiles, by M. Paul Vieille. A comparison of the resistance per square centimetre observed for a cylindrical projectile, having a plane face at right angles to the direction of motion, and calculated from the formulæ of MM. Riemann and Hugomot, shows that these are practically identical. The temperature corresponding to various velocities is also calculated, and lead to the conclusion that the temperatures of meteors, even taking into account the low pressure of the medium traversed, are amply explained by the law of propagation of discontinuities.—On the decomposition of a luminous motion into simple elements, by M. Ch. Fabry.—On the constitution of white light, by M. Gouy.—Polarised light emitted by a Geissler tube submitted to the action of a magnetic field, by M. R. Dongier. The intensity of the red ray of hydrogen is distinctly reduced in a magnetic field; similar effects, but less marked, are observed with tubes containing chlorine, nitrogen, carbon dioxide, carbon monoxide and argon, the spectrum of the latter undergoing curious modifications in the magnetic field.—Time of establishing the electric spark, by MM. H. Abraham and J. Lemoine. The duration of the Kerr effect in carbon bisulphide is divided into three parts, the duration of the establishment of the luminous intensity of the spark, the time of discharge, and the time during which the carbon bisulphide preserves its doubly refracting power after the electric field has disappeared. Each of these phenomena, taken singly, has a duration of less than 1/100,000,000 of a second.—On the detection of silver in presence of mercury amido-chloride, by M. F. Leteur. From a mixture of silver and mercurous chloride it is not possible to extract the whole of the silver salt with aqueous ammonia, since when the silver chloride is small in proportion to the calomel, nearly the whole of it is retained by the mercury amido-chloride formed, even after repeated digestions with ammonia.—Action of copper upon acetylene; formation of a condensed hydrocarbon, cuprene, by MM. Paul Sabatier and T. B. Senderens. Acetylene, passed over copper heated to 200° undergoes a complicated transformation, giving a liquid hydrocarbon and a mixture of ethylene, propylene, butylene, ethane, and hydrogen. At the same time the copper becomes coated with a solid deposit, of the composition $(C_7H_6)n$, to which the name of cuprene is given.—Acidimetry of the polybasic organic acids, by M. A. Astruc.—On isopyromucic acid, by M. L. J. Simon. The author has succeeded in obtaining good yields of the isopyromucic acid discovered by Limpricht, the existence of which has been denied by Oliveri and Peratoner, by the dry distillation of a mixture of mucic acid (350 gr.) and potassium bisulphate (550 gr.). The exact constitution of the acid is not yet worked out.—Genesis of terpene compounds in lavender, by M. Eugène Charabot.—On a new method for the extraction of india-rubber contained in the bark of divers plants, especially of *Landolphia*, by MM. A. Arnaud and A. Verneuil. The bark, finely powdered and ground up with warm water, gives up the whole of its india-rubber, no chemical reagent being necessary.—Defence of the organism against the injurious effects of glandular secretions, by MM. Charrin and Levaditi.—The intestinal reabsorption of sugars, by M. E. Hédon.—The peripheric organs of the sense of space, by M. E. de Cyon.—Photogrammetric focimetry in microscopy, by M. V. Legros.—On the endomorphic transformations of santoxin andesite, under the influence of calcareous enclosures, by M. A. Lacroix.—On the non-existence of the hexagonal system, by M. Fréd. Wallerant. The author concludes from the discussion of the crystallography of nepheline, potassium sulphate and arragonite, that the hexagonal system has no real existence in nature, and has only a theoretical importance.—The geology of Southern Australia, by M. Jules Garnier.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 8.

ROYAL SOCIETY, at 4.30.—The Spectrum of α-Aquilæ: Sir N. Lockyer, K.C.B., F.R.S., and A. Fowler. (1) On the Production of Artificial Colour-blindness by Moonlight: (2) On the Relation of Artificial Colour-blindness to Successive Contrast: G. J. Burch.—On Electrical Effects due to Evaporation of Sodium in Air and other Gases: W. C. Henderson.—On Electric *Touch* and the Molecular Changes produced in Matter by Electric Waves: Prof. J. C. Bose.

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

CHEMICAL SOCIETY, at 8.30.—Victor Meyer Memorial Lecture: Prof. T. E. Thorpe, F.R.S.

SOCIETY OF ARTS (Imperial Institute), at 4.30.—The Projects of Railway Communication with India: J. M. Maclean.

MATHEMATICAL SOCIETY, at 8.—A Formula in the Theory of the Theta-Functions: Prof. A. C. Dixon.—Some Elementary Distributions of Stress in Three Dimensions: J. H. Michell.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Standardisation of Electrical Engineering Plant: R. P. Sellon.

CAMERA CLUB, at 8.15.—Steam Turbines, Land and Marine: A. A. Campbell Swinton.

FRIDAY, FEBRUARY 9.

ROYAL INSTITUTION, at 9.—Symbiosis and Symbiotic Fermentation: Prof. J. Reynolds Green.

ROYAL ASTRONOMICAL SOCIETY, at 3.—Anniversary Meeting.

PHYSICAL SOCIETY, at 5.—Annual General Meeting.—Address by the President, Prof. O. J. Lodge, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Underground Sources of Water-Supply: D. E. Lloyd-Davies.

MALACOLOGICAL SOCIETY, at 8.—Annual General Meeting.—Also, Lecture on the Pearly Nautilus: Dr. Arthur Willey.

MONDAY, FEBRUARY 12.

SOCIETY OF ARTS, at 8.—The Nature and Yield of Metalliferous Deposits: Bennett H. Brough.

CAMERA CLUB, at 8.15.—Mountaineering in Switzerland and Scotland: Prof. Norman Collie.

TUESDAY, FEBRUARY 13.

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

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

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Annual General Meeting.

ANTHROPOLOGICAL INSTITUTE, at 8.30.

WEDNESDAY, FEBRUARY 14.

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

ESSEX FIELD CLUB (at Bishopsgate Institute), at 7.—Some New Sections in, and Contributions to, the Fauna of the River Drift of the Uphall Estate, Ilford: J. P. Johnson and G White.—The Stalk-eyed Crustacea, their Families and Genera; with especial reference to the Essex Species: Edward Lovett.

THURSDAY, FEBRUARY 15.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Genesis and Development of the Wall and Connecting Threads in the Plant Cell. Preliminary Communication: W. Gardiner, F.R.S.—Total Eclipse of the Sun, January 22, 1898. Observations at Viziadrug: Sir N. Lockyer, F.R.S., Captain Chisholm-Batten, and Prof. A. Pedler, F.R.S.—Photographs of Sound Waves: Prof. R. W. Wood.

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

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

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

FRIDAY, FEBRUARY 16.

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

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

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