THURSDAY, NOVEMBER 19, 1896.

THE FORCE OF ONE POUND.

Elements of Mechanics. By Thomas Wallace Wright, M.A., Ph.D. Pp. v + 372. (New York: Van Nostrand. London: Spon, 1896.)

THIS is a good elementary treatise; not too elementary, and yet a book that hard-working students may use from the beginning of their studies. It is a pity that the author ignores altogether the sort of work that is now getting to be very common, even in the older universities—experimental laboratory work in mechanics—but we have here an excellent text-book, even for students who are following an experimental course.

The author wisely assumes that some knowledge of the calculus may accompany a very elementary acquaintance with algebra and trigonometry, and he introduces calculus symbols freely in places where other authors are apt to evade their use, through a wrong notion that two pages of algebra and Euclid afford better mental training than a line of integration. I think that he is right, for every student possesses the fundamental idea of the calculus, and knows the use of squared paper before he knows algebra, and it is very easy to teach him the use of the symbols of differentiation and integration. The more advanced subjects include S.H. motion, forces in hinged structures, moments of inertia, D'Alembert's principle, the dynamics of rigid bodies, strain and impact. The exercises are very numerous; most of them are good, and many of them are of an original and taking kind.

On the other hand, I must say that I could not have believed the book to be a new edition of an older work, had the author not made the statement. It is in need of much correction, and not only of printer's errors, such as errors in decimal points. Then there is a mistake calculated to work great harm at page 12, line 6; the curve representing velocity of a piston as ordinate and space as abscissa, ought not to be like a curve of sines or cosines, being really nearly circular. Such mistakes as "That this principle (the independence of forces in producing accelerations) is not axiomatic, is evident from the opinion of Descartes . . ." (page 49), are, I believe, due only to careless writing; for the author surely does not mean that the opinion of Descartes settles the matter. There is a different sort of carelessness in (page 62, line 17) "At the close of the last century, in different parts of the world, the word *pound* was applied to 391 units of weight, . . ." The author means "391 different kinds of unit. . . ." As the book is not a metaphysical treatise, it seems hardly fair to put before a student the exercise, "Discuss the argument of Zeno of Elea against motion"; "Since an arrow cannot move where it is not, and since it cannot move where it is, it therefore follows that it cannot move at all." There is a reference for help to vol. iv. page 263 of Carlyle's "Friedrich"; but as I have only one edition of Carlyle, the reference is not of much value. The author is disappointing in his *parallelogram of forces.* Seeing that all metaphysical proof has failed, we must frankly adopt the plan of T and T', and say that the parallelogram of forces is included in Newton's laws of motion. It is interesting to note the disappearance, from all books, of the older proofs of fundamental principles which used to form so large a part of the student's work. They were generally based upon the assumption that because we could not conceive of something or other, therefore it could not exist; thus giving a premium to the limitation of our faculties. The method of reasoning is still much followed, but it is not usual to state it so ingenuously; Maxwell uses the method twice in his "Matter and Motion." In page 80, the author takes a line E F to represent the "force of the wind" (whatever that may be, outside the leading article of a daily paper), and he says that the component G F of E F, perpendicular to the sail, is the effective component in propelling the ship. These statements are wrong in such various ways that it might be thought they could do no harm, but in truth statements could hardly be framed to do more harm. The exercise in which a student is asked to criticise Hiawatha's achievements, reads as if the author had not made any attempt to understand the most transparent of poets; and I am sorry to say that some others of the original exercises are really only enlivening because they show that, like Silas Wegg, the author is fond of "dropping into" literature.

If there are these faults, how does it come that I like the book, and recommend it for the use of students? Because it is the work of a man who really thinks about the pedagogy of science; and a man who really thinks, is not to be met with every day; he is a good teacher, even if there is a mistake in every page The author knows his T and T' well (I imagine), and does not much depart from their excellent methods. The book is one of the best introductions that I have seen, to the study of applied mechanics, and therefore, as an engineer, I like it. It has the fault (to me), but in a less degree than all the best English treatises, of being what is sometimes called "orthodox" in regard to the "British unit."

I think that the only act of the late Prof. James Thomson which was not altogether excellent, was the invention of the word "poundal." But he did not invent the unit to which the name is given; the inventor of the unit has caused it to be true that students are never *sure* in their dynamics calculations. Engineering students dare not for their lives speak of foot-poundals of work and poundals of force among workmen or foremen; and in what place these quantities are familiarly used or needed, except examination rooms, I do not know. To support an artificial and unnecessary system, the old and excellent term "the force of a pound" is maligned in every text-book. It is said to be a variable unit, and according to the definitions of its enemies, it is a variable unit. As if when I say that a certain force is a pound, I mean the gravitational force on a certain piece of metal if it were on the moon or at the centre of the earth. When an engineer says that the pressure of steam is 100 pounds per square inch, there is absolutely no vagueness about his statement. For twenty-six years I have used as my unit of force the gravitational force *at London* on a certain piece of metal called by law a weight of one pound, kept in London. My unit of mass is the mass to which unit force gives an acceleration of 1 foot per second per second, and my students use these as engineers' absolute units. When they are told "a projectile is 20 lbs., and moves with the velocity of 1000 feet per second," before they start on their dynamical work they say: the mass or inertia in engineers' units is 20 ÷ 32·18, and they use $\frac{1}{2}mv^2$ and get their answer at once—not in foot-poundals or other absurd units—but in the foot-pound units in which they think and talk. Such students have no troubles and make no mistakes, for they use an absolute system in which their answers are in the language of their daily life, and not *Choctaw.* Clerk Maxwell said, "In fact, the only occasions in common life, in which it is required to estimate weight considered as a force, is when we have to determine the strength required to lift or carry things, or when we have to make a structure strong enough to support their weight." Very well then, in the "common life" of an engineer these are the most frequent occasions. He almost never needs to speak of the inertia of a body by itself; when he needs the idea, it is when on his way to a calculation of force or energy. The physicist uses the other set of so-called absolute units, the C.G.S., and cannot make mistakes; all the other readers of books on dynamics, almost all the readers of Maxwell's "Heat," in which the above passage occurs, are engineers. And all such engineers as do not openly scoff at the teaching of science colleges, have had their lives filled with worry through the misery of having to use the poundal in examinations, and of hearing men who know nothing about engineering or engineers, or their lives or their needs, declaiming against the want of scientific knowledge shown by the engineer. The evils created by mere want of humour in a few influential men have been very great. These men speak of the pull of a tram-car in pounds, and their students need to use pounds of force continually in their laboratories, and they never by any chance use the poundal, or need to use it, except in working academic written answers to academic questions, and in working with an Atwood's machine. When a student speaks of so many pounds of sugar or coals, he is not thinking, nor does he need to think, about its inertia, and the use of the pound in this connection could do no harm, even if g varied ever so much more than it does on the surface of the earth. I see no great objection to the use of the word *weight* as meaning the attraction of the earth for a body, anywhere. Of course this is a variable force, and for practical purposes the weight of a pound anywhere on the earth is a force of one pound.

We are always being told that the pound is legally a quantity of stuff, and so it is; but note the actual wording of the Act, "The weight in vacuo of the platinum weight declared to be the imperial standard shall be the legal standard of weight. . . ." Now I would ask whether the inertia of the standard body is different in vacuo from what it is elsewhere. But I refrain from trying to take an advantage from the wording of the Act; and besides, I do need for my case the words inserted after vacuo "in London," if the legal weight is to be taken as the force of one pound. As the standard piece of metal is kept in London, and is not likely to rust or decay, and possibly its inertia keeps constant and is not affected by temperature, as Prof. Fitzgerald has suggested, perhaps we may concede the following as a definition of our absolute unit of force: the force of one pound is that which would give to a body of 32·18 times the inertia of the standard object kept in London, an acceleration of 1 foot per second per second.

If, however, engineers are to undergo any continuation of the persistent scorn of the last thirty years, let our scorners show some scientific knowledge of our position, and let us hear no more of the engineers' unit of force being the force of gravity anywhere or everywhere upon the standard weight.

As for our useful term *centrifugal force*, even our worst opponents are beginning to find out that there was a third of Newton's laws of motion, and that we may ask: If a body is acted upon by centripetal force, there is an equal and opposite force acting; and if it is not the body that exerts this force, what is it? If the body exerts this force, surely we have a right to call it the centrifugal force of the body.

I would, therefore, make an appeal to our academic enemies: Your students are nearly all young engineers of one kind or another. Why not be satisfied with teaching them about absolute units only—the C.G.S. and the foot, second, force of one pound, system?

You now use three others: the so-called British or poundal system, the gramme gravitational and the pound gravitational systems. It is only, after all, an error of judgment, like the crime of Surajah Dowlah or the St. Bartholomew, and you probably do not know what a complicated mess you make of a young engineer's mind; and we are quite willing to imagine that it is only ignorance and prejudice, and not antagonism to education that impels you to retain this want of system. But one effect is this. Your finished engineering students cannot get into works without paying high premiums; such is the prejudice of the experienced engineer against college-bred men, a prejudice which I myself would again have if I were again to act as a manager of works.

Every now and again an academic friend will say such things as these, "Well, if he cannot take in these ideas, he is not fitted to be an engineer." "If he has all that difficulty about Euclid, he is not fitted to be an engineer." And these academic statements are made about young men who are heaven-born engineers, fellows who never tire of fiddling with engineering things, and who are sure to succeed in actual engineering work, and who, when they do succeed, will scorn the idea that there is any use in a scientific education, and "what for no?" I am very thankful that entrance to all professions is not by examination. Our friends, worshipping the German soul-destroying educational fetish, insist on the very worst system of education for the average Englishman; and when a healthy young soul refuses to be destroyed, you punish its owner by shutting him out of the very professions for which he is best fitted by your wretched examinations. You say he cannot think, and you actually make him believe it too, because he refuses your Duchaylus' proofs and the metaphysics of Alexandrian philosophers. He ought, I suppose, to be grateful that you do not insist on his spending a year in learning the Trireme method of multiplication, or what right he has to say that one line is twice the length of another. Alice's White Knight was not more protected from imaginary dangers than the young men who now are being prepared for their life's work by a wasteful and pedantic trifling with the metaphysics of physics: Euclid, logic, and the snakes of Iceland!

Although I feel so strongly about the necessity for experimental or kindergarten methods of education being adopted, I do not wish to blame the author of this book. Teachers of mechanics will find it an excellent text-book. JOHN PERRY.

THE FORMATION OF THE FAMILY.

Die Formen der Familie und die Formen der Wirthschaft. Von Ernst Grosse. Pp. 245. (Freiburg and Leipzig: Mohr, 1896.)

PROFESSOR GROSSE, as appears from his preface, took up the anthropological problem of the development of the family, but soon judged the preliminary studies as yet available to be insufficient to enable him or any one else to carry out such a task. Therefore, as a contribution to the work, he set himself to examine the relation of the family systems of the world to one great factor of civilisation, namely the provision of subsistence. The task was judiciously chosen, and students will acknowledge that in his attempt to carry it out, Prof. Grosse makes a contribution of value to the clearing and ultimate solution of the problem. His plan is to divide mankind according to their "Wirthschaft," or economic life, into five classes—the lower and higher hunters, the herdsmen, and the lower and higher agriculturists. He then examines the correspondence between these stages of society and the different forms of family, class, and tribe. At the outset this comparison tells against a state of matriarchal anarchy having ever prevailed among the human species. The low tribes subsisting by hunting, fishing, gathering wild fruits and digging roots, a condition which apparently represents that of primitive man, tend to live in separate small families under a rude patriarchal system extremely unlike promiscuity or communal marriage. Prof. Grosse is enabled by this evidence to fall into line with the increasing number of anthropologists who reject theories of primitive promiscuity. Among modern systems of social development founded on this chaotic basis, that of Morgan in his "Ancient Society" is here mentioned as the most eminent, with a remark which will somewhat surprise English readers, that it has given the American sociologist a place of honour among the Fathers of German Social Democracy (p. 3). In England it is doubtful whether the artificial social scheme of Morgan's later years ever made converts to any serious extent, notwithstanding our high regard for his early work of observation and collection of facts. Considering that Morgan was an adopted Iroquois, living in a Seneca tribe for years as one of themselves, the statement here made (p. 152) is quite inadmissible, that his description of the Iroquois clan-system, which was the starting-point of his anthropological work, was founded on the remarks of Father Lafitau in the last century. Passing on to the chapter in which Prof. Grosse deals with the lower agricultural tribes, we find an important addition to the theory of the maternal or matriarchal system. As hunting and herding belong to the men, so at first agriculture belonged to the women, as it still does among the less civilised peoples. Out of the plant gathering, which is the business of savage woman, arose the invention of agriculture. On this reasonable hypothesis Prof. Grosse accounts for the unquestionable fact that among the Iroquois the women were owners of the soil they tilled and the crops they reaped, and that similar cases are still to be met with among the Balonda in South Africa and the Kocch in Bengal, always in connection with inheritance on the mother's side. As Prof. Grosse reasons (p. 160), we have here a state of things out of which the maternal family, growing into the maternal clan, would naturally arise. The present reviewer has of late years advocated the opinion that the maternal form of society is mainly connected with the husband not taking his wife to his own home, but living in her family, so that her side of the house naturally prevails (see *Nineteenth Century*, July 1896). It is obvious that wherever the land belongs to the women, this would especially tend to happen. As, however, the maternal family and clan appear already among hunting tribes who do not till the soil, it is plain that the full origin of the matriarchal system cannot be sought in the modes of subsistence which come within Prof. Grosse's method of comparison. The same is true of the custom of exogamy, prevailing as it does among hunters, herdsmen, and tillers of the soil. Prof. Grosse's incidental remarks on exogamy, as derived from aversion to marriages of near kin, need not be criticised here, the value of his work being rather in his systematic comparison between the economic and the social sides of human life, which leads him to the conclusion that in every form of culture that form of family organisation prevails which is adapted to economic relations and wants (p. 245). Readers who cannot accept so extreme a claim for the effect of these economic influences, will at least admit their great importance.

EDWARD B. TYLOR.

OUR BOOK SHELF.

Annales de Géographie, No. 23.—Bibliographie de l'Année 1895. I. Partie générale; II. Partie régionale. Avec un Index alphabétique des auteurs, analysés, et cités. Pp. 288. (Paris: Colin, 1896.)

THE problem of bibliography threatens to become the most absorbing practical question for all scientific workers. It is not yet quite the time to discuss a proposition to sweep away all previous records and begin afresh; but the time has come for at least producing some sort of classified subject index to all branches of contemporary work. The editors of the *Annales de Géographie*, the foremost French journal of scientific geography, have brought out as their September number a bibliography of geography for 1895. This does not profess or attempt to be exhaustive, but the 1087 titles recorded have been carefully selected, and nothing of the first order of importance seems to be omitted. Notes are appended to each title, not in the nature of criticism, but simply as an indication of the contents of each book or memoir; and these notes are admirably done. They are the work of forty-nine contributors, and each is signed.

The division of the subject is primarily into general and regional geography. The former is divided into *History of Geography; Mathematical Geography; Physical Geography*, subdivided into geology (*i.e.* in its geographical aspect) and orography, climatology, botanical geography, zoological geography, oceanography, rivers and lakes; and *Political Geography*, under the heads races, states and nations, movements of population and colonisation, products and means of communication, methods of teaching and general works. These, however, only account for 239 titles; by far the greater part being classed under the continents. Europe is apparently the subject of the greatest amount of geographical work (the entries refer to maps and statistics as well as to written memoirs), Africa comes next, and all the rest of the world is dismissed in the same space as was required for Europe alone. This is perhaps the result of being somewhat more exhaustive in treating the countries of the predominant continent.

The bibliography is well planned, executed with praiseworthy impartiality; but for the language in which it is written it might, so far as a reader can detect, have been compiled in any capital of Europe or America, and considering the keenness of national spirit in many of the articles classified, this is high praise indeed.

Animals at Work and Play; their Activities and Emotions. By C. J. Cornish. With illustrations. Pp. 323. (London: Seeley and Co., Ltd., 1896.)

IN a previous little volume Mr. Cornish gave an account of life at the "Zoo," in which he called attention to the tastes and preferences of animals for colour, music, and perfumes. In this volume he deals, for the most part, with some of the general activities and emotions of the every-day life of some mammals and birds. Most of the papers, here collected into a well-illustrated and pleasantly-written volume, have appeared from time to time in the columns of the *Spectator*. They cannot be said to contain much that is new, but many of the facts recorded are placed in a new light. There is a wealth of apt quotation, and, without aiming at technical description, the main facts are well put.

To give the reader an idea of what he may find in this work, we may refer to the chapters on "Animals' beds." More might have been made of this subject; for, without venturing on the somewhat mythical subject of the beds said to be built by the anthropoid apes, the beautiful nests of the field-mouse might, with others omitted, have been alluded to. The "Emotion of grief in animals" is another subject admitting of an expanded treatment; indeed, though the chapters are, from the point of view of a weekly journal, all that could be expected, yet in their new form, and remembering the interest of their themes, most of them might most advantageously have been added to.

The full-page illustrations are good; those from a Japanese source, such as the one with the "social sparrows," are excellent.

Model Drawing and Shading from Casts. By T. C. Barfield. Pp. ix + 92. (London: Chapman and Hall, Ltd., 1896.)

IT is hardly possible to draw accurately what is seen without knowing why the group or scene being delineated presents the appearance it does. This book will give students a clear idea of the field of view, and, by acquiring from it a knowledge of the laws and limitations of vision, they will be able to make model drawings intelligently.

A Short Catechism of Chemistry. Part I. By A. J. Wilcox. Pp. 16. (London: Simpkin, Marshall, Hamilton, Kent, and Co., Ltd., 1896.)

THE worst way to teach science is by catechism, for it leads to belief in doctrines on the authority of the book, while experience and demonstration are neglected. For this reason, we think the compiler of these fifty questions and answers would have done chemical science better service if he had refrained from publishing them. The incorrectness of several of the definitions confirms us in this opinion.

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 Austro-Hungarian Map of Franz Josef Land.

WITH reference to Prof. Copeland's letter in your last issue, I must say that I am inclined to believe that Austria Sound will eventually be found to be more or less as Payer originally laid it down. I am inclined to this belief because it seems to me almost impossible that the map of the very track he trod should show any great error. Of course, the longitude laid down may well be erroneous—considering the circumstances—and we may expect rectification of this.

But I am not disposed to pass over the description which Payer gave us of Zichy Land with so light a touch as Prof. Copeland. For, however unintentional his error may have been, there can be no doubt that Payer has misled Arctic geographers into supposing that Zichy Land was a large mass of land. And belief in this, derived solely, of course, from Payer's description, induced Jackson to make certain modifications in his equipment and plans, which are naturally unnecessary now that he has proved Payer's description of Zichy Land to be inaccurate.

For Payer wrote thus of Zichy Land in his "New Lands within the Arctic Circle," vol. ii. p. 206.

"My attention was directed chiefly to the southern parts of Zichy Land, which formed a vast mountainous region beyond Markham Sound. Half the horizon was bounded by cliffs and heights gleaming with snow. The conical shape of the mountains prevailed here also; the only exception was Richthofen Spitze, the loftiest summit, perhaps, we had seen in Franz Josef Land, which rose like a slender white pyramid to the height of about 5000 feet."

Now, as every one knows, Jackson has travelled north across the "vast mountainous region" of Zichy Land, and found that all the time he was marching on sea-ice. He camped where Richthofen Peak is marked in Payer's map, and he was *still on sea-ice*. Richthofen Peak consequently disappears; but Jackson, having robbed Richthofen of his peak, has given him a cape (700 feet high) which is very near the site of the vanished peak.

To put it briefly, in fact, Zichy Land turns out to be a chain of small islands, on the west of Austria Sound, and these islands are of no considerable height. Westward of the chain, Jackson has discovered another Austria Sound, but wider and more important, and this he has named "the British Channel"; while to the north of this channel he has discovered a sea which is open both in winter and summer, and which now owns the name of "Queen Victoria Sea." Zichy Land is, in fact, no longer existent as a "vast mountainous region," and in its place we find a few islands, a wide channel, and a permanently open sea. And these, of course, completely alter the complexion of Jackson's work—the first part of which is to explore and map the Franz Josef Land Archipelago.

No doubt, as far as I can gather, has ever been thrown upon Weyprecht's valuable work. Jackson has, of course, not gone near the locality where Weyprecht observed, and consequently the accuracy or inaccuracy of Weyprecht cannot and does not enter into Jackson's map. But, on the other hand, I do not doubt that my absent friend entertains the highest respect for him, seeing that he has given to a bay he has discovered in the west of the archipelago the name of Weyprecht Bay.

ARTHUR MONTEFIORE-BRICE.

157 Strand, London, W.C.

Tournefort and the Latitudinal and Altitudinal Distribution of Plants.

TOURNEFORT has generally had the credit of being the first to indicate a parallelism in the latitudinal and altitudinal distribution of plants; yet it would seem without sufficient ground. Linnæus mentions ("Flora Lapponica," Proleg. n. 14) that certain plants grow on Mount Ararat as well as in Lapland. Later (in 1751), in his "Oratio de Tellure Habitabili" ("Amœnitates Academicæ," ii. p. 447) he distinctly connects Tournefort with latitudinal and altitudinal distribution of plants, and in such a way as to convey the impression that it was

Tournefort's idea. Here follows the paragraph :—" Memoratu dignissimum est, quod refert in Itinerario suo Orientali *Tournefortius:* reperisse se nimirum apud radices Ararati montis plantas illas quæ in Armenia erant vulgares : aliquantum progressus illas invenit, quas in Italia ante viderat : altius scandenti offerebantur Vegetabilia circa Lutetiam Parisiorum crescentia : Plantæ Suecicæ erant superiori loco positæ. Sed summum montis locum proxime ad culmen, nive obtectum, plantæ illæ occuparant, quæ sunt alpibus Helveticis et Lapponicis domesticæ."

Humboldt, writing in 1816, "Sur les lois que l'on observe dans la distribution des formes végétales," p. 2, attributes the idea to Tournefort, and its development to Linnæus. Schouw ("Grundzüge einer allgemeinen Pflanzengeographie" (1823), p. 21), almost repeats Linnæus, but uses fewer and somewhat different geographical names. Edward Forbes ("Memoirs of the Geological Survey," i. p. 351) also attributes the idea to Tournefort ; yet, as Sir Joseph Hooker states (NATURE, xxiv. p. 444), I also have been unable to find any such idea expressed in Tournefort's works. Indeed, his account of his ascent of Mount Ararat, as given in the English edition of his travels, and verified for me by Mr. Daydon Jackson as being essentially the same in the French edition, is about as weak and silly a piece of writing as one could well find, and quite unworthy of a man of his reputation. True, he mentions a few plants ; but not a word on their distribution, except that some of them were common and familiar. No Alpine plant is included in his meagre list. Instead of being a sober narrative of the journey, it is an attempt to be serio-comic with witless allusions to Noah's ignorance of the French language, &c.; and how the travellers filled themselves with water before starting, because none was to be had on the mountain, and their inability to climb in consequence ; how they descended on their backs by the hour, and when they were tired of that they turned over face downwards, and other equally senseless and improbable things. It is only fair to add, however, that Tournefort's travels were published after his death, and probably contain matter that he would have expunged.

So far, then, as the evidence goes as between Tournefort and Linnæus, the latter originated the idea, and on very slender materials, if taken from Tournefort, of parallelism in latitudinal and altitudinal distribution of plants. Considering, too, that Linnæus was born only a year before Tournefort's death, it is difficult to find any other explanation.

Kew. W. BOTTING HEMSLEY.

The Work of Local Societies.

MAY we beg a small portion of your space to give publicity to the accompanying circular, which is being issued to all the local scientific societies in the United Kingdom ? An abstract of Mr. Abbott's scheme was published in NATURE of October 29 (vol. liv. p. 636). A separate copy of the paper will be sent to the Secretary of any local society on application to the Secretary of the Corresponding Societies Committee, British Association, Burlington House.

To the Secretary of the Local Society.

SIR,—We are requested by the Corresponding Societies Committee to call your attention to a scheme drawn up by Mr. George Abbott (General Secretary of the South-Eastern Union of Scientific Societies), for promoting District Unions of Natural History Societies, a copy of which is enclosed. This scheme was discussed at the conference of delegates of the Corresponding Societies of the British Association, held at the Liverpool meeting of the Association last September, when the great advantages of federation were generally admitted, and some examples of it were explained. At a meeting of the Corresponding Societies Committee on October 29, the report of the conference of delegates was considered, and it was decided that, as the circumstances in which the local societies are placed are extremely varied, it is desirable that each society shall be asked its opinion on Mr. Abbott's scheme, and as to what kind of federation it considers to be the best. We have, therefore, to state that the Corresponding Societies Committee will be greatly obliged if your Society will be good enough to favour them with its views on the subject at any date not later than December 20, 1896.

We are, Sir, yours faithfully,
R. MELDOLA, *Chairman*,
T. V. HOLMES, *Secretary*,
Corresponding Societies Committee, British Association.

Floating Mercury on Water.

IN your review of Dr. Hertz' works you mention his investigations into the question of the flotation of thin metal plates, in connection with which I may mention that I have made mercury float on water on a somewhat similar principle. A few drops of mercury, half an ounce of water, and a pinch of some red powder, red lead, red oxide or vermillion were put into a small cylindrical bottle and shaken. A few small globules of mercury were then found floating together at the centre of the water surface. The shaking was frequently repeated until a small dish consisting of a large number of mercury globules was formed, which floated on the water and at the centre of its surface. Its diameter would be about 3/8 inch, and its depth about 1/16 inch. It did not disappear if allowed to rest, and though it must have been broken up each time that the bottle was shaken, it always reformed. I am unable to say whether the mercury was pure or not, or whether an acid, alkali, or salt had been added to the water, for this little experiment was made many years ago.

Glasgow, November 9. C. E. STROMEYER.

The Swallows.

I SAW martins, three or four stragglers at a time, hawking on our cliffs, on the 2nd, 3rd, and 7th of this month, and again a single bird in the gardens this morning.

May I suggest as to Lord Hobhouse's gatherings, that those which apparently returned were not the same birds, but new comers from the north. All our own sand-martins cleared out here in August.

By far the vastest, and I think the latest, great congregation I ever myself saw, was one October 12, at Wentworth House, Earl Fitzwilliam's Yorkshire seat. Almost every tree in the richly-wooded park was alive with their incalculable multitude. That was close upon 1850.

If, as has been recently said, temperature is the sole key to the times of migration, it seems strange that all our varieties of the swallow tribe should leave so much earlier in the south than in the north. This town being so recent, we have very few swallows or house-martins ; but our swifts and sand-martins all disappeared this year in August. HENRY CECIL.

Bournemouth, November 9.

AFRICAN RINDERPEST.

WITH reference to Prof. Koch's present mission, I would venture to observe that the German Government does not deserve the praise given in your last issue. The German Government, like our own, has been guilty of gross negligence in not studying the nature of the rinderpest in 1891 and in subsequent years, when it killed off the cattle and the wild game in the British and German possessions in East and Central Africa.

Up to the time that the epidemic reached the Zambesi, much might have been done, had the nature of the disease been then understood, to limit its progress from the South, while the German possessions in South-west Africa might have been further protected had steps been taken to avert its progress at the Kalahavi.

The attention of the British Government was, as you say, called to the danger in ample time, but it is doubtful if in Germany the danger was even realised. It is now too late for either the British Colonies, the South African Republic, or the Germans in the South-west to do anything to stop the progress of a scourge of the nature of which we are ignorant. Prof. Koch has been engaged by the Cape Government to investigate the nature of the disease, and in his hands we may be sure that this will be thoroughly done. The practical result may be to prevent the disease from being carried to Europe by means of hides, &c. ; but it is too late to save South Africa, where all ordinary means of transport have been paralysed.

I have just received a letter from Major Lugard, C.B., who is now at Lake Nyami, not far from the German frontier, which may be of interest to some. Writing on September 3 from his camp, near the Botletle River, he says: "I am glad the Royal Society is likely to take up the question of the cattle plague. It is strange that the natives here insist that the crocodiles and hippopotami are dying of it. I cannot believe it true, but we came upon a dead hippopotamus; an unusual thing, since the people are such keen hunters, and its hide so valuable here. I shall, however, try and verify these reports, and let you know. The plague has now reached Sekome's town (near Lake Nyami), and will presently be in Damaraland and German South-west Africa. It ought to have been most easy to prevent its progress westwards, for there is but little communication between Nyamiland and the rest of the Protectorate, since the Kalahari Desert, with its sand and thirst, intervenes. But nothing whatever has been done. Beddoe tells me the natives are dying of eating too much 'rinderpest' beef. I do not know if this is true; all the natives eat it, and convert it into 'Biltong' for future use. I see that Mr. Long pooh-poohed the idea of imported hides bringing the disease into England. Probably tanned hides would not, but surely raw hides would bring it for certain? There is nothing more extraordinary in the course of this plague than the different classes of animals it has attacked in different localities. In East Africa, the buffalo, eland, and giraffe, I believe, suffered most. The common water-buck, all harte-beests, and zebra were, I think, exempt. The smaller sort of water-buck (*Kobus Kobæ*) suffered to a great extent, but nothing like the other game. Yet Mr. Sharpe, now acting Commissioner in Nyasaland, reported that round Lake Moero, two years later, the animals that suffered most after the buffalo were zebra and lechive. Now here, on the Botletle River, they say crocodiles and hippopotami, and also, I have heard, elephants, donkeys, and dogs are affected. Animals are here said to go mad before death, and become very dangerous. I am delighted to hear the matter has been taken up, and is likely to be referred to a Committee of the Royal Society."

As Major Lugard has been in contact with the advance of the disease in East Africa in 1891–92, and is now brought face to face with it under most trying circumstances in South-west Africa, the account given of how differently it affects the various animals in different localities may be of interest; as also the impression left on his mind that, under proper care, the advance of the epidemic might have been averted had the British and German Governments a few years ago taken the step now adopted by the Cape Government, and examined the nature of the disease when it attacked their possessions in East Africa as in Nyasaland.

JOHN KIRK.

THE LEONID METEOR SHOWER, 1896.

THE expected display does not appear to have been a brilliant one. It may have offered a more attractive spectacle to American observers, for it seems to have been very probable that the richest part of the stream was encountered by the earth during daylight of the 14th in England. At stations far west an opportunity might have been afforded of witnessing a tolerably active return of the phenomenon; but of this we have not yet received definite information.

From my own observations at Bristol, and from others secured by Mr. Blakeley at Dewsbury, it appears that the shower was a very ordinary one, both on the mornings of the 14th and 15th. Mr. Blakeley watched the sky from midnight on the 13th to 4h. 15m. a.m. on the 14th, and during this long interval only recorded twelve Leonids. He says: "Meteors of all kinds were scarce, and the Leonid shower was especially disappointing, fewer of its meteors being seen than last year during a shorter watch of the sky. Twelve in a period extending over a period of $4\frac{1}{4}$ hours is a very poor result."

A dense fog obscured the stars at Bristol on the night of the 13th, and observations were not possible. On the 14th the sky cleared late at night, and the morning hours of the 15th were beautifully clear. From a position having a somewhat restricted view of the firmament, I counted nineteen meteors between 4 and 6 a.m., and of these eleven were Leonids. The display was, therefore, more active on the morning of the 15th than on that of the 14th, if we compare my figures with those obtained by Mr. Blakeley at Dewsbury. But the shower was of minor importance as regards numbers, and fell below the strength of that observed by me in 1879 and 1888, when certainly there was little reason to expect any pronounced activity.

Of the eleven Leonids observed by me on the morning of the 15th, three were pretty bright, and left streaks for about 5 seconds. The paths were as follows, and it would be interesting to hear of duplicate observations of either of these:—

Date.	G.M.T. h. m.	Mag.	From	To
Nov. 15	4 49 a.m.	♃	$200° + 18°$	$208° + 16°$
,,	5 1 ,,	>1	$203 + 20$	$210 + 18$
,,	5 27 ,,	< ♃	$149\frac{1}{2} + 31$	$149\frac{1}{2} + 33$

I carefully pencilled the tracks of these and eight other Leonids on an 18-inch globe, and found the radiant point sharply defined at

$$150° + 22\tfrac{1}{2}°,$$

and this agrees very closely with the position determined in previous years.

Among the meteors I recorded, there were two Taurids, and two very swift flights from Gemini at about $108° + 25°$.

A correspondent at South Croydon informs me that his attempted observations of the Leonids failed owing to overcast sky and rain. I fear, therefore, that reports generally from the London district will be very unfavourable.

Attempts to photograph the meteors, and to derive an accurate radiant by this means, will probably have met with little success anywhere in consequence of the poorness of the display. I believe that only during a very rich shower, will this method prove successful. Even then the limits of error will be larger than many people anticipate, as the meteor flights are not emanations from a point, but an area the actual centre of which is not defined with great precision. Still it is well the photographic method should be fully and fairly tried, as naked-eye observations are often more than 1° in error in fixing the radiant.

Since the above was written, several accounts have been received which show that the display of Leonids was pretty active in the early part of the night following November 14. One observer states that there was quite a rich shower of meteors at about 11h. 30m. Mr. Corder at Bridgwater watched the sky from 14h. to 18h. 30m. on November 14, and counted about seventy meteors. He saw eleven Leonids in the first thirty-five minutes of the period named, but the shower fell off rapidly afterwards. Mr. Corder determined the radiant at $146° + 25°$ on November 13, and thinks it shifted to $150° + 23°$ on November 14. On the nights of November 12 and 13 he saw fewer Leonids than on November 14, and there is little doubt that the maximum of the shower occurred early in the night of November 14, and before the moon had set.

W. F. DENNING.

For the observance of these meteors a watch was kept by me, commencing on the evening of the 12th, but the weather was such that only two nights were suitable for observation, namely the 12th and 14th. Arrangements had been previously made to keep a photographic record of the region about the radiant point, by fixing a camera on the polar axis of a siderostat, and driving it by clockwork. In this way each plate could be exposed for forty minutes without any intervention on the part of the observer; but little result was obtained, in consequence, most probably, of the great amount of dew that was deposited on the lens.

Five plates exposed on the 12th, between 12h. 55m. a.m. and 4h. 8m. a.m.—Greenwich mean time—showed no trace whatever of any meteor; and eye observations made during the same interval, but with occasional breaks, were not very fruitful as regards results, only about twenty meteors in all being recorded, and not even all these Leonids. The evening of the 14th was very cloudy, but towards midnight the weather cleared, and turned out eventually very fine. Four plates were exposed consecutively between 1h. 20m. a.m. and 4h. 20m., but no trail was caught, although a few trails were observed to pass in the range of the wide-angle lens. It was found, however, impossible to keep the moisture away, although special precautions were taken on this evening to shield the lens. More strict attention was paid, however, to eye observations, and an almost continuous watch during the interval (three hours), mentioned above, was not devoid of results. In all, thirty-two meteors were seen: nineteen of these were judged as Leonids, ten as Andromedes, and two as sporadic. At 2h. 37m. a.m. a fine meteor was observed to pass a little to the north, and parallel to the belt, of Orion. Five short trails of distinct Leonids were observed near the radiant point. The most brilliant meteor of the evening, or rather of the morning, was that which appeared at 4h. 17m. a.m. Commencing in the northern part of the constellation of Hydra (about ζ Hydræ), it moved in the direction of Jupiter, passing a little to the south of Regulus, skirting ι Leonis, and vanishing near ζ Ursæ Majoris. Its trail must have been quite 45° in length, being brilliant with a bright stellar nucleus. As this meteor's path was included in the region that was being photographed at the time of its appearance, it was a great surprise to find no sign of its trail on the plate. The general idea gathered from these two watches was that the Leonids were not more abundant than usual; in fact, one was surprised at the apparent dearth of these bodies. W. J. S. LOCKYER.

Almost exactly at 11 p.m., on November 12, 1896, I saw in the east a remarkable meteor. Castor and Pollux were practically in a vertical line, and the meteor appeared a short distance below Pollux, moving horizontally in a direction from right to left (south to north, as it were), at right angles to a line produced through the stars named. Curiously enough, the produced path of the meteor would lead to a position not far from the radiant point of the Leonids; but the direction of motion was centripetal, not centrifugal, as regards this radiant. The bright head of the meteor was soon extinguished, leaving behind it a very beautiful evanescent trail of tiny purple sparks. I saw no meteors coming from the radiant in Leo. C. T. WHITMELL.

Cardiff.

THE MOUTHE CAVE.

IN a recent number of *La Revue Scientifique*, an interesting account was given by M. Rivière of his anthropological work in connection with the "Mouthe Cave."

M. Rivière has done much research in this direction, and chiefly in the districts of Saint-Cyprien, Bugue, and Montignac. He has explored and studied minutely the caves of Pageyral, Combarelles, and Rey, about which he hopes to publish a volume, as the excavations are now complete. During his work he has come across some very curious finds.

Certainly the most interesting, because unique, cave yet visited by him is the "Mouthe Cave." It is situated near the hamlet of La Mouthe, in the neighbourhood of Saint-Cyprien, and was discovered by M. Rivière quite accidentally on September 2, 1894. The cave had been *emptied*, as was thought, by the owner, M. Lapeyre, forty-nine years before, and had been used as a barn for storing beetroot and potatoes during the severe winter months. The rubbish cleared out of it was thrown on the neighbouring fields; it consisted chiefly of bones, teeth, and cut flints, but the latter only could be found by M. Rivière. After a lapse of half-a-century, it is not surprising that the other remains had decayed and disappeared in the soil.

Returning to the cave later, in company with M. G. Berthoumeyrou, M. Rivière found at the furthest extremity several quaternary hearths, quite *untouched*. On removing a little of the soil, the explorers came across reindeers' teeth and pieces of bone; also a sea-shell, with a small hole, as if it had once been bored for suspension.

The work was not continued till the following year (1895), when in April, while levelling the floor, the slope formed by the hearths was slightly disturbed, and brought to light a semicircular hole, which proved to be the opening to a very narrow passage. A few days later the passage was explored by MM. E. and G. Berthoumeyrou, but not without great difficulty, it being little more than twelve inches high and twenty inches wide. The curious drawings, described later, were not seen till a distance of ninety yards had been reached.

Later, M. Rivière had a cutting made of dimensions strictly necessary for reaching the drawings more easily, and ascertaining the different epochs at which the cave was inhabited.

In the middle of July, some results of the excavations were sent to the Academy of Sciences, consisting chiefly of rubbings of a drawing of an animal resembling a bison or auroch. Three weeks later M. Rivière returned to La Mouthe, in order to commence a thorough and methodical exploration of the cave. All the earth, on being taken from the cave, was carefully sifted, so that nothing should be lost; bones, teeth, and flints were found. The work lasted a month, and was taken up in March and April of this year, and again in August and September.

The cave is at an altitude of about 200 yards, and 130 yards above the railway, which is about two miles away. It is situated at the top of a hill, the semicircular entrance being nearly eleven yards wide and a little over three yards high. The hamlet of La Mouthe is about 320 yards away, and the orientation of the cave is east-south-east. The rock is of very impure limestone, mixed with clay, and containing grains of quartz.

The following are the results at which M. Rivière has arrived concerning the age and former inhabitants of the cave, which has been inhabited by man at two distinct epochs.

(1) At the Neolithic epoch, since the upper surface is formed entirely of hearths containing cinders and coal, with bones of animals belonging to the present geological epoch, numerous pieces of coarse pottery, human bones, of which some seem to have belonged to one person, besides a good number of cut flints.

(2) At the Quaternary epoch, geologically speaking, for this upper surface rests on a fairly thick stalagmite which separates it from hearths which are much more ancient; the latter fact being proved by the fauna found by M. Rivière (Ursus spelæus, Hyæna, &c.). In this underlayer many cut flints were found, also weapons and instruments in bone. Amongst the latter may be mentioned a long fine needle, about six inches long, almost perfect; also bones engraved with figures, and teeth, bored, as if once used for amulets. No pottery, however,

or polished flints or human bones have been found in this lower layer up to the present time.

At a short distance from the entrance the Neolithic finds cease, leaving the stalagmite uncovered; but, on the other hand, the quaternary hearths persist, and they are less dark in colour, and of reddish hue, owing to clay with which they are mixed. Further on the hearths become simple layers of clay, containing quaternary fauna and worked flints. Further on still, about seventy yards from the entrance, there is a great accumulation of remains of bears, and hyænas' teeth, &c.

Owing to the excavations made under the direction of M. Rivière, it is possible to go about a length of 136 yards in the cave with perfect ease. A further distance of eighty yards may be traversed, but only by crawling, as the passage is very small.

The drawings on the sides of the cave were first noticed in April last year; they consist generally of two kinds—some simple, made on the walls and ceiling (vault) of the cave; others with certain features coloured with ochre. There is a third kind, consisting of a scratching of the rock, the scratches being covered also with ochre. The first and second represent animals only. In some cases it is difficult to make out what is represented; two, however, have been identified, one being a bison; the other the hinder limbs of which seem to represent a kind of ox, while the head (of which part is effaced) resembles a horse with a short mane. It measures no less than two yards in length from the tip of its snout to the end of its tail.

The photographs of these two drawings, which were sent to the Academy, were taken by M. Charles Durand, They were obtained by means of an illumination of 140 candles, and an exposure of four and a half hours. M. Rivière and M. Durand hope at some future time to photograph the other engravings.

HENRY NEWELL MARTIN.

HENRY NEWELL MARTIN was born on July 1, 1848, at Newry, Co. Down, Ireland. He was the eldest of a family of twelve, his father being at the time a Congregational minister, but afterwards becoming a schoolmaster. Both his parents were Irish, his father coming from South Ireland, and his mother from North Ireland. He received his early education chiefly at home; for though he went to several schools, his stay was not long at any one of them.

Having matriculated at the University of London before he was fully sixteen years of age (an exemption as to age being made in his favour), he became an apprentice to Dr. McDonagh, in the Hampstead Road, London, in the neighbourhood of University College, on the understanding that the performance of the services which might be required of him as apprentice, should not prevent his attending the teaching at the Medical School of the College, and the practice at the Hospital. It was here that I made his acquaintance in 1867. I was at that time teacher of histology and practical physiology at the School, having succeeded the late Dr. George Harley, and I well remember that Martin asked my permission to attend my course, in face of the drawback that, owing to his duties as apprentice above mentioned, he could only give to the study half the time demanded. I unwillingly gave permission; but soon found that Martin learnt in his half time more than the rest of the students in their whole time; and thus begun a friendship between us, which lasted until his death. During his career at University College he greatly distinguished himself, taking several medals and prizes. In 1870 he obtained a scholarship at Christ's College, Cambridge, Liversidge, now Professor of Chemistry in the University of Sydney, then a student at the Royal School of Mines, gaining one at the same time; he had, in the summer of that year, conducted at Cambridge a class of Histology for the late Sir G. Humphry. Though elected to the scholarship, Martin had some doubts whether he ought to take it up, and anxiously consulted me on the matter. I believe that my being able to tell him that I, too, was about to go to Cambridge, having been appointed Prælector of Physiology at Trinity College, finally removed all hesitation. Thus we two went up to Cambridge together in the October of that year. I at once asked him to assist me by acting as my demonstrator, and during the whole of his stay at Cambridge he was in every way my right hand. His energy and talents made my work much easier, and his personal qualities did much to make natural science popular in the University. At that time there was, perhaps, a tendency on the part of the undergraduate to depreciate natural and, especially, biological science, and to regard it as something not quite academical. Martin, by his bright ways won, among his fellows, sympathy for his line of study, and showed them, by entering into all their pursuits (he became, for instance, President of the Union, and Captain of the Volunteers), that the natural science student was in no respects inferior to the others.

In Cambridge, as in London, his career was distinguished. He gained the first place in the Natural Science Tripos of 1873, the second place being taken by Francis M. Balfour; at that time the position in the Tripos was determined by the aggregate of marks in all the subjects. While at Cambridge he took the B.Sc. and M.B. London, gaining in the former the scholarship in Zoology; he proceeded later to the D.Sc., being the first to take that degree in Physiology So soon as, or even before, he had taken his degree, he began to devote some time to research, though that time, owing to the necessity of his making money by teaching, was limited: his first publication was a little paper on the structure of the olfactory membrane, which appeared in the *Journal of Anatomy and Physiology*.

In the summer of 1873, I had assisted the late Prof. Huxley in the course of Elementary Biology which he initiated at the Royal College of Science, and in the following year I introduced a similar course into my teaching at Cambridge. In this Martin was my chief assistant; he also subsequently acted as assistant in the same course to Prof. Huxley. One result of this was that he prepared, under Huxley's supervision, a text-book of the course which, under their names, appeared with the title "Practical Biology," and which has since been so largely used.

In 1874 he was made Fellow of his College, and giving himself up with enthusiasm to the development of natural and, especially, of biologic science at the University, was looking forward to a scientific career in England, if not at Cambridge. About that time, however, the Johns Hopkins University at Baltimore was being established, and such was the impression made by Martin upon those with whom he came in contact, among others Dr. Gilman, of Baltimore, that in 1876 he was invited to become the first occupant of the chair of Biology which had been founded in the Johns Hopkins University. This offer he accepted, and thus nearly the whole of his scientific career was passed in America. He went out prepared to develop in his new home the higher teaching of biologic science, especially that spirit of research which alone makes teaching "high"; and during the rather less than a score of years which made up his stay at Baltimore, he produced a very marked effect on American science, fully working out the great aim of the University which had adopted him. By himself, or in concert with his pupils, he carried on many important investigations, among which may especially be mentioned those on the excised mammalian heart, one of which formed the subject of the

"Croonian Lecture" of the Royal Society in 1883. These were, in 1895, republished in a collected form by his friends and pupils in America, under the title of "Physiological Papers." And he sent out into the States a number of trained physiologists, fired with his own enthusiasm, who are continuing to advance the science, and one of whom has succeeded him at Baltimore. He also found time to write expository works, and his "Human Body," "Briefer Course" and "Elementary Course," deservedly became very popular in the States.

Upon his first appointment he had the charge of the whole subject of animal biology, and since he was himself more distinctly a physiologist, it was almost his first duty to secure or train up a colleague who should devote himself to morphology. Martin early saw the worth of one of his students, W. K. Brooks; to him he gradually entrusted morphological matters, and thus prepared not only the way for a separate chair of Zoology, but also the man to fill it.

He was elected into the Royal Society in 1885; he also received the title of Hon. M.D. from the University of Georgia.

Martin married in 1879 Mrs. Pegram, the widow of an officer in the Confederate army; but there was no issue, and in 1892 his wife died.

Even before his wife's death his health had begun to give way; and after that event, he became so increasingly unfitted for the duties which his own previous exertions had raised to a very great importance, that in 1893 he resigned his post.

After his resignation he returned to this country, for he had never become an American citizen, and was looking forward to being able, with improved health, to labour in physiological investigations, either at his old University or elsewhere in England. But it was not to be. Though he seemed at times to be improving, he had more than one severe attack of illness, and never gained sufficient strength to set really to work. During the past summer he visibly failed; and while he was striving to recover his strength by a stay in the quiet dales of Yorkshire, a sudden hæmorrhage carried him off on October 27, at Burley-in-Wharfedale, Yorkshire.

Having been for so long a stranger to this country, Martin was, personally, but little known in English scientific circles; in America, however, not in Baltimore only, but in many other parts of the States, especially among the younger physiologists, he has left behind him a memory which will not soon pass away; while those who knew the brightness of his early days in this country, will always hold him in affectionate remembrance. And it may here, perhaps, be granted to myself to say that I can never forget what he was to me in my early days at Cambridge, and the sadness which I am feeling in the thought that he now, as well as Balfour, is no more, is mixed with pride at having been a help to two such men.

M. FOSTER.

NOTES.

ADMIRAL SIR G. H. RICHARDS, whose death on Monday we regret to announce, earned the high esteem of men of science by his valuable hydrographical labours in various parts of the world. He was a scientific navigator, and during his life he contributed much important knowledge to marine surveying. The following particulars of his career are from an obituary notice in the *Times*:—Admiral Richards was born in 1820, and he entered the Navy in 1832. Three years later he was appointed as a midshipman in an expedition fitted out for a voyage of exploration and survey in the Pacific Ocean. He served for five years in the *Sulphur* during the surveys of the west coasts of South and North America, the Pacific Islands, New Guinea, and the Moluccas. As lieutenant on the *Philomel* he took part in a survey of the Falkland Isles in 1842, but circumstances arose which prevented the ship from completing the work. Later he was employed for four years surveying the coasts of New Zealand. Returning home in 1852, Commander Richards found an expedition fitting out for the Arctic regions, to continue the search for the missing ships under Sir John Franklin. He volunteered for and was immediately appointed to this service, sailing in command of the *Assistance* as second to Sir Edward Belcher in the Wellington Channel division of the expedition. While on this service he conducted several extended sledging expeditions, travelling more than 2000 miles over the frozen sea, and being absent from the ships on this duty for a period extending over seven months. Upon the return of the search party he was promoted to the rank of captain, and in 1856 he was appointed to the command of the *Plumper* for the survey of Vancouver Island and the coasts of British Columbia. He was employed for seven years in completing the surveys of Vancouver Island and the adjacent coasts, returning to England in 1863 by the islands of the Western Pacific, Australia, and Torres Straits, making surveys and carrying chronometric distances by the way. This voyage completed his third circumnavigation of the globe. On his arrival at home Captain Richards found himself appointed to the high post of Hydrographer of the Navy, and he discharged the duties of this responsible position for ten years, retiring in 1874. As was only natural, a man of the attainments and experience of Sir George Richards was welcomed and honoured by the principal scientific bodies. In 1866 he was elected a Fellow of the Royal Society, and in the same year a Corresponding Member of the Academy of Sciences of Paris. He was also a Fellow of the Royal Geographical Society. Nor did his energy permit him to relinquish active work on giving up the post of Hydrographer. After his retirement he occupied the position of managing director of the Telegraph Construction and Maintenance Company, and under his direction many thousands of miles of submarine telegraph cables were laid in various parts of the world. During his services at the Admiralty and subsequently he was a trusted adviser of several Administrations, and was a member of numerous Committees on confidential and general questions. He was also president of the Arctic Committee, which sat in 1875.

AN appeal is being made to the men of wealth in America to provide a suitable building for the societies composing the Scientific Alliance of New York. The combined membership of these societies is now over one thousand. Nearly all of them issue valuable publications; several of them possess important libraries and growing collections of specimens, and all are actively engaged in promoting original research. Burlington House partly provides for London scientific societies, but there is no building of like character in New York, though it is hoped that one will be provided by the enlightened liberality of private citizens.

THE meeting and journey to Brighton of motor-cars, arranged by the Motor-car Club as an inauguration of the appearance of those vehicles on highways under the sanction of the Act passed last Session, took place on Saturday, November 14. Fifty-four vehicles were entered for the run, but less than half of them were able to start, owing to the dense crowd of sight-seers in London and unfavourable weather. The distance to Brighton by the route followed is about fifty-five miles, over hilly country. The vehicles started at 10.30, but the crowd was so dense that they could only travel very slowly—about four miles an hour—over the first part of their course. The two Bollée cars were the first to arrive at Brighton, which they reached at 2.30 and 2.45 respectively. These did not, however, travel by way of Reigate, but went direct to Brighton, thereby saving several miles in point of distance, and the loss of time entailed by the crowded roads into and out of Reigate. Even when this is taken into account, their rate must have been sixteen or seventeen miles an hour. The Panhard car, which won the race from Marseilles to Paris, arrived at 3.46, and Mr. H. J. Lawson's car at 4.52, after which cars arrived every few minutes. Up to six o'clock thirteen cars had pulled up at their Brighton destination, and twenty arrived there without accident out of the twenty-two which left Brixton. The Panhard car, a phaeton of the British Motor Syndicate, and the "Present Times" car raced back from Brighton to London on Tuesday. The first of these covered the distance in three hours fifteen minutes, stoppages deducted—an average speed of sixteen miles an hour. The second car came in five minutes behind, and the third half an hour later. In connection with this subject, reference may be profitably made to the current number of *Industries and Iron*, dealing almost entirely with auto-cars and their development. One of the features of the number is a reprint of the paper on "Horseless Road Locomotion," read by Mr. A. R. Sennett at the Liverpool meeting of the British Association, accompanied by the many interesting illustrations shown at the meeting.

A COMPLETE edition of the works of Descartes, edited by Prof. Ch. Adams, of Dijon, and M. P. Tannery, of the Collège de France, is to be published under the auspices of the French Ministry of Public Instruction, in honour of the third centenary of the birth of that philosopher. The edition will contain not only Descartes' philosophical and scientific publications, but also five volumes of correspondence.

DR. PERCY FRANKLAND, F.R.S., will read a paper on November 24, at the Institution of Civil Engineers, on "The Bacterial Purification of Water." In view of the controversy which has recently arisen on the bacteriological aspect of the County Council's report on the London Water Supply, the above paper should afford an appropriate opportunity for the discussion of various questions connected with water bacteriology.

THE Sunday Lecture Society has arranged a short course of twelve lectures, to be given in St. George's Hall, Langham Place, on Sunday afternoons at 4 o'clock, commencing on November 29. Among the lecturers who have been engaged are Prince Kropotkin, Mr. Robert Wallace, M.P., Prof. Miall, F.R.S., Prof. Vivian B. Lewes, Prof. Norman Collie, F.R.S., Dr. Morris, C.M.G., Dr. C. W. Kimmins, Mr. Arthur Claydon, Rev. H. N. Hutchinson, Mr. Richard Kerr, and Mr. W. Herbert-Jones.

REFERRING to the note in last week's NATURE, announcing a prize of £50 for the best treatise upon "the causes of the present obscurity and confusion in psychological and philosophical terminology, and the directions in which we may hope for efficient practical remedy," we are informed that the members of the Committee of Award to whom competing essays may be sent, are as follows:—Prof. Sully, 1 Portland Villas, East Heath Road, Hampstead, London, N.W.; G. F. Stout, University, Aberdeen, N.B.; Prof. Titchener, Cornell University, Ithaca, N.Y.; Prof. Kulpe, Wursburg, Germany. Arrangements are being made to add a French member to be Committee.

THE *British Medical Journal* states that the Russian National Health Society has finally selected November 24 (December 6) as the date for the Jenner celebration. The numerous delays and postponements which have occurred, while they have been unfortunate in some ways, have enabled the Society to gather a more representative collection of exhibits than they could have done had the celebration been held earlier. Nearly all the foreign Governments to whom application was made have sent something of interest. Quite recently a friendly expression of good will was received in reply from Lord Salisbury, who stated that he had brought the matter before the Queen, and that her Majesty had been graciously pleased to present the Society with an engraved portrait of Lady Mary Wortley Montague, whose connection with small-pox prevention is well known to every one. This gift from the Queen is highly appreciated by the Society.

THE *Times* correspondent at Buffalo reports that immediately after midnight on Sunday last, the machinery which has been erected at Niagara Falls for the production of electric power and its distribution, was set in motion; and the receipt of the power at Buffalo, twenty-six miles distant, was announced by a salute of artillery. The first Buffalo customer is the Buffalo Street Railway Company, supplying street conveyance for the entire city of 375,000 souls. This was originally worked by horses, and later by dynamos driven by local steam-engines. The latter are now superseded to the extent of 1000 horse-power out of a total of 7000 from the cataract of Niagara. The aggregate horse-power from Niagara already contracted for in Buffalo is 10,000; and many manufacturers are anxiously waiting to have their applications accepted. From this it is safe to predict that it is only a question of time, and no very great time, when all of the industries here requiring power will receive it from Niagara Falls, and that the twenty-two miles separating the two cities will be built solid with smokeless and teeming factories.

PROF. D. G. ELLIOT, the leader of the Field Columbian Museum of Chicago Expedition, and Mr. C. E. Akeby, his assistant, left Southampton on Saturday for New York by the *St. Louis* on their return from a most successful expedition into Somaliland, whither they went in March last for the purpose of making a natural history collection for the museum. In conversation with a representative of Reuter's Agency, Prof. Elliot said:—"I have obtained a very extensive collection, chiefly of the large mammals, probably the most complete ever brought out of any country by one party. No fewer than fifty-eight cases and barrels were shipped direct from Aden to Chicago, where they will arrive at the end of November. I obtained, moreover, over 300 specimens of birds, fish, insects, and reptiles."

IN an interview with a representative of Reuter's Agency, M. de Gerlache, the lieutenant in the Belgian Navy who is the organiser and leader of the projected Belgian Antarctic expedidition, stated that the expedition is to start from Antwerp on or about July 15 next, in the steamer the *Belgica*, which at present is lying at Sande Fiord, in Norway. The vessel will have to undergo extensive alterations before she enters on her voyage, especially with a view to securing her against ice-pressure; and a laboratory is to be constructed on the deck for the use of the scientific members of the expedition. The *Belgica* will carry a three-years' supply of provisions, a considerable portion of the preserved food having been specially prepared for the expedition. The scientific staff will consist of M. Archowsky, a Belgian geological chemist, who is attached to the General Institute of Chemistry at Liège; M. Danco, a Belgian artillery lieutenant, to whom the magnetic and meteorological observations will be entrusted; M. Racovitza, who will conduct the dredging operations; and M. Taguin, a Belgian, who, in addition to his duties as doctor to the expedition, will assist the other scientific members in their work. The members of the expedition will devote themselves more especially to geological and zoological research. They will determine the sea temperature at different depths, and, in short, aim at making researches similar to those made by the *Challenger* and in other Antarctic expeditions.

THE Russian Geographical Society has received a very interesting piece of news from Sven Hedin, the Swedish explorer, who now completes already his second year of travels in Central Asia. He went in December last from Kashgar to Khotan, and from this town he undertook the exploration of the part of the Gobi Desert which is known under the name of Takla Sands. There he discovered the ruins of two cities, one of which was very big, and now strikes the traveller by the purely Indian character of its ruins. Following the banks of the Keria River northwards, Sven Hedin crossed the desert, meeting on his way with a tribe, entirely isolated from all communication with the outer world; and finding full herds of the wild camel, of which he secured three specimens. Then, after an eight days' march, he reached the region where the Chinese maps place Lake Lob-nor, and which is situated to the north of the lake which was first visited by Przevalsky, and was described by him as the Lob-nor, going since on our maps under this name. Traces of an immense lacustrine basin, partly covered with woods and thickets, were discovered by Hedin in the region assigned to Lob-nor by the Chinese maps, as well as several lakes, which were filled up, nine years ago, by the waters of the Tarim River, as its bed seems to have been obstructed by sands, and it consequently began to flow northwards. We thus have two separate lacustrine basins, the Northern and the Southern Lob-nor, which are in mutual dependency, and, both being fed by the Tarim, alternately receive its waters.

SOME little time ago (August 27, p. 402) the announcement was made in these columns that Prof. J. C. Ewart had succeeded in obtaining a male hybrid between a male Burchell's zebra (*Equus Burchelli*) and a mare (*E. caballus*). A full description of the animals, with illustrations, appears in the November number of *The Veterinarian*.

REFERRING to the strange purple patches on pavements, described by Miss A. Pedder in last week's NATURE, two correspondents suggest that they are produced by the aniline colour of fragments of so-called copying-ink pencils, dropped in the process of sharpening, or broken off while the pencils were being used.

THE Annual "Cryptogamic Botanical" meeting of the Essex Field Club will be held on Saturday next, at Chingford. The objects of search will be mainly the smaller fungi and the Mycetozoa, under the direction of Mr. Arthur Lister and Dr. M. C. Cooke. Those wishing to attend should communicate with Mr. W. Cole, Buckhurst Hill, Essex.

A CIRCULAR announces to us the formation of the British Mycological Society, having for its objects the study of mycology in all its branches, systematic, morphological and pathological, the publication of annual reports recording all recent discoveries in any branch of mycology, and more especially giving a brief synopsis of the work of European mycologists and the recent additions to the British Fungus Flora. An annual week's meeting or foray will be held at some place previously determined at the annual meeting. Mr. George Massee, Royal Herbarium, Kew, has been elected first President, and Mr. Carleton Rea, 34 Foregate-street, Worcester, is the Secretary. The first meeting of the Society will be held in Sherwood Forest, commencing on the third Monday in September 1897.

LORD WALSINGHAM and his Zoological Secretary, Mr. J. H. Durrant, have published a pamphlet entitled, "Rules for Regulating Nomenclature, with a view to secure a strict application of the law of priority in entomological work." The subject of zoological nomenclature has been a vexed question for half a century, and, if we may judge from the amount of discussion that has recently occurred, we must conclude that zoologists are still far from agreement as to the best means for attaining the object they so much desire, viz. a set of cosmopolitan and permanent names for all kinds of animals. Lord Walsingham has not, we believe, hitherto expressed any formal opinion on the subject; and as he has for many years devoted great attention to one of the most extensive and difficult departments of zoology, his opinions will no doubt receive full consideration from other naturalists. The point most prominent in this pamphlet is the method of treating the names of genera. No doubt this, as well as other details, will be fully discussed elsewhere.

THE identification of the individual, with special reference to the system in use in the office of the Surgeon General of the United States Army, is the subject of a communication by Dr. C. H. Alden in the September number of *The American Anthropologist*. The method adopted consists solely of noting scars or other marks on outline diagrams representing the front and back view of a nude man. Scars form the most important group, and are arranged first as to location *L. B. head* (left back head), *R. B. head*, &c.; then according to height of subject, those upon individuals under 67 inches being placed together. Then come the tattoos, which are similarly classified according to regions, and subdivided by heights; and so on. The first classification is of course racial, whether white or coloured. The system is claimed to be specially adapted for army use, from its simplicity and facility of application. No apparatus and no camera, or elaborate personal description is required. The main object of identification is to detect deserters, and to prevent repeated enlistment. The author states that the Bertillon system requires more time than can ordinarily be given to each recruit at his examination, and there is the difficulty of the transport of apparatus. The success which has attended the use of the army system, covering a period of nearly six years, is perhaps the best proof of its value.

A DESTRUCTIVE cyclone was experienced in the Gulf of Aden on October 14, and the reports of the storm already to hand show that the disturbance is of considerable interest from a meteorological point of view. Cyclones are of very rare occurrence in the Gulf, and the storm of last month is probably the only instance of such an occurrence at this season in recent years. The disturbance was evidently travelling approximately from east to west, and must have been met with by many vessels either in the Arabian Sea or the Gulf of Aden. A discussion of the storm would be interesting, and any observations forwarded to the Royal Meteorological Society, 22 Great George Street, Westminster, will be used for tracing the development and movement of the disturbance.

THE Washington Weather Bureau has issued a pamphlet containing replies to some questions referred to the recent Meteorological Conference at Paris, and giving an account of the methods of extending meteorological observations in the interest of agriculture. By a liberal use of the telegraph and the co-operation of the Postal Service, the dissemination of weather forecasts has steadily increased until at the present time they are exhibited in more than 30,000 places. One of the simplest and most effective means of making the forecasts known consists in telegraphing them to a central point, and duplicating the messages, by using the Government franked postal cards, to all places that can be reached in useful time. A simple printing outfit, consisting of rubber logotypes with hand-stamp, is sufficient for the purpose. A novel means has also been lately tried with some degree of success, viz. the utilisation of the post-office stamp for dating the time of receipt of letters, &c., at the office of destination, by combining the weather forecast with the stamp showing the name of the receiving office, &c. Thus the recipients of the letters get the weather forecast at practically no additional cost of labour to the post-office officials. The issue of the Daily Weather Map is very speedily done by what is called the chalk-plate printing process. It consists of a steel plate, covered with specially prepared chalk, making a surface suitable for receiving the curves and symbols representing the conditions of weather. The plate when thus prepared is stereotyped in the usual way, while the text is rapidly made up by the use of logotypes.

IN the *Atti dei Lincei*, Dr. Uberto Dutto describes an interesting series of observations performed with a D'Arsonval calorimeter on the common marmot and other animals. According to the ordinary law of dimensions, the quantity of heat radiated from the skin of an animal at a given temperature should be proportional to the square of its linear dimensions, but Dr. Dutto finds that the emission of heat is considerably greater from the marmot than from a rabbit of the same size and colour; although the temperature of the former is four or five degrees lower than that of the latter. It is suggested that these circumstances explain why the marmot and certain other mammals hybernate in winter. With the fall of temperature the vitality of the animal becomes insufficient to keep up the necessary supply of internal heat, and a period of torpor ensues.

IN a recent number of the *Johns Hopkins Hospital Bulletin* Dr. Robert Randolph gives an account of some investigations he has been carrying out on the use of absolute alcohol as a disinfectant for surgical instruments. The use of absolute alcohol as a germicide is not new. Fürbringer was the first, in a pamphlet published in 1888, to call attention to its value as a disinfectant for the hands, and Reinicke has confirmed these observations, as well as, more recently, Krönig, Ahlfeld, and Schaefer. Dr. Randolph is of opinion that although under ordinary conditions instruments may with advantage be disinfected by means of absolute alcohol, yet should pyogenic organisms be present in large numbers in any operation, this mode of sterilisation cannot with safety be resorted to.

TWO or three months ago a St. Petersburg medical review, *Vrach*, inserted a letter from a Russian doctor, M. Denisenko, who earnestly entreated his colleagues to experiment upon the sap of the Wart-wort, *Chelidonium majus*, Linn., as a possible remedy for the treatment of cancer. The sap of this plant is widely used in Russian popular medicine, as it is also in this country, for making warts disappear. Having tried for some time to use it externally against cancer-growths, M. Denisenko, came to the use of a preparation of the *Chelidonium* sap, which he rendered public, as an internal remedy. After a prolonged use in very small doses, this preparation seemed to make the cancer growths disappear. Now the same review (No. xxxiv., August 25, September 6) contains a paper, by the Russian doctor, in which the history of seven cases of cancer are given, four being cases of external growths in such places of the body as rendered surgical operations of no use, and three cases being internal-growth in the œsophagus and the stomach. The former are illustrated by photographs, from which it would seem that the effects of the above-mentioned internal treatment are simply astonishing. The growths have totally disappeared. As to the cancer-growth in the œsophagus, it has so much diminished that the patient, who formerly could swallow liquid food only, can now swallow chopped meat, bread, and hard-boiled eggs, while no more traces of a swelling are to be found in the œsophagus. This appears to be the first case on scientific record of cancer-growths having been made to disappear by the use of internal remedies only. Of course, it has to be ascertained whether the growths will not re-appear; and moreover, as the *Chelidonium* sap contains two deadly alkaloids, the chelidonine and the sangui-pyrine, it has to be seen whether its continued use, even in small doses, will not tell in the long run. It hardly need be added that, owing to the poisonous nature of the remedy, it must, in no case, be used without the prescription of a medical man. Cases of *Chelidonium* poisoning are not uncommon in popular medicine. Dr. Denisenko concludes by appealing for further experiments, in such cases where surgical operation is not possible.

THE *Kew Bulletin* for September-October records the successful growth in Queensland of a new seedling variety of the sugar-cane, derived originally from seed obtained from Barbadoes.

INTEREST in Arctic matters is so keen at the present time, that many people will probably be glad to have their attention directed to the second part of a paper on the glacial geology of Arctic Europe and its Islands, which Colonel H. W. Feilden contributes to the current *Quarterly Journal* of the Geological Society. The paper refers to proofs of changes of level in northern Norway, terrace-making in Kolguev Island, glacial geology of the Kola Peninsula, Novaya Zemlya, Franz Josef Land, and Spitzbergen. Another paper of general interest in the same number of the *Journal* is on seismic phenomena in the British Empire, by M. F. de Montessus de Ballore.

IN the third part of the first volume of the *Centralblatt für Anthropologie, Ethnologie und Ungeschichte*, in addition to the usual valuable epitome of recently published papers, there is a short original article by Prof. Aurel von Török, of Budapest, on some characteristic differences between human and animal skulls. The author looks at the skulls from above, in front, sideways and behind, and by observation, and entirely without taking measurements, he notes that the relative position of certain parts is distinctly human or characteristically animal; he gives technical names to these different conditions.

THE November Pilot Chart of the North Pacific Ocean, issued by the U.S. Hydrographic Office, contains an account of the chronological and geographical distribution of icebergs in the Southern and Antarctic Oceans, accompanied by two charts, one showing the seasonal iceberg limits, and the other the icebergs reported in the different seasons during the years 1891-5. An inspection of the charts seems to show that the bergs are formed at special parts of the Antarctic continent, and are then drifted northward and easterly, the principal groups of bergs being in the vicinity of Cape Horn, the Falkland Islands, and South of Africa, while the limits differ with the seasons. The life of a berg in the southern oceans is probably much longer than of one in the northern oceans, as they are larger and more compact, and drift to lower latitudes in the South Atlantic than those in the North Atlantic.

THE Rev. Johann G. Hagen, Director of the Observatory of Georgetown College, Washington, has rendered good service to mathematicians by preparing a complete catalogue of the works of Leonard Euler. Although several catalogues of this mathematician's works have previously been published, it was found that the information contained in these was in some respects fragmentary and incomplete in regard both to the exact titles of the papers, and to the dates of their publication. The present catalogue is divided into four sections, dealing with mathematical, physical, astronomical, and miscellaneous works respectively; and an idea of the magnitude of Euler's work may be gathered from the fact that no less than 796 memoirs and notes are included in this catalogue. The publisher is Felix L. Dames, of Berlin.

THE first issue of the *Academy*, published on October 9, 1869, contained a review of Dr. Haeckel's "Natural History of Creation," by Huxley. In the more than a quarter of a century which has elapsed since then, science has not figured very prominently in the pages of our contemporary, but it has been given a place, and Tyndall, as well as Huxley, have shone in that place. Because of this memory we have pleasure in calling attention to the entirely new issue of the *Academy*, begun by the current number (November 14). It is proposed to widen the scope of the interests and influence of the paper; but whether the changes will mean increased attention to science, it is difficult yet to decide. At present the expansion seems to be confined to the limits of a page of science notes.

WE have received from Messrs. C. W. Faulkner and Co., the well-known artistic colour printers, some specimens of their new parlour games, together with numerous samples of their Christmas and New Year cards and calendars. In the case of the first-named, this firm has hit upon some ingenious games which combine both amusement and scientific skill, and which can be played by both the old and the young with delight. Of these we may mention the game entitled, "Attracto" or "Catch 'em," which is a novel form of fish-ponds. In place of the hook a magnet is employed, by which one must catch in a prescribed way small metal fish. "Nurky," or the game of "Ducks and Drake," also requires some skill in manipulation, and is a good round table game. Perhaps the most striking feature about the cards, in addition to their artistic nature, is the excellence of the process illustrations; the subjects being both well chosen and of a varied nature. An excellent series of new publications, both in photogravure and platinotype, in most cases well worth framing, are also issued, the types of which are both humorous and sedate. Mention must also be made of the many different styles of calendars for the coming year, for all of them are very attractive.

WE have on our table new editions of several scientific works. From Messrs. Longmans, Green, and Co. has come the third edition of Dr. Augustus D. Waller's "Introduction to Human Physiology." The principal changes in this edition are in the chapters on nerve and animal electricity, the results described in this year's Croonian lecture at the Royal Society having been incorporated. The same publishers have just issued a second edition of "The Life and Letters of George John Romanes," written and edited by his wife. To the new issue of Stanford's compendium of geography and travel, another volume by Mr. A. H. Keane has been added. The volume is on Southern and Western Asia, and like the one on Northern and Eastern Asia, published a short time ago, it forms an admirable work for reading and reference. A revised edition (the third) of "A New Course of Practical Chemistry," by Mr. John Castell-Evans, has been published by Mr. Thomas Murby. The course covers the principles of qualitative and quantitative analysis, and comprises a systematic series of experiments and problems for the laboratory and class-room. "The book is intended," says the author, "to help students to attain a real knowlege of scientific chemistry, and not to prepare for mere examinations." Certainly the student who performs all the experiments in the book, and works out all the numerical problems, will advance his knowledge considerably. So long ago as 1872, the first edition of "A Junior Course of Practical Chemistry," by Mr. Francis Jones, was published by Messrs. Macmillan and Co. It speaks much for the character of this little volume that in general arrangement, and in the prominence given to experimental work on the principles of chemistry, the course followed much the same lines as that adopted only last year by the Science and Art Department as suitable for chemical laboratory practice. The eighth edition now published will, no doubt, be widely adopted in departmental classes, and it may be introduced with advantage into all schools and colleges where elementary practical chemistry is taught.

IN the current number of the *Berichte*, Prof. Victor Meyer records some remarkable observations which he has recently made on the oxidation of hydrogen and carbon monoxide. It has been long known that these gases, even when pure, are slowly absorbed by a solution of potassium permanganate. The process has hitherto been regarded merely as one of slow oxidation, presenting no special feature of interest. But in the attempt to devise an apparatus for the exact study of the change, a remarkable fact came to light. It was found that an acidified solution of the permanganate, when continuously shaken with either hydrogen or carbon monoxide in a closed vessel, absorbed these gases, and was reduced, but that at the same time a large volume of oxygen was liberated. It was proved by a series of experiments that the evolution of oxygen in the quantity observed was in some way dependent on the oxidation process, for the permanganate solution evolved a comparatively small amount of oxygen when agitated in an indifferent gas or *in vacuo*. Without committing himself to a final opinion, Prof. Meyer can, at present, suggest no other tenable explanation of the phenomenon than that in the slow oxidation process one atom only of each molecule of oxygen yielded by the permanganate is used for oxidation, the unused halves of the molecules being set free and combining to form fresh molecules of oxygen gas. This view is in reality the same as that to which van 't Hoff has been led by the study of other less simple cases of slow oxidation. The scheme would be as follows:—

$$\begin{array}{c}\boxed{H_2\ \ O}\,|\,O\\ +\\ \boxed{H_2\ \ O}\,|\,O\end{array} = 2H_2O + O_2.$$

The quantitative results, so far as they go, offer some support to this view; but a further study of the question is in progress, and the results will be awaited with great interest.

THE additions to the Zoological Society's Gardens during the past week include a Diana Monkey (*Cercopithecus diana*), a Campbell's Monkey (*Cercopithecus campbelli*) from West Africa, presented by Mrs. Skottowe; a Macaque Monkey (*Macacus cynomolgus*, ♀) from India, presented by Mrs. Monillot; a Himalayan Bear (*Ursus tibetanus*, ♂) from India, presented by Mr. Alfred W. Alcock; a Virginian Opossum (*Didelphys virginiana* from North America, presented by Mr. Edward Johnson; a Great Eagle Owl (*Bubo maximus*), European, deposited; a Green-cheeked Amazon (*Chrysotis viridigena*) from Colombia, a Malaccan Parrakeet (*Palæornis longicauda*) from Malacca, purchased; a Cocteau's Skink (*Macroscincus cocteaui*) from the Cape Verde Islands, a Gay's Frog (*Colyptocephalus gayi*) from Bolivia, received in exchange.

OUR ASTRONOMICAL COLUMN.

PARTIAL IMPACT OF CELESTIAL BODIES.—We have received from Prof. A. W. Bickerton, of the New Zealand University, a collection of papers which he has published on his theory of partial impact. This theory, he says, gives "a perfectly simple explanation of the origin of temporary, variable and double stars, and accounts for all their peculiarities. It explains the formation of multiple stars, star clusters, and also the mode of evolution of every definite form of nebula . . ."

As for the theory itself, something may be said in its favour. The author has grasped the fact that enormous masses of incandescent matter cannot cool practically in a few weeks, and his hypothesis explains satisfactorily the phenomenon of new stars. "A typical new star is probably a thousand times as bright as our sun; it appears suddenly and disappears in a year . . . The formation of such a body is difficult enough to explain on any theory except that of impact, but to explain its disappearance is more difficult still. It is estimated that it will take the sun ten million years to lose half its lustre. Think of a sun a thousand times as bright cooling in a year. The idea is absurd." Prof. Bickerton suggested his idea of partial impact as long ago as 1879, and it certainly strengthens the hypothesis put forward by Mr. Norman Lockyer, that some stars are not stars like our sun, but masses of meteorites, which in the case of new stars and variables collide with one another.

This hypothesis was suggested in the year 1877, and in a paper read before the Royal Society on April 16, 1891, entitled

"On the causes which produce the phenomena of new stars," an historical summary of various theories is given.

THE COMPANIONS OF PROCYON AND SIRIUS.—Prof. Kreutz, telegraphing from Kiel on Sunday, has informed us that Prof. Schaeberle, of the Lick Observatory, has discovered a companion to Procyon. Its position angle was measured as 318°, the distance being 4″·6; its magnitude is 13.

A communication from Prof. Holden tells us that Clark's companion to Sirius has been also observed at the Lick by Prof. Aitken on October 24 (position angle 189°·0, distance 3″·81), October 29, and October 31, and by Prof. Schaeberle on October 29 and 31 (position angle 189°·1 and distance 3″·65). Nothing was seen of the companion at position-angle 220°, as reported by Dr. See.

"BRISBANE ASTRONOMICAL SOCIETY."—Under this title a new astronomical society has just been founded; the formation being in this wise. A 6-inch refractor, equatorially mounted, belonging to Mr. F. D. G. Stanley, Toowong, was for sale. To keep the instrument in the colony Mr. Dudley Eglinton prepared a short subscription list, and obtained sufficient contributions to purchase it. Seventy subscribers of £1 were obtained, and their subscriptions were sufficient to secure the telescope, the observatory, and "all that therein is." The purchasers then formed themselves into an astronomical society. Arrangements have been made for different sections of the society to carry out distinct branches of work, and certain evenings have been fixed when members can use the telescope. We look forward to results from this co-operative astronomical observatory.

"BULLETIN DE LA SOCIÉTÉ ASTRONOMIQUE DE FRANCE."—The November number of this journal contains three beautiful reproductions of the enlargements made by Prof. Weineck from the Lick photographs of the lunar surface. The first of these shows the crater *Tycho* and the mountainous region around it, the scale of enlargement from the original negative being about eleven times; this photograph was taken last year in October, that is about two days before the moon's last quarter. The second shows the smaller craters around *Flammarion*, while the third gives one a good view of that enormous crater *Clavius*, which has a diameter of 230 kilometres, or nearly three times that of *Tycho*. M. Gilbert gives a first contribution on mechanical proofs of the earth's rotation, dealing chiefly, in this number, with the different experiments carried out of dropping bodies from aigh elevations, and from the top of deep pits. An observer, stationed at Li-ka-wei in China, gives a brief description of the eclipse of the sun of August 9, which was unfortunately only partial there. He relates that the atmospheric conditions were excellent, which were more than they were on the island at Yéso, as our observers can testify. Photographs were taken at the most interesting stages of the phenomenon.

THE WORK OF THE SCIENTIFIC AND TECHNICAL DEPARTMENT OF THE IMPERIAL INSTITUTE.[1]

THE Scientific and Technical Department of the Imperial Institute has been recently inaugurated in order to provide for the scientific investigation of Indian and Colonial natural products, especially those which are new or little known, chiefly with a view to their utilisation in commerce, in medicine, and the arts, both within the British Empire itself, and also in foreign countries. The capacious rooms on the west corridor of the second floor have now been equipped as laboratories (Figs. 1 and 2), instrument rooms, and sample preparation rooms, to which a small reference library has been added; and a staff of skilled chemists has been appointed to assist in investigating problems relating to the utilisation of natural products of all kinds which have been referred to the Department by the Government of India, or by the Colonial Governments.

FIG. 1.

The necessary funds for the appointment of a skilled staff adequate for the commencement of operations have been contributed, with far-sighted generosity, by H.M. Commissioners of the 1851 Exhibition, who make an annual grant for the purpose; whilst the Goldsmiths' Company have made themselves responsible for the provision of the whole of the equipment of the laboratories and much of the special apparatus required. Besides this, grants are made by the Government of India towards the expenses of prosecuting Indian inquiries; whilst the Executive Council of the Imperial Institute, in addition to setting aside an annual sum from its general fund, on which there are already numerous and heavy calls (including the enormous sum of 5000*l.* per annum for Government and parochial rates and taxes), undertakes to defray expenses of a general character, both in respect of equipment and maintenance. The Imperial Government at present renders no pecuniary assistance, either directly or indirectly, to the Department. Gifts of physical and chemical instruments have been made by Dr. Ludwig Mond, F.R.S., and by Mr. George Matthey, F.R.S. The Salters' Company have rendered signal assistance to the undertaking, by founding, in association with the Department, a Research Fellowship of the value of £150, it being understood that the Salters' Company's Research Fellow shall primarily devote himself to inquiries into the chemistry of medicinal plants of Indian and Colonial origin. In another direction, too, the Salters' Company have assisted the work of the Scientific Department by endowing at St. Thomas's Hospital an additional Research Fellowship, the holder of which is expected to devote himself to inquiries into the action of drugs; so that in this way the medicinal action and remedial value of Indian and Colonial drugs, which are being chemically investigated in the Scientific Department, may be made the subject of medical study by the Salters' Research Fellow in Pharmacology at St. Thomas's Hospital. There is so much important work to be done in determining the medicinal value and precise mode of action of both old and new drugs and their constituents, that the need is already felt of further assistance in this direction.

Provision of the same kind will also be needed for conducting parallel inquiries in economic botany, particularly in the direc-

[1] Abstract of a lecture delivered at the Imperial Institute on November 9, by Prof. Wyndham R. Dunstan, F.R.S., Sec. C. S., Director of the Scientific Department; ir Joseph Lister, Bart.. President of the Royal Society, in the chair.

tion of the anatomical study and identification of economic products of vegetable origin.

It may therefore be said that there now exists, in connection with the Imperial Institute, the framework of the necessary machinery for making scientific and technical investigations of natural products of every description from all parts of the Empire. But however numerous the staff of the Department may in the future become, it is unlikely that it will ever be able to cope successfully with the enormous mass of material which present experience shows is likely to be laid before it for investigation.

There has already been formed in connection with the Department an external staff of honorary scientific and technical referees, who are high authorities on their special subjects, and who have undertaken to advise the Department on any questions which may be referred to them. The Department has been also fortunate in securing the co-operation and advice of members of the staffs of several of the most eminent public institutions in this country, and particularly of those which are furnished with appliances for undertaking special technical inquiries. Among these may be mentioned the Royal College of Science and the City Guilds Central Technical College, both of which are adjacent to the Imperial Institute at South Kensington, St. Thomas's Hospital, the Pharmaceutical Society, the Royal Indian Engineering College at Cooper's Hill, the Government Laboratories at Somerset House, at the Royal Arsenal, Woolwich, and at the Royal Mint, also the Yorkshire College at Leeds, where much valuable assistance has been rendered by the Research Laboratory of the Dyeing Department, which is endowed and maintained by the Clothworkers' Company. It is hoped that it may be possible greatly to extend this system of external referees on scientific and technical matters, and to secure the co-operation and assistance of the leading scientific and technical institutions, not only in this country but also in India and the Colonies. For while there can be no doubt that it is advantageous that the scientific examination and commercial valuation of Indian and Colonial natural products should in most cases be conducted in the metropolis, still much of the preliminary as well as some of the later operations in connection with, and arising out of these inquiries, might often be conducted in the university and technical laboratories and in the botanical gardens of our Colonies, especially if their instructions were federated with, and were working in association with the Central Scientific and Technical Department at the Imperial Institute. Such a federation, through the Imperial Institute, of scientific and technical workers in all parts of the Empire, could not fail to be an important source of strength to science, industry, and to the nation at large.

The principal work which the new department of the Imperial Institute is prepared to undertake when requested by the Indian or Colonial Governments, may be summarised as follows :—

(1) The scientific investigation of new or little-known natural products derived from India and the Colonies, with a view to their commercial utilisation throughout the Empire.

(2) The comparative examination with the same ends in view, of products of recognised value and importance, which, although known to occur and to be producible in India and the Colonies, are at present obtained commercially from other sources.

(3) Advising the Indian and Colonial Governments on all scientific questions relating to the production, manufacture, and commercial utilisation of materials occurring within the British Empire.

In order that the new organisation may be of real utility to India and the Colonies, it is necessary that their Governments, through their recognised representatives in this country, should bring themselves into close communication with the scientific department, and be the means of transmitting inquiries and suggestions from their respective Dominions as to the investigations which should be made, and also reporting to their respective Governments the result of the inquiries and the recommendations based upon them.

It may be useful to allude here to the excellent preliminary arrangements which have already been made by the Indian Government for this purpose ; for the example thus set by India will, it is hoped, be followed by at least all the more important of our colonies. The Government of India has arranged that information as to the questions demanding attention shall be obtained in Calcutta by a specially appointed officer attached to the Revenue and Agricultural Department, the Reporter on Economic Products, Dr. George Watt, C.I.E., who is in constant communication, through the India Office, with the Imperial Institute, and is charged with the collection, in India, of samples of the various products requiring investigation, and their transmission to the Imperial Institute, together with suggestions as to the points needing inquiry.

The arrangements connected with the disposal of these products are made by a special Committee appointed by the Secretary of State for India, which is presided over by Sir Steuart Bayley, K.C.S.I., and consists of Indian officials who are familiar with the needs of India, and the possibilities of

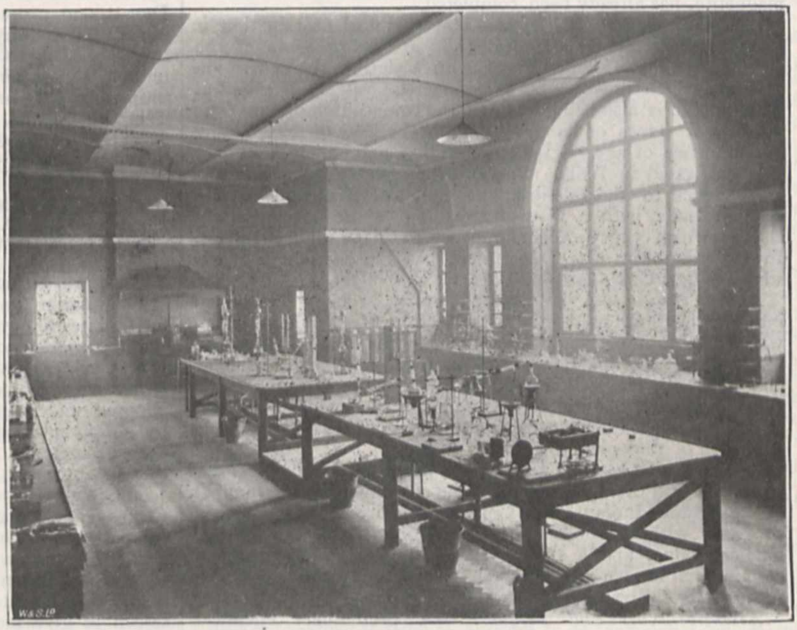

Fig. 2.

promoting Indian commerce, viz. :—Sir Charles Bernard, K.C.S.I., Sir Owen Tudor Burne, K.C.S.I., Sir George Birdwood, M.D., K.C.S.I., and Sir Alexander Wilson, K.C.S.I. The experienced Curator of the Indian Section of the Imperial Institute, Mr. J. R. Royle, C.I.E., acts as secretary. To this Committee is added any official of the Government of India who may be on leave in this country, and is likely to be able to render assistance.

The Committee is charged with the maintenance and renewal of a thoroughly representative collection in the galleries of the Imperial Institute, illustrative of the chief natural products and principal manufactures of India. A similar but more extensive collection is maintained, under the supervision of Dr. Watt, at the Indian Museum at Calcutta.

The Committee receives periodical reports from the Director of the Scientific Department of the progress of investigations, and acts as the channel of transmission to India of results and recommendations.

Now that the Scientific and Technical Research Department has been organised on its experimental side, the Executive Council of the Imperial Institute have in view the perfection of preliminary arrangements that have already been made to bring the results and information obtained by this department under the immediate notice of merchants and others who control

British and foreign markets, and in this matter, too, they will look for active assistance and co-operation from all the Colonies.

No account of the organisation of the Scientific and Technical Research Department would be complete without some reference to the part which Sir Frederick Abel, the Secretary and Director of the Institute, has played in this matter. The bringing into existence and into prominence of this side of the work of the Imperial Institute, the importance of which was fully realised by its founders, is mainly due to his enthusiasm and energy, and indomitable courage in face of numerous difficulties.

The following is a brief epitome of the more important work which is at the present time occupying the attention of the Department.

The Indian Coal Supply.—Chemical analyses are being made in order to determine the value of the coal deposits occurring in different parts of India, and the results thus obtained are being supplemented by practical tests.

The Iron Ores of India.—Chemical examinations are being made of the deposits of iron ore occurring in different districts of India, and after the analytical results have been obtained the question of the best methods of smelting these ores will be investigated. The examination of a number of specimens derived from the Salem district of Madras, and composed generally of magnetite, has already been completed.

Indian and Colonial Fibres.—The chemical examination is being conducted, and practical tests are being made of the chief Indian and Colonial fibres, with a view to the cultivation of those which prove to be of commercial value. A chemical investigation is also being made of the composition of jute fibre at different stages of its growth, with the view of determining the influence of age on the composition and strength of jute fibre cultivated in India. Special experiments are in progress in reference to the possibility of chemical treatment of jute fibre in India, with a view of retarding or preventing certain changes which occur during its transport to this or other countries. In their inquiries the Department has the advantage of the advice of Mr. G. F. Cross and Mr. C. E. Collyer.

Indian Opium.—A systematic inquiry is being conducted into the methods used in the production of opium in India, with a view to improving the quality of Indian opium for medical use and for the manufacture of morphia and other valuable alkaloids. In connection with this inquiry the Government of India is causing to be collected a number of specimens of poppies, of opium, and of the bye-products and materials used in preparing it in each of the opium districts of India.

Indian and Colonial Medicinal Plants.—The chemical examination and therapeutic trial of the constituents of a number of important Indian and Colonial medicinal plants is in progress, with the object of determining which are of real medical value, and a similar examination is being made of certain well-known drugs which it would appear might be successfully cultivated in India and the Colonies.

Essential Oils and Perfumes.—A preliminary chemical examination of a number of essential oils and perfumes produced at the Government Flower Farm at Dunolly in Victoria has been completed, by M. Umney, and these are also being compared, with especial reference to their commercial value, with the best English and French oils now in commerce.

Indian Dye-stuffs.—The chemical examination of the principal Indian dye-stuffs has been undertaken in order to ascertain the nature of the chief colouring matters, and to determine which are likely to be valuable as dyes, and to ascertain the best methods or employing them. Most of this work is being carried on by Prof. Hummel and Mr. A. G. Perkins in the Clothworkers' Research Laboratory at the Yorkshire College, Leeds.

The Food Grains of India.—A systematic investigation of the constituents of Indian food grains is being conducted, their chief constituents are being ascertained, and their dietetic value determined. This inquiry includes not merely new grains, but also the effect which climate, altitude and other conditions may have upon various well-known grains which are grown in India. On these subjects the Department has secured the valuable assistance of Prof. B. H. Church, F.R.S., and of Mr. Horace Brown, F.R.S.

Indian and Colonial Tanning Materials.—A number of Indian and Colonial plants which have been proved to possess, or are likely to have, value as tanning materials, is being conducted, and information is being obtained as to the best methods of cultivating them, and the most suitable time of collecting them for use as tanning agents.

Indian and Colonial Timbers.—A large number of Indian and Colonial timbers, specially selected by the Governments, have been submitted to mechanical tests and practical trial, so that their commercial value might be accurately determined. This work has been conducted by Prof. W. C. Unwin, F.R.S., at the Central Technical College.

All that has been attempted in this lecture is to afford a general idea of the character of the principal work on which the Scientific Department is engaged, and of its commercial bearings. The technical results of the inquiries, when complete, will be communicated to the Colonies and afterwards published, whilst any results of strictly scientific interest which may be gained will be communicated to the appropriate Scientific Society. The results of many of the inquiries must necessarily be almost entirely of technical interest, but in some cases problems of considerable scientific interest are raised. The dividing line between science and practice is hard to draw in investigations of this kind, and the interests at stake will not be faithfully served if scientific, as well as immediately practical ends, are not kept in view. It often happens that the science of to-day becomes the practice of to-morrow.

From what has been said to-night, it will be evident that the operations of the Imperial Institute in its Scientific and Technical Department are such as to command sympathy and active support in this country, as well as in India and the Colonies. It is to be hoped that all possible assistance may be rendered in extending the sphere of influence of this Department, so that it ultimately may become an Imperial Bureau of Scientific and Technical Advice, having for its chief object the acquisition of exact knowledge of the natural resources of this great empire.

EXPERIMENTS ON RÖNTGEN RAYS.

The Introduction of the use of the Camera to reduce the Size of Plates.

WE have yet no means of bringing Röntgen rays to a focus, but the thought occurred to me that instead of using large plates to cover half of the body, one might photograph the shadows as seen on the fluorescent screen by means of the camera. It was evident uniformity and steadiness of illumination for a period would be necessary; these were obtained by the methods adopted under the next heading. I tried this experiment by simply placing the camera and lens in front of the fluorescent screen and focusing on the ordinary ground glass. This experiment gave a much-reduced picture in an exposure of 1 minute 50 seconds, but a very curious result was also obtained. Clearly enough I got a photograph of the screen with the pair of forceps on it reduced in the proportion of 12 to 2 in size, but all the X-rays had not been stopped by the potassium platinocyanide screen, and although the camera was four feet from the tube, a sufficient number of rays had passed through the screen to give me a picture (on the same plate) of the brass mountings and lens of the camera. On the sensitive plate, therefore, I had obtained two pictures, one due to the ordinary rays of light from the fluorescent screen, and the other due to Röntgen rays. In the former the object was reduced, the ordinary rays having been focused by the lens, and in the latter the shadow of the brass mountings and lens of the camera were enlarged owing to the divergence of the Röntgen rays. In my next attempt I covered the front of the camera with a sheet of lead, in which I had cut a hole sufficient to allow the lens to pass through. The lens prevented the Röntgen rays going through the centre, and the lead on the outside protected the remainder of the plate, so that only one picture was got, showing a reduced photograph of the hand with the bones of the fingers quite well defined. By this means I hope to reduce the time of exposure. Now, by this new method we may be able to reduce a picture of a large portion of the human body to magic-lantern slide size right away. Another thing was noticed in this experiment—the barium salt did not photograph as easily as the potassium; but it must be remembered that the barium is yellowish-green in colour, while the potassium is blue or even slightly violet.

Another important point to be gathered from the above experiments may be noted. While we have been striving to produce more Röntgen rays in the tube, it is evident we are not utilising what we have with our present fluorescent screens. I placed three ordinary screens in front of each other, one foot apart, and found that while each became luminous under the influence of Röntgen rays, a sufficient number of them were still passing through the whole three to give a shadow of the bones of the hand on another screen. I have advantageously employed a large screen, therefore, in which the crystals are even coarser than those previously used, and the thickness very much increased. By this means I have now no difficulty in seeing many of the deep structures of the body in movement.

Different Conditions of the Tube may be utilised for Different Effects.

Lately I have been trying to follow up Prof. J. J. Thomson's suggestion about there being different kinds of X-rays, in order to discover, if possible, whether a particular set of rays might be utilised for different tissues. Whether it be a matter of difference or intensity or difference in quality (as Prof. Thomson suggests), there can be no doubt with the tube in a certain condition the bones of the hand appear jet black on the fluorescent screen, while the soft tissues are scarcely visible. On the other hand, in a different condition of the tube the soft tissues are much more prominent and the bones faint. Following up this inquiry, I made a series of experiments by way of placing metal rings near the kathode, some of them earthed and all adjustable. I am quite aware others have placed rings of metal near the kathode, and described alterations in the tube which they have attributed to different causes. The sole object in my experiments was to afford an indication of alteration in a given condition of the tube. These experiments were so far successful, but I found much the same results could be obtained by using the discharge rods of the coil. The method adopted was, first, to heat the tube by means of a Bunsen burner until I got the exact condition required. The discharge rods were approximated until they cut out the focus tube, and then one was very slightly withdrawn until the tube again became fluorescent. The slightest alteration in the vacuum afterwards was immediately indicated by sparking across the gap. It need hardly be pointed out that an arrangement like Mr. Campbell Swinton's for correcting the vacuum by means of a magnet instead of heat would be an advantage if it could be applied to the ordinary focus tube. Once having selected the particular condition required, a small Bunsen burner below the tube may be so regulated as to give the necessary heat. By these means a particular condition of the tube may be kept up for a very long period without trouble. I have had it going on constantly in some instances for half-an-hour at a time with little or no apparent change in the appearance of the shadow of the tissues, and consequently had no difficulty in focusing the fluorescent screen on the ground glass of the camera, nor in photographing the screen with shadows of objects thereon.

Action upon Tissues and Fluorescent Screens.

Actions upon the tissues of the body have been recorded from several sources, and severe loss of skin and hair as a direct result of the application of the rays has been noted. Although I worked for months, it was only within the last few weeks that, having to place my hand near the tube, between it and the fluorescent screen, for long periods and several nights in succession, evidence of a dermatitis ensued. The hand looked as if it had been sunburned, and became red and swollen; there was afterwards shedding of epidermis and loss of hair. The severer effects remained for over a fortnight.

Another curious action on the tissues was noticed while photographing a fish. The apparatus used was the old form of German tube, and an induction coil with Tesla. After half-an-hour's exposure the back of the fish was covered with patches of phosphorescence, which remained for some hours afterwards.

It is usually considered that the action of the rays upon the potassium or barium screen is of very short duration. I have several times tried to see if the luminescence remained for any length of time after the current had been turned off, but could never record anything definite in this way. For reasons which need not be here entered upon, I had been experimenting with a view of putting the fluorescent screen into a particular condition for a period of time, and some metal objects were hung over the back of the screen to serve as a shadow. It was exposed to the effects of the rays for a quarter of an hour, and afterwards set aside where it was not acted upon by the daylight. The following evening I resumed my experiments, and found an image of the metal ring which had been used the previous night. The bluish colour was different inside and outside of the ring from that part of the screen which had been protected by the metal. The screen was immediately put past and examined for four nights in succession; each time, though less distinct, I could see the image, and it did not completely disappear for a week, during which time the screen was kept in the dark.

With regard to the action upon the tissues, I think it right to point out that there are at least two other forces at work—heat and electricity—and that while the former might not have much to do with the action on the skin, the latter might. In any case, however, the above-mentioned results were obtained after, and seem to have been the direct result of exposure to the action of forces in the region of the focus tube.

JOHN MACINTYRE.

JUMPING COCOONS.

THE curious movements of jumping beans have lately attracted some attention, though to style the spasmodic jerks of the beans jumps is to court disappointment. Some "jumping cocoons," described by Dr. D. Sharp in the *Entomologist*, were however, remarkably good athletes, for they could spring out of a small vessel, such as a tumbler, in which they were placed. These cocoons were from South Africa, but in spite of their exceptional gymnastic efficiency, Dr. Sharp hardened his heart and sacrificed them upon the altar of science, in the hope of discovering something unusual that would explain the powers of jumping. The cocoons looked like a piece of oval pottery, about five millimetres long, and having a rough surface. In each of the two investigated a pupa was found; the two were similar in every respect, and they no doubt belonged to the larvæ that made the cocoons. "This little pupa," says Dr. Sharp, "is shut up in a remarkably hard thick cocoon, and it has to get out. Nature has not provided it with caustic potash for the purpose, but has endowed it with a mechanism of complex perfection to accomplish this little object. On the front of the head it has a sharp chisel edge, and with this it has to cut through the pottery; contracting itself to the utmost in the posterior part of the cocoon, and retaining itself in this position by the hooks on the mobile part of the body, it is in a condition of elastic tension in consequence of the other side of the body being so differently formed and immobile; therefore, releasing the hold of the hooks, the pupa is discharged forwards, and the chisel piece strikes the front part of the cocoon; repeating this an enormous number of times a circle may be gradually inscribed on the inside of the far end of the cocoon, which gives way when sufficiently weakened, and the insect becomes free. In both the specimens the inside of the cocoon is about half-cut through; either this is done as the result of a prolonged series of wriggles, or of shocks such as I have described. It is by no means improbable that the early part of the performance is carving the groove by wriggling, the later part knocking it off by jumping against it." The pupa is thus a most interesting one to entomologists. The order of insects to which it belongs appears to be somewhat uncertain, but Dr. Sharp thinks it will prove to be an anomalous lepidopterous insect allied to Trichoptera, and possibly somewhere near to *Adela*.

MECHANICAL CONCEPTIONS OF ELECTRICAL PHENOMENA.[1]

MATTER AND MOTION.

UNTIL the middle of the present century the reigning physical philosophy held to the existence of what were called imponderables. The phenomena of heat were explained as due to an imponderable substance called "caloric," which ordinary matter could absorb and emit. A hot body was one which had absorbed an imponderable substance. It was, therefore, no heavier than before, but it possessed ability to do work proportional to the amount absorbed. Carnot's ideal engine was described by him in terms that imply the materiality of heat. Light was another imponderable substance maintained by Sir David Brewster as long as he lived. Electricity and magnetism were imponderable fluids, which, when allied with ordinary matter, endowed the latter with their peculiar qualities.

During the fifty years, from about 1820 to 1870, a somewhat different kind of explanation of physical events grew up. The

[1] Abridged from a lecture delivered before the Franklin Institute by Prof. A. E. Dolbear.

interest that was aroused by the discoveries in all the fields of physical science—in heat, electricity, magnetism and chemistry—by Faraday, Joule, Helmholtz and others, compelled a change of conceptions; for it was noticed that each special kind of phenomena was preceded by some other definite and known kind; as, for instance, that chemical action preceded electrical currents, that mechanical or electrical activity resulted from changing magnetism, and so on. As each kind of action was believed to be due to a special force, there were invented such terms as mechanical force, electrical force, magnetic, chemical and vital forces, and these were discovered to be convertible into one another, and the "doctrine of the correlation of the physical forces" became a common expression in philosophies of all sorts. By "convertible into one another" was meant that, whenever any given force appeared, it was at the expense of some other force; thus, in a battery, chemical force was changed into electrical force; in a magnet, electrical force was changed into magnetic force, and so on. The idea here was the *transformation of forces*, and *forces* were not so clearly defined that one could have a mechanical idea of just what had happened. That part of the philosophy was no clearer than that of the imponderables which had largely dropped out of mind. The terminology represented an advance in knowledge, but was lacking in lucidity, for no one knew what a force of any kind was.

The first to discover this and to repudiate it were the physiologists, who early announced their disbelief in a vital force, and their belief that all physiological activities were of purely physical and chemical origin, and that there was no need to assume any such thing as a vital force. Then came the discovery that chemical force, or affinity, had only an adventitious existence, and that, at absolute zero, there was no such activity. The discovery of, or rather the appreciation of, what is implied by the term *absolute zero*, and especially of the nature of heat itself, as expressed in the statement that heat is a mode of motion, dismissed another of the so-called forces as being a metaphysical agency having no real existence, though standing for phenomena needing further attention and explanation—and by explanation is meant *the presentation of the mechanical antecedents for a phenomenon, in so complete a way that no supplementary or unknown factors are necessary*. The train moves because the engine pulls it; the engine pulls because the steam pushes it. There is no more necessity for assuming a steam force between the steam and the engine, than for assuming an engine force between the engine and the train. All the processes are mechanical, and have to do only with ordinary matter and its conditions, from the coal pile to the moving freight, though there are many transformations of the forms of motion and of energy between the two extremes.

During the past thirty years, there has come into common use another term, unknown in any technical sense before that time, namely, *energy*. What was once called the conservation of force is now called the conservation of energy, and we now often hear of forms of energy. Thus, heat is said to be a form of energy, and the forms of energy are convertible into one another, as the so-called forces were formerly supposed to be transformable into one another. We are asked to consider gravitative energy, heat energy, mechanical energy, chemical energy, electrical energy. When we inquire what is meant by energy, we are informed that it means ability to do work, and that work is measurable as a pressure into a distance, and is specified as foot-pounds. A mass of matter moves because energy has been spent upon it and has acquired energy equal to the work done on it, and this is believed to hold true, no matter what the kind of energy was that moved it.

What a given amount of energy will do depends only upon its *form*; that is, the kind of motion that embodies it. The energy spent upon a stone thrown into the air, giving it translatory motion, would, if spent upon a tuning-fork, make it sound, but not move from its place; while if spent upon a top, would enable the latter to stand upon its point as easily as a person stands on his two feet, and to do other surprising things, which otherwise it could not do. One can, without difficulty, form a mechanical conception of the whole series without assuming imponderables, or fluids or forces. Mechanical motion only, by pressure, has been transferred in certain directions at certain rates. Suppose now that some one should suddenly come upon a spinning-top while it was standing upon its point, and, as its motion might not be visible, should cautiously touch it. It would bound away with surprising promptness, and, if he were not instructed in the mechanical principles involved, he might fairly well draw the conclusion that it was actuated by other than simple mechanical principles, and, for that reason, it would be difficult to persuade him that there was nothing essentially different in the body that appeared and acted thus, than in a stone thrown into the air; nevertheless, that statement would be the simple truth.

All of our experience, without a single exception, enforces the proposition that no body moves in any direction, or in any way, except when some other body *in contact* with it presses upon it. The action is direct. In a letter from Newton to his friend Bentley, he says: "That one body should act upon another through empty space, without the meditation of anything else by and through which their action and pressure may be conveyed from one to another, is to me so great an absurdity that I believe no man who has in philosophical matters a competent faculty of thinking can ever fall into it."

For mathematical purposes, it has sometimes been convenient to treat a problem as if one body could act upon another without any physical meaning between them; but such conception has no degree of rationality, and I know of no one who believes in that as a fact. If this be granted, then our philosophy agrees with our experience, and every body moves because it is pushed, and the mechanical antecedent of every kind of phenomenon is to be looked for in some adjacent body possessing energy—that is, the ability to push or produce pressure.

It must not be forgotten that energy is not a simple factor, but is always a product of two factors: a mass with a velocity, a mass with a temperature, a quantity of electricity into a pressure, and so on. One may sometimes meet the statement that matter and energy are the two realities; both are spoken of as entities. It is much more philosophical to speak of matter and motion, for in the absence of motion there is no energy, and the energy varies with the amount of motion; and furthermore, to understand any manifestation of energy one must inquire what kind of motion is involved. It is now too late to stop with energy as a final factor in any phenomenon; and the *form of motion* which embodies the energy is the factor that determines *what* happens, as distinguished from how *much* happens. Here, then, are to be found the distinctions which have heretofore been called forces; here is embodied the proof that direct pressure of one body upon another is what causes the latter to move, and that the direction of movement depends on the point of application, with reference to the centre of mass.

ACTION AT A DISTANCE.

Let us now look at the other term in the product we call energy, namely, the substance moving, sometimes called matter or mass. It has been mentioned that the idea of a medium filling space was present with Newton, but his gravitation problem did not require that he should consider other factors than masses and distances. The law of gravitation as considered by him was: Every particle of matter attracts every other particle of matter with a stress which is proportional to the product of their masses, and inversely to the squares of the distance between them. Here we are concerned only with the statement that every particle of matter attracts every other particle of matter. Everything then that possesses gravitative attraction is matter in the sense in which that term is used in this law. If there be any other substance in the universe that is not thus subject to gravitation, then it is improper to call it matter.

We are now assured that there is something else in the universe which has no gravitative property at all, namely, the ether. It was first imagined in order to account for the phenomena of light, which was observed to take about eight minutes to come from the sun to the earth. Then Young applied the wave theory to the explanation of polarisation and other phenomena; and, in 1851, Foucault proved experimentally that the velocity of light was less in water than in air, as it should be if the wave theory be true, and this has been considered a crucial experiment which took away the last hope for the corpuscular theory and demonstrated the existence of the ether as a space-filling medium capable of transmitting light waves known to have a velocity of 186,300 miles per second. It was called the luminiferous ether, to distinguish it from other ethers which had also been imagined, such as electric ether for electric phenomena, magnetic ether for magnetic phenomena, and so on—as many ethers as there were different kinds of phenomena to be explained.

It was Faraday who put a stop to the invention of ethers, by suggesting that the so-called luminiferous ether might be the one concerned in all the different phenomena, and who pointed out that the arrangement of iron filings about a magnet was indicative of the direction of the stresses in the ether. This suggestion did not meet the approval of the mathematical physicists of his day, for it necessitated the abandonment of the conceptions they had worked with, as well as the terminology which had been employed, and made it needful to reconstruct all their work to make it intelligible.

It has turned out that Faraday's mechanical conceptions were right. Every one now knows of Maxwell's work, which was to start with Faraday's conceptions as to magnetic phenomena, and follow them out to their logical conclusions, applying them to molecules and their reactions upon the ether. Thus he was led to conclude that light was an electro-magnetic phenomenon; that is, that the waves which constitute light and waves produced by changing magnetism were identical in their nature, were in the same medium, travelled with same velocity, were capable of refraction, and so on. Now, that all this is a matter of common knowledge to-day, it is curious to look back no further than ten years. Maxwell's conclusions were adopted by scarcely a physicist in the world. Although it was known that inductive action travelled with finite velocity in space, and that an electro-magnet would affect the space about it practically inversely as the square of the distance, and that such phenomena as are involved in telephonic induction between circuits could have no other meaning than the one assigned by Maxwell, yet nearly all the physicists failed to form the only conception of it that was possible, and waited for Hertz to devise apparatus for producing interference before they grasped it. It was even then so new, to some, that it was proclaimed to be a demonstration of the existence of the ether itself, as well as a method of producing waves short enough to enable one to notice interference phenomena. It is obvious that Hertz himself must have had the mechanics of wave motion plainly in mind, or he would not have planned such experiments. The outcome of it all is, that we now have experimental proof, as well as theoretical reason, for believing that the ether, once called luminiferous, is concerned in all electric and magnetic phenomena, and that waves set up in it by electro-magnetic actions are capable of being reflected, refracted, polarised, and twisted, the same as ordinary light waves can be, and that the same laws are applicable to both.

Phenomena of the ether are so utterly unlike the phenomena of ordinary matter that it is apparent the name matter ought not to be applied to this medium. Furthermore, it is also apparent that all attempts to describe the properties of the ether in the terms applicable to matter will be misleading. Here is a substance which, experimentally, shows itself to be illimitable, continuous, homogeneous, isotropic, non-atomic, frictionless, incompressible, incapable of transforming its own energy, gravitationless, and insensible to all nerves, compared with what is limited, discontinuous, heterogeneous, eolotropic, atomic, frictionable, compressible, capable of transforming energy, gravitative, and upon which all nerve action depends. Are not these distinctions wide enough to make one beware of thinking of them and describing their phenomena in the same terms?

ANTECEDENTS OF ELECTRICAL PHENOMENA.

When we would give a complete explanation of the phenomena exhibited by, say, a heated body, we need to inquire as to the antecedents of the manifestation, and also its consequents. Where and how did it get its heat? Where and how did it lose it? When we know every step of those processes, we know all there is to learn about them. Let us undertake the same thing for some electrical phenomena.

First, under what circumstances do electrical phenomena arise? (1) *Mechanical*, as when two different kinds of matter are subject to friction. (2) *Thermal*, as when two substances in molecular contact are heated at the junction. (3) *Magnetic*, as when any conductor is in a changing magnetic field. (4) *Chemical*, as when a metal is being dissolved in any solution. (5) *Physiological*, as when a muscle contracts. Each of these has several varieties, and changes may be rung on combinations of them, as when mechanical and magnetic conditions interact.

If one confines his attention to the only variable factor in the energy in all these cases, and traces out in each just what happens, he will have only motions of one sort or another, at one rate or another, and there is nothing mysterious which enters into the processes.

We will turn now to how electricity manifests itself, and what it can do. It may be well to point out at the outset what has occasionally been stated, but which, in my judgment, has not received the philosophical attention it deserves, namely, that electrical phenomena are reversible, that is, any kind of a physical process which is capable of producing electricity, electricity is itself able to produce. Thus, to name a few: If mechanical motion develops electricity, electricity will produce mechanical motion; the movement of a pith ball is a simple case. If chemical action can produce it, it will produce chemical action, as in the decomposition of water and electro-plating. As heat may be its antecedent, so will it produce heat. If magnetism be an antecedent factor, magnetism may be its product. What is called induction may give rise to it in an adjacent conductor, and, likewise, induction may be its effect.

Suppose we have a series of active machines. An arc lamp, radiating light waves, gets its energy from the wire which is heated, which in turn gets its energy from the electric current, that from a dynamo, the dynamo from a steam engine, that from a furnace and the chemical actions going on in it. Let us call the chemical actions A, the furnace B, the engine C, the dynamo D, the electric lamp E, the ether waves F.

Chemical energy	Furnace.	Steam engine	Dynamo	Arc lamp	Ether waves
A	B	C	D	E	F

The product of the chemical action is molecular motion, called heat in the furnace. The product of the heat is mechanical motion in the engine. The product of the mechanical motion is electricity in the dynamo. The product of the electrical current in the lamp is light waves in the ether. Nobody hesitates an instant to speak of light waves as forms of motion, for they are described as undulations in the ether at right angles to the direction of the radiation. No one hesitates for an instant to speak of the heat as being molecular motion, nor of the motions of the engine as being mechanical; but when we come to the product of the dynamo, which we call electricity, behold, nearly every one says, not that he does not know what it is, but that no one knows! Does any one venture to say he does not know what heat is, because he cannot describe in detail just what goes on in a heated body as it might be described by one who saw with a microscope the movements of the molecules? Let us go back for a moment to the proposition stated early in the address, namely, that if any body of any magnitude moves, it is because some other body in motion and in contact with it has imparted its motion by mechanical pressure. Therefore, the ether waves at F imply continuous motions of some sort from A to F. That they are all motions of ordinary matter from A to E is obvious, because continuous matter is essential for the maintenance of the actions. At E the motions are handed over to the ether, and they are radiated away as light waves.

ROTATION IN ELECTRICAL CONDUCTORS.

A puzzling electrical phenomena has been what has been called its duality—states which are spoken of as positive and negative. Thus, we speak of the positive plate of a battery and the negative pole of a dynamo, and another troublesome condition to idealise has been, how it could be that, in an electric circuit, there could be as much energy at the most remote part as at the source. But, if one will take a limp rope, eight or ten feet long, tie its ends together, and then begin to twist it at any point, he will see the twist move in a right-handed spiral on the one hand, and in a left-handed spiral on the other, and each may be traced quite round the circuit; so there will be as much twist, as much motion, and as much energy in one part of the rope as in any other; and if one chooses to call the right-handed twist positive, and the left-handed twist negative, he will have the mechanical phenomenon of energy distribution and the terminology analogous to what they are in an electric circuit. So far, there is no trouble; but one can see the rope as a whole twisting, and nothing can be seen in an electric conductor. Are not the cases more dissimilar than the mechanical analogy would make them seem to be?

Are there any phenomena which imply that rotation is going on in an electrical conductor? There are. An electric arc, which is a current in the air, and is, therefore, less constrained than it is in a conductor, rotates. Especially marked is this when in front of the pole of a magnet; but the rotation may be noticed in an ordinary arc by looking at it with a stroboscopic disc, rotated so as to make the light to the eye intermittent at the rate of four or five hundred per second. A ray of plane polarised light, parallel with a wire conveying a current, has its plane of vibration twisted to the right or left, as the current goes one way or the other through the wire, and to a degree that depends upon the distance it travels; not only that, but if the ray be sent, by reflection, back through the same field, it is twisted as much more—a phenomenon which convinces one that rotation is going on in the space through which the ray travels. If the ether through which the ray be sent were simply warped or in some static stress, the ray, after reflection, would be brought back to its original plane, which is not the case. This rotation in the ether is produced by what is going on in the wire. The ether waves called light are interpreted to imply that molecules originate them by their vibrations, and that there are as many ether waves per second as of molecular vibrations per second. In like manner, the implication is the same, that if there be rotations in the ether they must be produced by molecular rotation, and there must be as many rotations per second in the ether as there are molecular rotations that produce them. The space about a wire carrying a current is often pictured as filled with whorls indicating this motion, and one must picture to himself, not the wire as a whole rotating, but each individual molecule independently. But one is aware that the molecules of a conductor are practically in contact with each other, and that if one for any reason rotates, the next one to it would, from frictional action, cause the one it touched to rotate in the opposite direction, whereas the evidence goes to show that all rotation is in the same direction.

How can this be explained mechanically? Recall the kind of action that constitutes heat, that it is not translatory action in any degree, but vibratory, in the sense of a change of form of an elastic body, and this, too, of the atoms that make up the molecules of whatever sort. Each atom is so far independent of every other atom in the molecule that it can vibrate in this way, else it could not be heated. The greater the amplitude of vibration, the more free space to move in, and continuous contact of atoms is incompatible with the mechanics of heat. There must, therefore, be impact and freedom alternating with each other in all degrees in a heated body. If, in any way, the atoms themselves *were* made to rotate, their heat impacts not only would restrain the rotations, but the energy also of the rotation motion would increase the vibrations; that is, the heat would be correspondingly increased, which is what happens always when an electric current is in a conductor. It appears that the colder a body is the less electric resistance it has, and the indications are that at absolute zero there is no resistance; that is, impacts do not retard rotation, but it is also apparent that any current sent through a conductor at that temperature would at once heat it. This is the same as saying that an electric current could not be sent through a conductor at absolute zero.

MATERIAL CONDITIONS OF ELECTRICAL MANIFESTATIONS.

So far, mechanical conceptions are in accordance with electrical phenomena, but there are several others yet to be noted. I have spoken of electrical phenomena as molecular or atomic phenomena, and there is one more in that category which is well enough known, and which is so important and suggestive, that I wonder its significance has not been seen by those who have sought to interpret electrical phenomena. I refer to the fact that electricity cannot be transmitted through a vacuum. An electric arc begins to spread out as the density of the air decreases, and presently it is extinguished. An induction spark that will jump two or three feet in air cannot be made to bridge the tenth of an inch in an ordinary vacuum. A vacuum is a perfect non-conductor of electricity. Is there more than one possible interpretation to this, namely, that electricity is fundamentally a molecular and atomic phenomenon, and in the absence of molecules cannot exist? One may say: "Electrical *action* is not hindered by a vacuum," which is true, but has quite another interpretation than the implication that electricity is an ether phenomenon. The heat of the sun in some way gets to the earth, but what takes place in the ether is not heat conduction. There is no heat in space, and no one is at liberty to say, or to think, that there can be heat in the absence of matter.

When heat has been transformed into ether waves it is no longer heat, call it by what name one will. Formerly such waves were called heat waves; no one, properly informed, does that now. In like manner, if electrical motions or conditions in matter be transferred, no matter how, it is no longer proper to speak of such transformed motions or conditions as electricity. Thus, if electrical energy be transformed into heat, no one thinks of speaking of the latter as electrical. If the electrical energy be transformed into mechanical of any sort, no one thinks of calling the latter electrical because of its antecedent. If electrical motions be transformed into ether actions of any kind, why should we continue to speak of the transformed motions or energy as being electrical? Electricity may be the antecedent, in the same sense as mechanical motion of a bullet may be the antecedent of the heat developed when the latter strikes the target; and if it be granted that a vacuum is a perfect non-conductor of electricity, then it is manifestly improper to speak of any phenomenon in the ether as an electrical phenomenon. It is from the failure to make this distinction that most of the trouble has come in thinking on this subject. Some have given all their attention to what goes on in matter, and have called that electricity; others have given their attention to what goes on in the ether, and have called that electricity, and some have considered both as being the same thing, and have been confounded.

RELATION BETWEEN AN ELECTRIFIED BODY AND THE ETHER.

Let us consider what is the relation between an electrified body and the ether about it.

When a body is electrified, the latter at the same time creates an ether stress about it, which is called an electric field. The ether stress may be considered as a warp in the distribution of the energy about the body, by the new positions given to the molecules by the process of electrification. I have already said that the evidence from other sources is that atoms, rather than molecules, in larger masses, are what affect the ether. One needs to inquire for what knowledge we have as to the constitution of matter or of atoms. There is only one hypothesis today that has any degree of probability; that is the vortex-ring theory, which describes an atom as being a vortex ring of ether, in the ether. It possesses a definite amount of energy in virtue of the motion which constitutes it, and this motion differentiates it from the surrounding ether, giving it dimensions, elasticity, momentum, and the possibility of translatory, rotary, vibratory motions and combinations of them. Without going further into this, it is sufficient, for a mechanical conception, that one should have so much in mind, as it will vastly help in forming mechanical conceptions of reactions between atoms and the ether. An exchange of energy between such an atom and the ether is not an exchange between different kinds of things, but between different conditions of the same thing. Next, it should be remembered that all the elements are magnetic in some degree. This means that they are themselves magnets, and every magnet has a magnetic field unlimited in extent, which can almost be regarded as a part of itself. If a magnet of any size be moved, its field is moved with it, and if in any way the magnetism be increased or diminished, the field changes correspondingly.

Assume a straight bar electro-magnet in circuit, so that a current can be made intermittent, say, once a second. When the circuit is closed and the magnet is made, the field at once is formed and travels outwards at the rate of 186,000 miles per second. When the current stops, the field adjacent is destroyed. Another closure develops the field again, which, like the ether, travels outwards; and so there may be formed a series of waves in the ether, each 186,000 miles long, with an electro-magnetic antecedent. If the circuit were closed ten times a second, the waves would be 18,600 miles long; if 186,000 times a second, they would be but one mile long. If 400 million of millions times a second, they would be but the forty-thousandth of an inch long, and would then affect the eye, and we should call them light waves, but the latter would not differ from the first wave in any particular except in length. As it is proved that such electro-magnetic waves have all the characteristics of light, it follows that they must originate with electro-magnetic action, that is, in the changing magnetism of a magnetic body. This makes it needful to assume that the atoms which originate waves are magnets, as they are experimentally found to be. But how can a magnet, not subject to a varying current, change its magnetic field? The strength or density of a magnetic field depends upon the form of the magnet. When the poles are near together, the field is densest; when the magnet is bent back to a straight bar, the field is rarest or weakest, and a change in the form of the magnet from a U-form to a straight bar would result in a change of the magnetic field within its greatest limits. A few turns of wire wound about the poles of an ordinary U-magnet, and connected to an ordinary magnetic telephone, will enable one, listening to the latter, to hear the pitch of the former loudly reproduced when the magnet is struck like a tuning-fork so as to vibrate. This shows that the field of the magnet changes at the same rate as the vibrations.

Assume that the magnet becomes smaller and smaller until it is of the dimensions of an atom, say, for an approximation, the fifty-millionth of an inch. It would still have its field; it would still be elastic and capable of vibration, but at an enormously rapid rate; but its vibration would change its field in the same way, and so there would be formed those waves in the ether, which, because they are so short that they can affect he eye, we call light. The mechanical conceptions are legiimate, because based upon experiments having ranges through nearly the whole gamut as waves in ether.

The idea implies that every atom has what may be loosely called an electro-magnetic grip upon the whole of the ether, and any change in the former brings some change in the latter.

What I would like to emphasise is, that the action in the ether s not electric action, but more properly the result of electromagnetic action. Whatever name be given to it, and however it comes about, there is no good reason for calling any kind of an ether action electrical.

Electric action, like magnetic action, begins and ends in matter. It is subject to transformations into thermal and mechanical actions, also into ether stress—right-handed or left-handed—which, in turn, can similarly affect other matter, but with opposite polarities.

In his "Modern Views of Electricity," Prof. O. J. Lodge warns us, in a way I quite approve, that perhaps, after all, there is no such *thing* as electricity—that electrification and electric energy may be terms to be kept; but if electricity as a term be held to imply a force, a fluid, an imponderable, or a thing which could be described by some one who knew enough, then it has no degree of probability, for spinning atomic magnets seem capable of developing all the electrical phenomena we meet.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The election to the Professorship of Geology, vacant through the death of the late Prof. Green, will take place in Hilary Term, 1897. Candidates are requested to send their applications, together with such evidence of their qualifications as they may desire, to the Registrar of the University on or before February 1, 1897. The Professor is required to lecture in Geology and Palæontology in two of the three University Terms, and to take charge of the Geological and Palæontological collections belonging to the University. He is entitled to receive £400 per annum from the University chest, which sum may be augmented to not less than £700 nor more than £900 per annum, if the University revenues permit, and unless provision for the payment of a corresponding amount shall have been made from some other source. Mr. W. B. Prowse is at present acting as Deputy Professor.

Mr. W. Ramsden has been elected Sheppard Medical Fellow of Pembroke College.

The Burdett-Coutts Scholarship will not be awarded for 1896, the only candidate who presented himself having withdrawn before the close of the examination.

Prof. E. B. Poulton has recently returned to Oxford from a visit to America.

The following have been approved by Convocation as Examiners in Medicine for 1897, 1898, and 1899:—1. For the first M.B. Examination: Prof. A. Macalister (Cambridge), in Human Anatomy. 2. For the second M.B. Examination: Prof. W. MacEwen (Glasgow), in Surgery. Dr. David Berry Hart (Edin.), in Midwifery.

The Junior Scientific Club held its first meeting this term on Friday, November 6, when Mr. D. Meinertzhagen (New Coll.) gave an interesting account of "Hawks and Hawking," and Mr. W. Garstang read a paper entitled, "The Ancestry of the Vertebrata as a Physiological Problem." The Committee for the present term is composed as follows:—President: H. P. Stevens. Treasurer: A. W. Brown. Secretaries: E. H. Hunt and I. B. Billinghurst. Editors: R. A. Buddicum, A. E. Boycott, A. C. Pilkington and A. R. Wilson.

CAMBRIDGE.—An election to an Isaac Newton Studentship of 200*l.* a year for three years will be held in the Lent Term, 1897. The student is to devote himself to research in Cambridge in astronomy or physical optics. Candidates must be Cambridge B.A.s under the age of twenty-five on January 1, 1897. Applications are to be sent to the Vice-Chancellor not later than January 25.

Mr. S. F. Harmer has been appointed Chairman of Examiners for the Natural Sciences Tripos, 1897.

The Sedgwick Memorial Museum Syndicate propose that the site granted by the University near the new museums should be abandoned, and that a new site on the ground formerly belonging to Downing College, and recently acquired by the University, should be assigned instead. Some difference of opinion is likely to arise on the expediency of the proposal, which will involve the preparation of new plans and further delay.

The following awards in Natural Science were made at Trinity College on November 14: Major Scholarship (80*l.*), O. W. Richardson, Batley School; Minor Scholarship (50*l.*), G. Barger, High School, The Hague; Sizarship, R. E. Robinson, Newcastle (Staffs.) School; Exhibitions (40*l.*), H. Gaskell (Rugby), G. Savory (Harrow), and E. E. Walker (Bradford).

DR. PHILIPP LENARD has removed from Aachen, to take up a professorship of theoretical physics in the University of Heidelberg.

MR. THOMAS TICKLE, of the School of Pharmacy, has been elected to the Salters' Company Research Fellowship in Chemistry, tenable in the Research Laboratory of the Pharmaceutical Society.

WITH reference to the note on the University College, Bristol, in last week's NATURE (p. 46) we are informed that the Bristol Town Council has altogether given the College 4000*l.* The Council gave 2000*l.* towards the Engineering wing, just opened by Mr. Wolfe Barry, and has recently granted another 2000*l.* towards the capital sum of 10,000*l.* which the College authorities are trying to raise.

A RECENT law restored to the various French University centres the title of University, together with some measure of self-government; whereas since the time of Napoleon they had simply been sections of one University, and with the title of faculties. The *Times* correspondent at Paris states that arrangements have been made to celebrate the opening of term under the new system to-day by a gathering of professors and students, over which M. Faure will preside.

AT the distribution of prizes at the Barking Technical School, by the Countess of Warwick, on November 11, an address on the technical education movement was delivered by Prof. R. Meldola, F.R.S., of the Technical Instruction Committee of the Essex County Council. In the course of his remarks, the speaker deplored the line of action so generally followed throughout Essex, as well as in other counties, and which resulted in the greater part of the fund at their disposal being frittered away in small efforts at evening instruction. The main portion of the address was devoted to pointing out the true position of evening work in the scheme of technical education. It was contended that this kind of instruction, although to a certain extent useful, and even necessary, was not in itself more than an aid to true technical education, and could not, unless crowned by higher efforts, be of any use to the country at large as a means of enabling us to compete successfully with our foreign rivals in manufacturing and agricultural industries. For this reason the speaker, while admitting the good work which had been hitherto carried on at Barking, felt bound to express his regret that so much of the resources available for technical instruction had been used up in the formation of classes for cookery, ambulance, dressmaking, and other subjects, which, in his opinion, should have been subsidised from other sources, or else taught in schools. Reference was made to the recent correspondence in the papers on the state of technical education on the continent as compared with that in this country, and figures were quoted showing the relative amount of endowment of technical high schools and polytechnics in Germany and Switzerland as compared with those in England. The speaker described from personal experience, and in high terms of praise, the zeal and energy with which men engaged all day in arduous work will come to evening classes to improve their knowledge of scientific principles. He felt sure, however, that such men were sensible enough to see how hopeless it was to make headway against the expert knowledge of highly-trained and specialised students from the German schools, who devote the best years of their youth and manhood to acquiring a competent knowledge of the science of their subject, unless they (the evening students of this country) had, as the leaders of their industries, men of an equal training to that of their competitors. The general tendency of Prof. Meldola's remarks was to encourage more concentrated effort on the part of such large urban districts as Barking, East Ham, Dagenham, and surrounding parishes, which contain a population of some 40,000 people, and he expressed the hope that the local committees would see their way to federation and joint action in the carrying on of organised day classes, as well as the evening work upon which they had hitherto concentrated their efforts. At the conclusion of the address the Countess of Warwick, in a short and forcible speech, also urged the importance of organised day work, and endorsed the wish expressed by Prof. Meldola that Barking would be in possession of such schools at no very distant period. Mr. W. Bewers, to whom the success of the Barking School is so largely due, and who is chairman of the local committee, presided at the meeting.

SOCIETIES AND ACADEMIES.

London.

Physical Society, November 13. — Captain Abney, President in the chair.—A paper on some experiments with Rontgen's radiation, by Prof. Threlfall and Mr. Pollock, was, in the absence of the authors, read by the Secretary.—The authors describe a form of Crookes' tube which, while it can be made by any one capable of the most elementary glass-blowing, gives a plentiful supply of Röntgen rays. The results of their experiments may be summed up as follows: (1) The Röntgen radiation does not consist in the projection of gaseous matter, or, if it does, the amount of such matter involved is extraordinarily small. (2) The Röntgen radiation does not consist in the projection of æther streams having a velocity above a couple of hundred metres per second; this is true, whether the radiation takes place in air or in benzene. (3) The properties of the æther regarded as determining the velocity of electromagnetic waves are not greatly changed (*i.e.* not at all within our experimental limits) by the Röntgen radiation; and this applies alike to the æther in air and in benzene. (4) A selenium cell composed of platinum electrodes and highly purified selenium, is affected by Röntgen radiation to an extent which is comparable with the effect produced by diffused daylight. (5) No permanent or temporary electromotive force is set up in a selenium cell by the Röntgen radiation. The authors have come to the first conclusion by exposing an exhausted tube placed in parallel with a spark-gap, so adjusted that the spark just passes over the gap rather than through the tube, to the Röntgen radiation. They find that a vacuum tube in parallel with a spark-gap is very sensitive to changes in pressure within the tube. Conclusions (2) and (3) were arrived at by using Michelson's arrangements for the interference of two beams of light. Mr. Shelford Bidwell said he had made some experiments on the effect of Röntgen rays on the resistance of selenium, but with a negative result, although he would have detected a much smaller change than that found by the authors. It might be that this difference was due to the tube, for, in his experiment, the radiation started from a platinum plate within the tube, while in the authors' arrangement the radiation starts from where the kathode rays strike the glass of the tube. Prof. Silvanus Thompson said there were a number of points with reference to the Röntgen radiation which required clearing up. For instance, the suggestion that they were vortices in the æther had not been tested. Again, Lafay says that if the rays are passed through a metal screen which is charged with electricity, then the rays can be deflected by a magnet. He (Prof. Thompson) had not been able to repeat this experiment, neither had he that of Galitzine on the polarisation of the rays by tourmaline. The statement of Prof. J. J. Thomson, that under the influence of the radiation paraffin became a conductor, had not been satisfactorily proved. As to the wave-length, while some observers obtained values about one-tenth that of the extreme violet, another had obtained a value greater than that of the extreme red. He (the speaker) did not understand the authors' device for detecting changes in the vacuum of a tube, since every one who has worked with Crookes' tubes has found that the resistance is always greater for a spark in one direction than the other, and also varies with the battery power employed. Lenard, adopting Hertz's arrangement, uses as anode a cylinder surrounding the kathode (a disc), the idea being that by using such a symmetrical arrangement the kathode radiation was more homogeneous. It might be advisable, when seeking to produce homogeneous Röntgen rays, to adopt such a symmetrical arrangement.—Mr. Bryan then read a paper, by himself and Dr. Barton, on the absorption of electrical waves along wires by a terminal bridge. The authors employ, for the generation of the oscillations, an arrangement of the same description as that used by Bjerknes, the waves being propagated along two parallel wires about 116 m. long. In order to measure the waves, they use a small electrometer with an uncharged needle. The resistances employed to form the bridge consist of pencil-marks on ground glass. Bridges of three resistances have been examined, one having, as nearly as may be, the resistance necessary, according to Heaviside's theory, to give complete extinction of the reflected wave, and, of the others, one was of higher, and the other of lower resistance. In each case the results confirm the theory, and it is thus experimentally proved that by using a bridge of this description the reflected train of waves can be completely extinguished. Mr. Blakesley asked if the authors had made any allowance for the capacity of the wires. Mr. Campbell asked if the resistances given were expressed in ohms or in electro-magnetic units. Mr. Bodwell asked if the authors had found that the pencil-trace resistances obeyed Ohm's law. He had found that if you balanced with one cell in the battery circuit, then, on increasing the battery power to two cells, the resistance altered. Mr. Appleyard suggested that the variation was caused by the contacts at the ends not being good. Mr. Campbell said the same variation occurred in the case of mixtures of clay and plumbago, where the contacts were quite good. Mr. Carter suggested electroplating the ends to give good contact. Mr. Bryan, in his reply, said that they had not considered the question of capacity, and that, in their case, they did not require to know the resistance very accurately.

Entomological Society, November 4.—Prof. Raphael Meldola, F.R.S., President, in the chair.—Mr. McLachlan exhibited a collection of the cast nymph-skins of more than one-third of the species of European dragon-flies from the Département de l'Indre, France, sent to him by M. René Martin. Two or three of the species had been reared in an aquarium, but the identification of most of them had been secured by finding the imago drying its wings in the immediate vicinity of the cast skin.—Mr. R. Adkin exhibited a long series of *Acidalia marginepunctata* taken on the sea-coast at Eastbourne, Sussex, during the past eight summers.—Mr. Horace St. John Donisthorpe exhibited a female specimen of *Dytiscus circumcinctus*, Ahr., with elytra resembling in form those of the male. He said the specimen had been taken in Wicken Fen in August last.—Mr. Tutt exhibited a specimen of *Mellinia ocellaris* recently taken near Southend, together with a specimen of *M. gilvago* for comparison; also four specimens of *Argyresthia atmoriella* taken by Mr. Atmore last June at Lynn, Norfolk. Mr. Tutt also exhibited a long series of a *Melampias* which he had captured at Le Lautaret in the Dauphiné Alps, at an elevation of 7000-8000 feet. He observed that the specimens exhibited were peculiar in some very important particulars, combining some of the characteristics of *Erebia* (*Melampias*) *melampus*, and *M. pharte*. He said his attention had been first drawn to this form by some fine examples captured by Dr. Chapman and himself on Mont de la Saxe in 1895. Compared with the Tyrolean examples of *M. melampus*, this form showed a tendency to a lengthening of the forewings and to an obsolescence of the black dots, thus approaching *M. pharte*, but the females presented none of the typical characters of the female of *M. pharte*. On the whole, he felt satisfied that the Mont de la Saxe specimens were a form of *M. melampus*. Mr. Elwes observed that though all the continental butterflies had been so long studied by European entomologists, he did not think the form exhibited by Mr. Tutt had been hitherto noticed.—Mr. E. Ernest Green exhibited a typical specimen of *Ephyra omicronaria*, together with what he believed to be a remarkable melanic variety of the same species, taken by Dr. Dudley Wright at Pegwell Bay, near Ramsgate, in September last. Some of the Fellows present, after an examination of the specimen, expressed an opinion that it was a variety of an Acidalia, and not of *Ephyra omicronaria*.

Anthropological Institute, November 10.—Mr. E. W. Brabrook, President, in the chair.—Mr. P. L. Sclater exhibited a draught-board from Nyasaland; Mr. C. H. Read, a dance-mask and a curious carving from the north-west coast of America; and Mr. Thompson, some small terra-cotta heads from ancient Mexico.—Mr. Henry Balfour exhibited various native Indian preparations of hemp for consumption, and an ancient bow of Assyrian type found in Egypt in a tomb of the XXVIth Dynasty, on which he read a paper. The interesting point about the bow was that it was of the composite type, at least one of the ingredients of which was not to be found in Egypt. The evidence available pointed to a more northern region, probably Assyria, as its place of origin, and this supposition was also borne our by historical facts. The indigenous Egyptian bow, a specimen of which was originally found near the other, and was now exhibited with it, was fundamentally different, being plain and not composite; the arrows also differed absolutely. A somewhat similar bow was now in the Berlin Museum. Mr. Balfour also exhibited a screen of typical Asiatic composite bows, and some transparencies in the form of thin sections cut from a number of bows of the same kind. Mr. Balfour subsequently read a paper on the life-history of an Aghori Fakir, illustrated by an extensive exhibition of drinking-cups made from human skulls. At the conclusion of the paper Dr. Leitner made some interesting remarks on the Aghori sect.

MANCHESTER.

Literary and Philosophical Society, November 3.—On methods of determining the dryness of saturated steam, and the condition of steam gas, by Prof. Osborne Reynolds, F.R.S. In certain recent attempts to ascertain the proportion of steam and water in the fluid which enters a steam engine, by means of what is called the wire-drawing calorimeter, the published results show that there remains from 0 to 5 per cent. by weight of water in the steam, after it has been drained by gravitation, in the same manner as the steam on which Regnault's experiments were made. This has necessarily excited great interest in steam engineering, and is naturally welcome, as it apparently brings the performance of the engines by so much nearer perfection. Although the results of these recent experiments appear to show the condition of dry saturated steam to be other than that on which Regnault's experiments were made, and from which the present steam tables have been calculated, still these tables have been used in deducing the percentage of water latent in the steam. Whereas, if the latent water exists, it must have existed in the steam used by Regnault, and the steam tables must also be subject to identical corrections; and, consequently, the percentage of theoretical performance of steam engines would be unchanged. It is then pointed out that, in the reduction of such of these results as have been published, use has been made of Regnault's determination of the specific heat at constant pressure of steam gas (0·48) in a manner which is not consistent with the theory of thermodynamics. Thus, in Rankine's notation, S_1 is the weight of steam per pound of fluid, and H_1 the total heat per pound from 0° C. to T_1°, h_1 the heat required to raise water per pound, and H_2, h_2, T_2, the corresponding values for saturated steam at the pressure after wire-drawing, and T_s° the observed temperature after wire-drawing. The notation assumed for the equation of heat, neglecting incidental losses, is

$$S_1(H_1 - h_1) + h_1 = H_2 + 0{\cdot}48\,(T_s^\circ - T_2^\circ) \;.\;.\;.\; (1)$$

Whereas, it has been proved by Rankine that the thermodynamic expression for the total heat in superheated steam at T_s° C., provided it has reached the condition of steam gas, to which the 0·48 only applies, is

$$C_1 + 0{\cdot}48\,(T_s^\circ - T_0^\circ)$$

C_1, being a constant, depends only on the temperature of the water, (T_0°) from which the steam is produced, the value of which from 0° C. is 606·7, approximately, as deduced by Rankine. Using Regnault's formula for H_2, the right member of equation (1) becomes

$$606{\cdot}5 + {\cdot}305\,T_2^\circ + 0{\cdot}48\,(T_s^\circ - T_2^\circ)$$

while the value by the thermodynamic formula is

$$606{\cdot}7 + 0{\cdot}48\,T_s^\circ$$

which gives us the excess of heat over that assumed

$${\cdot}2 + 0{\cdot}175\,T_2^\circ$$

This excess, if T_2 were 100° C., is 17·7 thermal units, and if the initial steam pressure were 200 lbs. above the atmosphere, the latent heat being 467·5 thermal units, the percentage of water it would evaporate, at boiling point, is

$$\frac{177}{4675} = 3{\cdot}8 \text{ per cent.},$$

which is about as much as needs to be accounted for. It is also shown that, in order to render Rankine's formula applicable to wire-drawing experiments, it is necessary that the wire-drawing should be continued till the steam is gaseous, whence arises the difficulty of securing that this state has been reached. This, however, may be secured by lowering the pressure gradually after wire-drawing, and so increasing the extent of wire-drawing while observing the temperature (T_s°), which, after falling, will gradually become constant as the wire-drawing increases, and, when constant, will be a definite indication of this gaseous state. The necessary conditions to ensuring accuracy are then considered, and, in conclusion, it is stated that a research to verify these conclusions has been commenced by Mr. J. H. Grindley, in the Engineering Laboratory of Owens College, Manchester.

PARIS.

Academy of Sciences, November 9.—M. A. Cornu in the chair.—On the composition of the fruits of *Phœnix melanocarpa*, by M. Aimé Girard. The average weight of the fruit was nearly 8 gr., 80 per cent. of which was edible. The analysis of the latter part showed that about one-half was soluble, the chief constituent being levulose (39 per cent.); no other sugar could be detected.—On the mode of formation of the sedimentary deposits of phosphate of lime, by M. A. Carnot. From an experimental study of the ratio of fluorine to phosphorus in phosphates of various origin, and from the artificial production of such apatites by the action of solutions of fluorides upon bone, the conclusion is drawn that phosphatic deposits are of animal origin, the alkaline liquid resulting from the putrefaction of organic remains having the property of dissolving calcium phosphate to a small extent, and depositing it again upon organic substances in a manner analogous to the petrifaction of wood. The fluorine must be supplied by the sea-water. Since fluorine had not been proved with certainty to exist in sea-water, a careful examination was made, and fluorine found in sea-water in amount corresponding to 1·69 gr. per cubic metre.—On a method of steering aërostats, by M. L. Baudey.—On the distribution of motion in a homogeneous medium, and the formation of cyclones, by M. E. Leclère.—On the production of floods in the basin of the Seine, by M. H. Tarry.—Observations on the new Perrine comet (November 2, 1896), made at the Paris Observatory, by M. G. Bigourdan.—Occultation of the Pleiades, of October 23, 1896 (Lyons Observatory), by M. Ch. André.—Observations on the sun, made at the Lyons Observatory, during the third quarter of 1896, by M. J. Guillaume.—On a geometry of ruled space, by M. René de Saussure.—Linear forms of the divisors of $x^2 \pm A$, by M. P. Pépin.—On the resistance of bridges under the passage of periodic loads, especially of those provided against in the regulation of August 29, 1891, by M. Marcellin Duplaix.—On the compressibility of some gases at 0° C., and near atmospheric pressure, by M. A. Leduc. With a view of determining the molecular volumes of gases at 0° at corresponding pressures, a pressure of 1/76th of the critical pressure was chosen, so that the values fell between 35 and 113 centimetres of mercury. By means of a modified Regnault apparatus, the variations from Boyle's law were measured in the cases of carbon dioxide, nitrous oxide, hydrogen chloride, ammonia, and sulphur dioxide.—A method of studying the expansion of liquids by means of photography, by M. Alphonse Berget. Two balances of equal sensibility, with their planes of oscillation at right angles, carry two weight thermometers, one containing the liquid under examination, and the other mercury. A ray of light is reflected from two mirrors, one on each beam, and this records on a sensitive plate a curve analogous to Lissajou's figures. This curve is the graphical representation of the expansion of the liquid.—On some abnormal cases of solubility, by M. Le Chatelier.—Action of aluminium chloride upon camphoric anhydride, by M. G. Blanc. By carrying out the reaction in presence of an inert solvent, such as chloroform, a new acid $C_9H_{14}O_2$ is obtained, the salts, ethers, and chloride of which are described.—On essence of roses, by MM. Eug. Charabot and G. Chiris. This essence appears to contain minute quantities of an ether, to the presence of which in French essences the latter probably owe their more fragrant odour.—On a new ferment in the blood, by M. Hanriot. Under the name of lipase, a new ferment of blood serum is described, which is characterised by its power of saponifying fatty ethers. This ferment is destroyed by heating to 90° C.—On a chemical method of valuing commercial wheaten flours, by M. E. Fleurent. The gluten is shown to consist of two substances, to which the names gliadine and glutenine are given. The baking value is shown to depend upon the ratio in which these two are present in the flour.—On the origin of the beetroot disease, by M. Paul Vuillemin. It is shown that the parasite named *Entyloma leproideum* by M. Trabat, and *Œdomyces leproides* by M. Saccardo, is not a new species, but is identical with the *Cladochytrium pulposum* of Fischer.—New observations on scab in potatoes, by M. E. Roze.—On the mode of formation of zeolites, by M. A. Lacroix. In the Pyrenees, zeolites are found in considerable quantity which have been formed by the action of nearly pure water, at temperatures near 0° C., upon basic felspathic rocks.—The application of Röntgen rays to Palæontology, by M. Lemoine.—On the apparent density of clays deposited from water, by M. J. Thoulet.—On the return of some exceptional meteorological phenomena in November 1896, by M. Chapel.—On the destruction of *Heterodera schachtii*, and other animals prejudicial to the culture of the beetroot, by M. Willot.

NEW SOUTH WALES.

Linnean Society, September 30.—The President, Mr. Henry Deane, in the chair.—The Sooty-Mould (*Capnodium citricolum*, n.sp.) of Citrus trees: a study in polymorphism, by D. McAlpine. The species so far as known is peculiar to Australia. It has a remarkable life-history, and well illustrates the phenomenon of polymorphism.—Australian Lampreys, by J. Douglas Ogilby.—On the botany of the Rylestone and Goulburn River Districts, N.S.W., by R. T. Baker.—Note on *Cypræa angustata*, Gray, var. *subcarnea*, Ancey, by C. E. Beddome.—Mr. Edgar R. Waite contributed a note on the range of the Platypus. The northern habitat is extended to 16° 45′ S. and localities quoted on the Gulf of Carpentaria 140° 56′ E., the most north-westerly point hitherto recorded.—Mr. T. Whitelegge exhibited a rare and curious Isopod, *Amphoroidea australiensis*, originally described from N.S. Wales by Dana in 1852, since when it appears to have escaped notice. The specimen exhibited was obtained on seaweed at Maroubra Bay last June; when alive it was bright olive-green, and of a similar tint to the seaweed to which it was adhering.—Prof. David contributed the following note on a remarkable radiolarian rock from Tamworth, N.S.W.:—"On September 10, in company with Mr. D. S. Porter, I observed the occurrence of a remarkable radiolarian rock on the Tamworth Temporary Common. Of this rock a hand specimen and section prepared for the microscope are now exhibited. The section is an opaque one prepared by cementing a slice of the rock about one-tenth of an inch thick on to an ordinary glass slip with Canada balsam and then etching its upper surface with dilute hydrochloric acid. The rock being partially calcareous, probably an old radiolarian ooze, the lime filling in the delicately latticed shells and interstices between the spines of the radiolaria is dissolved out, and the siliceous shells of the radiolaria become exposed to view. Some of them are exquisitely preserved for palæozoic radiolaria. The rock of which they constitute by far the larger proportion weathers into a brown pulverulent friable material like bath brick. The unweathered portions are dark bluish-grey and compact. The radiolaria appear to be chiefly referable to the porulose division of the Legion *Spumellaria*. This discovery confirms the previous determinations by me of radiolarian casts in the rocks of the New England district, and of the Jenolan Caves, N.S. Wales. The geological age of the formation in which this rock occurs is probably either Devonian or Lower Carboniferous, as *Lepidodendron australe* appears to occur on a horizon not far removed from that of this radiolarian rock. The Moor Creek limestone, near Tamworth, I find also contains numerous radiolaria."

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Elements of Physics: E. L. Nichols and W. S. Franklin. Vol. 2. Electricity and Magnetism (Macmillan).—The Gases of the Atmosphere; the History of their Discovery: Prof. W. Ramsay (Macmillan).—A New Speculation on the Past and Future Temperature of the Sun and Earth: W. H. (J. Heywood).—Colliery Working and Management: H. F. Bulman and R. A. S. Redmayne (Lockwood).—Autobiography of Sir George Biddell Airy (Cambridge University Press).—Cat and Bird Stories (Unwin).—Cowham's Graphic Lessons in Physical and Astronomical Geography, 6th edition (Westminster School Book Depôt).—New Zealand Papers and Reports relating to Minerals and Mining (Wellington, Mackay).—Experimental Science: A. Hubble (Chapman).—Light: W. T. A. Emtage (Longmans).—Physiography for Beginners: A. T. Simmons (Macmillan).—Alternating Currents and Alternating Current Machinery: Profs. D. C. and J. P. Jackson (Macmillan).—The Buddhist Praying Wheel: W. Simpson (Macmillan).—Physics Note-Book (Macmillan).—An Introduction to Structural Botany: Dr. D. H. Scott, Part 2 (Black).—Mountaineering and Exploration in the Japanese Alps: Rev. W. Weston (Murray).—The Scientific Papers of John Couch Adams. Vol. 1 (Cambridge University Press).—Catalogue des Bibliographies Géologiques: E. de Margerie (Paris, Gauthier-Villars).—L'Éclairage: Éclairage électrique: Prof. J. Lefèvre (Paris, Gauthier-Villars).—Bibliographia Physiologica, 1895: Prof. Ch. Richet (Paris, Alcan).—Fuel and Refractory Materials: Prof. A. H. Sexton (Blackie).—Versuch einer Philosophischen Selektionstheorie: Dr. J. Unbehaun (Jena, Fischer).—Das Klima von Frankfurt am Main (Frankfurt a.M.).—A Text-Book of Special Pathological Anatomy; Prof. E. Ziegler, translated and edited by Drs. MacAlister and Cattell, Sections i. to viii. (Macmillan).—Hand-Atlas der Anatomie des Menschen: Profs. His and Spaltcholz, 2 Band, 1 Abthg. (Leipzig, Hirzel).—Elementary Solid Geometry and Mensuration: Prof. H. D. Thompson (Macmillan).—Life in Ponds and Streams: W. Furneaux (Longmans).—Life of Brian Houghton Hodgson: Sir W. W. Hunter (Murray).—The Principles of Sociology: Herbert Spencer, Vol. 3 (Williams).—The Survival of the Unlike: L. H. Bailey (Macmillan).—Report of the Commissioner of Education for the Year 1893–94, Vol. 1, Part 1 (Washington).—Lehrbuch der Vergleichenden Mikroskopischen Anatomie: Dr. H. Fol, 2 (Schluss) Liefg. (Leipzig, Engelmann).—Physiologische Pflanzenanatomie: Dr. G. Haberlandt (Leipzig, Engelmann).—Festschrift zum Siebenzigsten Geburtstage von Carl Gegenbaur Am 21 Aug., 1896, 2 Vols. (Leipzig, Engelmann).—De la Double Réfraction Elliptique et de la Tétraréfringence du Quartz: Dr. G. Quesneville. I. Examen et Critique des Recherches Anterieures (Paris, *Moniteur Scientifique*).

PAMPHLETS.—Rules for regulating Nomenclature: Lord Walsingham and J. H. Durrant (Longmans).—A Short Catechism of Chemistry: A. J. Wilcox, Part 1 (Simpkin).—Demeter und Baubo: E. Hahn (Lübeck, Schmidt).—Agricultural Science, its Place in a University Education: Prof. R. Warington (Frowde).

SERIALS.—Geographical Journal, November (Stanford).—Scribner's Magazine, November (S. Low).—Observatory, November (Taylor).—Proceedings of the Physical Society of Londan, November (Taylor).—Humanitarian, November (Hutchinson).—Strand Magazine, November (Newnes).—Psychological Review, Monograph Suppleinent. No. 3. The Mental Development of a Child: K. C. Moore (Macmillan).—Journal of the Chemical Society, November (Gurney).—Veterinarian, November (Adlard).—American Journal of Science, November (New Haven).—Transactions of the Edinburgh Field Naturalists' and Microscopical Society, Sessions 1894–96 (Blackwood).—Quarterly Journal of the Geological Society, No. 208 (Longmans).—Engineering Magazine, November (Tucker).—Journal of the Franklin Institute, November (Philadelphia).—Psychological Review, November (Macmillan).—Zeitschrift für Physikalische Chemie, xxi. Band, 2 Heft (Leipzig, Engelmann).—Bulletin of the Geological Institution of the University of Upsala, Vol. 2, Part 2, No. 4 (Upsala).—Beiträge zur Geophysik. iii. Band, 1 Heft (Leipzig, Engelmann).—L'Anthropologie, tome vii. No. 5 (Paris, Masson).—American Naturalist, November (Philadelphia).

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