THURSDAY, SEPTEMBER 24, 1891.

PHYSICAL UNITS AND CONSTANTS.

Illustrations of the C.G.S. System of Units, with Tables of Physical Constants. By Prof. Everett, F.R.S. (London: Macmillan and Co., 1891.)

THIS may be taken to be the fourth edition of a work first published by the Physical Society in a somewhat different form. Those who know Dr. Everett need not be told that he has done everything that it is possible for an accurate, painstaking author to do, to bring each successive edition as near to perfection as possible. The value of the work to the physics investigator is exceedingly great, as everybody knows; but it is not so generally well known that it is an excellent class exercise book for students. There is much new matter in this edition, including determinations of viscosities, terrestrial magnetic elements, magnetic properties of iron and other substances, and heat measurements.

The labours of many men have given to the present generation this beautiful system of units, which has made physical calculation so easy, and which has pointed out in certain cases the directions in which new discoveries might be expected. And it only requires a short study of certain parts of this book to put any student in such possession of the system that he can use it with certainty and ease. Indeed, to become well acquainted with the scientific method of calculation has almost been made too easy for certain clever men of our acquaintance. It is far nobler to swim the Hellespont than to cross in a steamer. At the present time many clever men are possessed by a mania for crossing the Atlantic in boats of eighteen feet keel. It adds much more to one's credit to talk of all kinds of hybrid and home-made magnetic influences, than to use the simple idea of self-induction. In the same way it is unfair to say that certain practical engineers shirk the study of Dr. Everett's book; it is much better to put it that these gentlemen have too much originality to follow the easy path, and when in their practical applications of physical principles they adopt all sorts of ingenious units of their own manufacture to whose use there are limits in all sorts of ways, we can even feel sorrowful over their skilfulness, without attempt- to thwart their ambition.

The mechanical engineer is accustomed to the use of a curious unscientific want of system in his calculations. His unit of force is the weight of a pound in London. His velocity is in feet per second, perhaps, in the very same calculation as that in which his pressure is in pounds per square inch. It seems to be too late to change this. No engineer can venture to educate his pupils in the use of the C.G.S. system for mechanical engineering calculations. Mrs. Ali Baba measured her gold by the quart, and a mechanical engineer thinks and designs and talks with other engineers in the usual shop units; and we may as well think of altering our decimal system to a duodecimal one, as to talk of an alteration in the mechanical engineer's methods of calculation. It is a very great pity, but the difficulties in the way of reform seem to be insurmountable. The story of these difficulties is too long for the present notice. But in new applications of physics, in electrical engineering, for example, the use of the C.G.S. system is not only easy; it requires a large amount of ingenuity in any engineer to calculate in any other than in C.G.S. units, unless, indeed, he ignores all the experimental determinations already made for him and tabulated in the C.G.S. system. And yet such ingenuity has already been exercised, and laborious investigations have been carried out by some electrical engineers, with the result that certain parts of electrical engineering are getting to be even more unscientific in the units employed than any part of mechanical engineering. On behalf of the culprits we may say, however, that even Dr. Everett's book —their best guide—has not given them the precise information that it might have done. In the subject of heat, we can now ignore the steam-engine constructor; we can say to him, "Go on using your wretched pounds per square inch and your foot-pounds per minute, and we will go on using our dynes per square centimetre and our ergs per second because we are nearly independent of one another"; but we can make no such speech to the electrical engineer. We physicists have to say to him that we rely upon him to make new discoveries, to state to us new problems; and if he gives us information in vague units of his own, we cannot tabulate it for general use, and if he does not state to us his problem in the usual language, we are unable to understand him, and we can be of no mutual use to each other. But when he says to us that our language is cumbrous, that he has ideas to express for which we have no words, when he uses towards us, properly for once, that adjective "academic" which has been more misused than Shakespeare's word "occupy," the culprit and the judge change places.

We can blame him if he invents unsystematic units, but not until we have given him the language and units that are correct. And in some particulars the electric engineer has the right to blame us. For example, our definition of unit electric current is so stupid that a multiplier or divisor of π or 4π enters quite unnecessarily into all electro-magnetic calculation.

Concerning electro-magnets and the magnetic circuit of a dynamo machine or a transformer, the practical engineer has a simple and quite modern way of considering problems, not yet recognized in such orthodox books as this of Dr. Everett. *Magneto-motive* force and the magnetic *resistance* of a circuit are expressions which cannot be found in such a book, and it is not at all unusual for the orthodox physicist to treat the idea underlying the use of such expressions with profound contempt. The engineer and experimenter care less than nothing for "magnetic susceptibility" or for "intensity of magnetization," or for "free magnetism"; these are, to him, mementos of the time of twelve years ago, when the inventor made bricks in Egypt, and the very cleverest mathematical electricians were only distinguished from other inventors by the greater magnitude of their blunders. Dr. Hopkinson and Mr. Kapp and Mr. Bosanquet have given us simple ways of dealing with practical problems, and some of these are now known to every apprentice of an electric engineering factory; but we know of no mathematical treatise in which they are recognized. Is it too much to hope that Dr. Everett, in his next edition, will ignore the orthodox critics, and mention *ampere-hours*, and *ampere-turns*, and *Board of Trade units?* It would perhaps be going too far to expect him to speak of the drop of potential per ampere in 100 yards of "a cable of nine-seventeens," for he does not aim at displacing the electricians' pocket-books; but it is to be remembered that of all engineers the electrical engineer is the one who is most inclined to orthodoxy, who most leans upon the mathematician and physicist, who is most likely to use such a book as this; and if Dr. Everett can stretch a point in his favour, and devote, say, four pages to "electrical engineers' pocket-book" information, it will bind the electrical engineer to orthodoxy for ever. Why, for example, should Dr. Everett define the "impedance" of a circuit merely with reference to the circuit when conveying one particular kind of alternating current?

This book deserves much more than a short notice, and the time may perhaps come when one of our leaders will write a long critical article on the whole subject of units, pointing out the great differences in derivation of calorimetric units, for example, and the mere dynamical units employed in mechanics and electricity—an article which will teach the student that, although electric resistance has the same dimensions as a velocity, yet this is a very different thing from the statement that it *is* a velocity; that, in spite of Paris Congresses and Committees of the British Association, *sec-ohm* is a scientific name, and *quadrant* is not. But, over and above all this, the writer of the article must not be, as the present reviewer is, a poor specialist; he must criticize this book from the point of view of the general physicist. This book contains the results of all the best experimental work of more than a century. It is a book of mnemonics. A single line in the whole book recalls to us those magnificent memoirs of Dr. Andrews which revolutionized our ideas on liquids and gases, and yet that single line is quite enough to the physicist. It is dreadful and yet pleasing to think that all the work of a great man, or perhaps of a generation of great men, may be condensed into a single line of information in such a book as this. Would Dr. Andrews trouble himself very much over this fact if he were alive? or would he console himself with the thought that every physical fact discovered since 1869, and here recorded, was, to some extent, discovered through him, because he had made all physical workers his pupils? Would he need the consolation that Newton is not once mentioned, and that Sir William Thomson has less space devoted to him than the meanest of his pupils? Hundreds of years hence, the scientific world will be the better for the experimental work now going on, and it will have forgotten the name of almost every worker. Our determination of something is only right to four significant figures, and so it will never be quoted because a man of next century will have measured it with accuracy to five significant figures. How many of us can be sure that a single line of such a book as this, published a century hence, will be devoted to the record of any of his experimental results? Is there or is there not a satisfaction in knowing that, one thousand years hence, the names of even Faraday and Maxwell and Thomson will be as little known as ours. The age deserves a Homer, and a memory of thousands of years; and one book of the epic ought to be a list of all the men mentioned by Dr. Everett, saying what weapons each of them had brought for the common fight against the powers of darkness. But alas, the new Homer will probably not come into being for another three hundred years, and he will be a blind poet, and he will probably immortalize the wrong people.

JOHN PERRY.

OYSTERS.

Oysters and all about them. Being a Complete History of the Titular Subject, exhaustive on all points of necessary and curious information from the Earliest Writers to those of the Present Time, with numerous Additions, Facts, and Notes. By John R. Philpots (London and Leicester: Richardson and Co., 1891.)

The Oyster: a Popular Summary of a Scientific Study. By Prof. W. K. Brooks, of the Johns Hopkins University. (Baltimore: Johns Hopkins Press. London Agents: Messrs. Wesley, 1891.)

HISTORIANS of the oyster revel in ambitious titles. "The Oyster: Where, How, and When to Find, Breed, Cook, and Eat it" suggested a somewhat extensive field for the tiny octavo which Cruikshank illustrated, but yet greater anticipations are raised by the title of Mr. Philpots's contribution to the subject.

Unfortunately, this promise is not borne out; not from lack of labour on the writer's part, but from the want of that critical knowledge which can alone make a compilation of this nature valuable. Mr. Philpots has thrown together, with but little arrangement, into two volumes of 1300 pages, scraps from every conceivable source relating to the oyster, and this without any critical treatment whatever: all are oysters that come to his dredge. Since at least as much erroneous information is current about the oyster as about any other well-known animal, and since it appears to exert nearly the same deleterious influence as the horse on the truthfulness of those who deal in it, it will be readily understood that the 1300 pages abound with errors and contradictory statements, and form a most untrustworthy guide to the complicated subject of which they treat.

The melancholy side of the situation is that, had the compiler, evidently an enthusiast for his subject, devoted the time and labour expended on the collection of paragraphs from untrustworthy authorities, to qualifying himself for his task by obtaining a personal and practical acquaintance with the oyster in all its relations of life, he might have produced a less bulky work, but one of permanent value; as it is, the only passages which we have been able to identify as indicating that Mr. Philpots has seen an oyster or an oyster-bed, are to be found in his account of ten sorts of oysters sent to him by a London dealer, among which, by the way, the real native does not occur (pp. 332–36), and in chapter xix., containing a short account of the Poole fisheries.

To correct the errors of Mr. Philpots's authorities, and to indicate his omissions, would be to criticize, not one book, but all the readily accessible matter which has been written on oysters for the last half-century; accessible matter only, for even as a compiler Mr. Philpots has not the requisite qualifications for his task, being seemingly dependent for his information about foreign oysters upon the translations and abstracts which have appeared from time to time in the Report and Bulletin of the United States Fish Commission, and upon the Hand-books, &c., to the International Fisheries Exhibition. These, with Grenville Murray's "The Oyster, Where, How, When," &c. (1861 and 1863), Williams's "Silvershell; or the Adventures of an Oyster" (1856), and Eyton's "History of the Oyster" (1858), are the chief part of his stock-in-trade; to which may be added newspaper articles, reviews, extracts from popular natural histories, &c. Besides these "authorities," some fifty pages, largely taken from Gwyn Jeffreys's "Conchology," deal with Brachiopoda (!), Anomiadæ, Pectinidæ, and Ostreidæ; under the latter family there is an account of *Ostrea edulis*, but none of *Ostrea* (*Gryphœa*) *angulata* and *virginica*, although the book does not profess to be confined to the former species; and about 212 pages are occupied by reprints of Parliamentary papers of various sorts.

The only chapter in which we are at one with Mr. Philpots is that in which an appeal is made to the Government to take the "oyster question" seriously in hand, though even here we cannot but regret the tone in which he speaks of the Board of Trade. Unhappily, however, there is no denying the fact that the inspectors sent by the Board to report on oyster fisheries have often been unfit for their task, and have, sometimes at any rate, been freely fooled by interested parties, for want of a little practical acquaintance with their subject. This has been pointed out again and again, not only as regards oyster fisheries, but also in connection with other fishery questions; but it cannot be pointed out too often. A point to which Mr. Philpots should have drawn public attention is that, if the proposition to move the London drainage outfall to Foulness take effect, the best of the few remaining grounds for breeding the almost extinct "native" (*sensu stricto*) will in all probability be ruined.

A book of a different calibre is that of Prof. Brooks. It is avowedly merely an attempt to rouse the State of Maryland to take such measures with regard to the oyster-fisheries as can alone prevent their ruin, measures such as some other States have already taken with marked success. It is hardly necessary to say of Prof. Brooks that his little book is a clear and accurate summary of what is known about the American species, for few men can speak with more authority on the subject. We can only hope that the Legislature to which he appeals may be more far-sighted than our own. Had the restrictions which he advocates been laid on our English public beds fifty years ago, the rare "native" might be almost as cheap now as in those almost forgotten days when the market was not yet flooded with French and Dutch produce posing as the genuine article, and oyster grottos were a familiar feature of the streets.

THE DESTRUCTION OF MOSQUITOES.

Dragon-flies v. Mosquitoes. (New York: D. Appleton and Company, 1890.)

THE book before us consists of three prize essays written in response to a circular issued in 1889 to "The Working Entomologists of the Country," offering certain prizes for essays containing original investigations on methods for destroying the mosquito and the house-fly.

The prizes were offered by Mr. R. H. Lamborn, whose position as Director of the Lake Superior and Mississippi Railway had caused him to spend a considerable time encamped in the swampy forests which surround the head of the great lake. Here he came into contact with mosquitoes of the most irritating kind, and here he made the interesting observations on their destruction by dragon-flies which stimulated him to offer the above-mentioned prizes. The lines laid down in the circular as to the direction which the investigations should follow have reference chiefly to the destruction of these insect pests by dragon-flies. The competitors were also required to examine which species of Odonata are best adapted for the purpose, to investigate their habits, and the possible methods of breeding them in large numbers. But although this line of inquiry is suggested, the practical object of the investigation is to determine whether it is possible to diminish or extinguish the noxious Diptera, and if so, by what means.

The essay which gained the first prize is by Mrs. C. B. Aaron, who gives a careful account of the habits and life-history of both the Diptera in question, and of the Odonata, and then considers the advisability and the means of exterminating the former. The gravest charge which is adduced against these Diptera, apart from the irritation they cause, is that they act as carriers of such parasites as Filaria, and possibly of some species of Tænia, whilst they undoubtedly serve to disseminate Bacteria associated with certain infectious diseases. In their favour it may, however, be said that they act as very efficient scavengers, especially during the larval period of their life-history; and it is a very open question whether the world would be much benefited by the total extinction of the two genera Culex and Musca. Without attempting to decide this point, Mrs. Aaron proceeds to consider the possibility and the cost of attempting their extermination.

The plan of pitting the dragon-fly against the gnat—a plan similar to that which Prof. Riley has brought to such a successful termination by encouraging the destruction of the orange scale, *Icerya purchasi*, by means of a small beetle, the *Vedalia cardinalis*, imported from Australia—is dismissed in a few words, for reasons which are considered at greater length in the following essays; but several mechanical means are suggested, the most promising and cheapest of which, in the case of the mosquito, is to spray with crude petroleum all collections of stagnant water which cannot be easily drained. The oil forms a thin film on the surface of the water, and effectually clogs the aperture of the breathing tubes as soon as the larvæ come to the surface, as they must do, for air.

The authors of the two remaining essays, Mr. Weeks and Mr. Beutenmuller, divide the second and third prizes. The former commences his essay with a valuable table, giving details of the time of appearance, of the comparative voracity, and of the habitat of sixteen species of dragon-fly found in the neighbourhood of New York. From these, three are selected—*Anax junius*, and *Æschna constricta* and *heros*—as the most likely to prove destroyers of mosquitoes. When, however, the life-histories of the opposed insects are compared, it becomes at once evident that we must not trust to the Odonata to rid us of the biting Culicidæ. The breeding and artificial rearing of dragon-flies present almost insuperable difficulties, for, when the larval stage is attained, each individual would have to be isolated, because they are apt to devour each other when confined in a limited space. Irrespective of the question of breeding, an insect which produces but one brood a year, and lives but a few days in the imago condition, has little chance of seriously affecting a race whose numerous annual generations succumb only to the severest weather. In its natural condition the dragon-fly does not correspond sufficiently closely with the mosquito, either in time or space, to give it any real chance of effecting the destruction of the latter; its breeding-places are also more restricted, as it requires a volume of water which is constant for some little time, whereas the mosquito, with its quicker metamorphosis, can make use of any temporary puddle.

The conclusion to be drawn from all three essays is, that if a serious attempt is to be made to combat these most annoying insects, the means to be adopted with most chance of success lie rather in the direction of draining swamps, raising fish, and encouraging water-fowl in the infested ponds, and, where it would not be injurious, using crude oil, than in any efforts to increase the supply of dragon-flies.

Mrs. Aaron and Mr. Beutenmuller have appended to their essays useful lists of papers on the subject of their work; and the latter has added a preliminary list of the Odonata in the State of New York, and a very useful catalogue of the "described transformations of the Odonata of the world." The book is illustrated with several plates, which depict stages in the life-history of the insects in question, and various mechanical devices for attracting mosquitoes, by means of lamps, to an oily grave; and for spraying with petroleum the water in which they breed.

A. E. S.

OUR BOOK SHELF.

Materials for a Flora of the Malayan Peninsula. No. 3. By George King, M.D., F.R.S., &c. Reprinted from the Journal of the Asiatic Society of Bengal, Vol. LX. Part 2.

DR. KING'S third contribution towards a flora of the Malayan Peninsula contains the *Malvales*, and comprises almost as large a proportion of new species as the two preceding parts, but no new genus. The Malvaceæ number twenty-four species belonging to eleven genera; the Sterculiaceæ, forty-eight species belonging to twelve genera; and the Tiliaceæ, fifty-eight species belonging to nine genera. Although 25 per cent. of the species are new, there are only three of the first natural order and five of the second; the rest belong to the Tiliaceæ, of which nearly half are new. Nine out of ten species of *Pentace* were previously undescribed, and only two others are known. There are seven additional species of the characteristic genus *Elæocarpus*, out of a total of twenty-three. This is the largest number of any one genus, though *Sterculia* comes next with twenty-two species. It will be perceived that the new species are almost exclusively trees. The flora of Malacca and Cochin-china is exceedingly rich in the arboreous element; the number of new species described by Dr. King in his various monographs and by Dr. Pierre in his "Flore Forestière de la Cochinchine" being something enormous.

W. B. H.

Zoological Wall Pictures. Three Diagrams, each 32 inches by 42 inches. (London: S.P.C.K.)

The Animals of the World, arranged according to their Geographical Distribution. Third Edition, Revised and Re-drawn. Size, 58 inches square. (London: Moffatt and Paige.)

THE first named depict (1) fishes, as represented by the cod, eel, and herring; (2) chelonians, as exemplified by the common water tortoise and the Greek land tortoise, together with drawings of parts of the chelonian skeleton; (3) insect pests, in the *personæ* of the Pine Bark and Colorado beetles, the larvæ of which are delineated. The diagrams are both bold and accurate, and good of their class.

The second named embodies an attempt to represent the distribution of the animals selected in latitudinal series. The plan, although a good one, is manifestly insufficient, inasmuch as by its means no provision can be made for overlap. However, for a bold wall diagram, the picture may be recommended. Its meaning is at once obvious; and a fact such as the occurrence of seals and whales at extreme latitudes, which at once arrests the attention, is sufficient in itself to arouse the spirit of inquiry in any active mind. In future editions the word "Some" might with advantage be substituted for the article "The" which heads the title.

Crozet's Voyage to Tasmania, New Zealand, the Ladrone Islands, and the Philippines, in the Years 1771-72. Translated by H. Ling Roth. Illustrated. (London: Truslove and Shirley, 1891.)

IN 1769 a Tahitian was brought to Europe by Bougainville as "a human curiosity." Afterwards he was sent to the Mauritius, the Governor of which was instructed to forward him to his destination. The task of restoring him to his native land was undertaken by Marion du Fresne, who was then a well-to-do resident in the Île de France; and thus originated the expedition the story of which is recorded in the present volume. The party started in two vessels, and Marion proposed, in the course of the voyage, to do much exploring work—a kind of enterprise for which he seems to have been well fitted, as he had been a distinguished officer of the French navy. Unhappily, some members of the expedition, including Marion himself, were massacred by the Maories. The voyage, however, was continued, and in 1783 an account of it was published which had been compiled and edited by the Abbé Rochon, the well-known traveller, from the log of M. Crozet, who, after Marion's death, commanded one of his two ships. It is this account which Mr. Ling Roth has translated. The work will be read with interest by students of the history of geographical discovery, and a good many of M. Crozet's statements about savage life have considerable value from the point of view of the ethnographer and the anthropologist. A preface, and a brief reference to the literature of New Zealand, are contributed by Mr. J. R. Boosé, Librarian of the Colonial Institute; and the volume contains, besides maps, very good illustrations of some works of Maori art.

Livingstone and the Exploration of Central Africa. By H. H. Johnston, C.B., F.R.G.S., &c. (London: G. Philip and Son, 1891.)

THIS volume ranks with the best of the series to which it belongs—"The World's Great Explorers and Explorations." Mr. Johnston realizes fully the splendour of Livingstone's achievements, and has succeeded admirably in bringing out their significance in the history of African exploration. He begins with two excellent general chapters dealing with the "natural history" and the "human history" of Central Africa; and afterwards he gives vivid accounts of all the various regions traversed by his hero. Thus the reader is enabled to form his own opinion as to the value of Livingstone's services. The strictly biographical part of the work is equally well done. All the world agrees that Livingstone was one of the noblest men who have ever devoted themselves to travel. This is felt strongly by Mr. Johnston, and he has been able to express his feeling effectively without extravagance and without any attempt at fine writing. The book will especially interest young readers, but may be studied with pleasure and profit by readers of any age. There are many good illustrations from photographs or drawings by the author, and seven maps by Mr. E. G. Ravenstein.

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 National Home-Reading Union.

WHEN one remembers the difficulties with which one's own first efforts to study Nature were beset, it seems a pity that any youthful student should be ignorant of the existence of an organization which can do much towards making his path smooth.

The National Home-Reading Union endeavours to guide those who cannot obtain aural instruction into the safest and most attractive roads. Lists of books are drawn up; difficulties and discrepancies in systematic reading are, as far as possible, foreseen and removed in the pages of the magazine; questions are answered by those who conduct the courses. Last year and the year before, the courses on organic and inorganic Nature were in the charge of Mr. Francis Darwin, Dr. Hickson, and Dr. Kimmins. This year, geology is undertaken by Mr. Marr, and cryptogamic botany by Mr. Murray; and any persons who wish to work at these subjects may save themselves much labour and misplaced reading by writing to the Secretary of the Union, Surrey House, Victoria Embankment, for a prospectus. Mr. Murray tells me that it is often pitiful to see how mnch effort has been wasted by people who come to the British Museum to educate themselves, owing to the need of guidance to the right books with which to commence their studies.

I trust that this good work will commend itself to you as worthy of notice. ALEX. HILL.

Downing Lodge, September 17.

Notoryctes typhlops.

ALLOW me to protest against the misnomer "Marsupial Mole" applied to Dr. Stirling's marvellous mammal by Mr. Sclater, both in the *Times* and in NATURE. "Mole-like Marsupial" it may be, but the other phrase has quite a different meaning, and either shows a want of appreciation of important characters, or implies a theory which, however plausible, has not been proved. ALFRED NEWTON.

September 12.

"W = Mg."

I WISH that Prof. Greenhill would kindly explain to a bewildered reader of your paper the nature of his quarrel with "$W = Mg$," and with the writers of "theoretical" treatises who use this equation.

To those trained to regard quantity of matter as measured by its inertia, and who regard the "mass" of a body as the quantity of matter, so measured, which it contains, the equation $W = Mg$ has a pretty clear meaning.

A certain body "has a mass M," this being the measure of its inertia in terms of that of the mass-unit. This body is observed to have an acceleration g. We argue, from Newton's experimental laws, that there is a force acting on it; and we measure this force by a number which is the product of the two numbers, M (the measure of the mass of the body), and g (the measure of the acceleration observed).

If we observe a tight string attached to the body in question, and have every reason to believe that there is no other cause for the observed acceleration, we say that Mg measures the tension T of the string; or write "$T = Mg$." If the acceleration be due to the presence of the earth only, we say that the earth exerts a force [the "half" of the mutual stress] on the body, measured by Mg. This force we call the "weight of the body"; and the equation $W = Mg$ gives us the measure of the "weight" as deduced from the observation of rate of change of momentum produced by it.

If I felt sure that Prof. Greenhill considers M to be *still* merely a convenient abbreviation for $\frac{W}{g}$, I would say more on this matter; but I am in doubt as to what are the views of which he is so strong an opponent.

I see that he wishes to abolish "g" from works on hydrostatics. Why? I do not see how we can conveniently indicate the dependence [*cæteris paribus*] of hydrostatic pressure on the strength of the earth's gravitational field of force at any given place otherwise than by the introduction of g. But, as I have already implied, I am as yet in the dark as to the precise nature of the quarrel between Prof. Greenhill and the theorists.

Devonport, August 17. W. LARDEN.

[WE look to America for clear, unprejudiced ideas on the definitions of elementary dynamics, and Mr. Frederick Slate's letter from California is a valuable contribution, to which I hope Mr. Larden has directed his attention.

The quotations from certain elementary treatises which form Mr. Larden's letter are the statements it was my chief object to dispute; according to this school of writers, the Standard Pound Weight is not the lump of platinum preserved at the Exchequer, but rather it is the pressure on the bottom of the box in which it is kept.

When goods are sold in commerce by weight, they are weighed in scales, and the weight is the same wherever the weighing is carried out, whether at the equator, or the poles, or in the Moon, Sun, or Jupiter; so that the weight cannot be said to depend on the local value of g, the only effect of which is to slightly alter the infinitesimal strain of the balance.

Let Mr. Larden consult the recent Report of the Committee on Electrical Standards, to see how carefully the units must be defined to satisfy practical commercial requirements.—A. G. G.]

WHEN I was young, I never had the presumption to understand the use of "g" in questions connecting mass and weight, and I fear my boy takes after me.

He told me the other day that he understood how a falling body could have its velocity increased per second with a velocity of g, or 32 feet per second; and that he knew that m = stuff in a body, and w = its weight, but he could not see what the "blooming g" (I think that is what he called it) had to do with the matter.

I replied that no doubt, if we could only understand it, it had a beneficent use in the economy of nature.

TOMMY ATKINS, Senior.

Sleep Movements in Plants.

I READ the other day in a local paper that "Mr. Seemann, the naturalist of Kellett's Arctic Expedition," states that plants undergo sleep movements at regular intervals (presumably once in 24 hours) during the long period when the sun never sets. Has this been authenticated? I thought it was well known that a plant does not undergo periodic variations of the kind if it has never been subjected to the regular succession of light and darkness. Other instances are the daily periodicity of the strength of so-called "root-pressure" and of the rate of growth. But if the above observations are correct, not only have the sleep-movements become independent of the ordinary determining conditions in the individual, but they have become hereditary in the species. If the movements really possess the significance usually assigned to them (of checking excessive radiation) this would seem to negative the prevalent view that the state of panmixia alone suffices for the disappearance or degeneration of a structure or mechanism. A. G. TANSLEY.

September 19.

An Oviparous Species of Peripatus.

MR. DENDY'S observation of the extrusion of incompletely developed eggs in Peripatus is not, as he appears to think, entirely new. Captain Hutton was the first to observe it, in *P. novæ-zealandiæ*, and I confirmed his observation for the same species in my monograph of the genus. No one knows whether the eggs so extruded undergo complete development. I am inclined to think that the process, which has only been observed in animals in captivity, is an abnormal one, and is caused by the alteration in the conditions of the animal's life. We know that the New Zealand species does bring forth fully-developed young.

I hope that Mr. Dendy will carry out his intention of fully investigating the development of the Australian species.

A. SEDGWICK.

Trinity College, Cambridge, September 18.

A Rare Phenomenon.

ON a visit to Dunecht, I was just leaving the Observatory about 11.18 G.M.T. on the 10th inst., when I saw a sharply-defined straight streak of light arching the sky from east to west. It was about 1° in width, and of uniform brightness from side to side, but more intense towards the western horizon, where it disappeared behind the trees at an altitude of some 4°. Eastward it extended across the constellation of Andromeda, near the girdle, quite beyond the convergence point of auroral rays, or fully 120° from the western horizon. This much I saw, but cannot say if the streak passed north or south of the Great Nebula.

Endeavouring to lay down its course, I perceived that it was rapidly fading, and at the same time drifting southwards at a rate of, perhaps, 1° in five minutes. At 11h. 21·0m. G.M.T. the western portion was considered to cross the celestial equator in R.A. 262½°, passing through a point in R.A. 310° and Decl. + 23° (1840·0). In the meantime the eastern portion had faded away. Although there was a bright aurora in the north-north-west, I did not think that the streak was auroral in character, but rather that it had been caused by the passage of a large meteorite. Next day, however, I stumbled on an account of a similar appearance seen, together with an aurora, by the Rev. Edmund Barrel, at Sutton at-Hone, in Kent, on March 30, 1717 (O.S.). In the Philosophical Transactions, vol. xxx., after describing an ordinary aurora, the account runs:—

"Near Eleven a Clock, there was (besides the *Northern* Brightness) a long Streak, not very broad, extended *East* and *West:* Which beginning in the *Serpent's-Head*, near *Hercules'-Club*, and covering *Arcturus*, proceeded near *Berinices Hair*, and so went over *Cor Leonis*, and thence to *Canicula*, [Procyon, for Sirius had already set] and ended a little beyond that Star. It shone very bright at first, but faded away in about Eight or Nine Minutes. If it had Motion (which I am not sure of) it was Southward. I waited for the next Fit of Brightness of the *Aurora;* and in about Seven Minutes, the *Eastern* Part of the Streak, viz. from the *Serpent's-Head* to near *Berinices Hair*, became visible again tho' dim, and was quite effaced in Four or Five Minutes more: And I did not yet perceive any Change of its Place."

The course described agrees fairly with the arc of a great circle 120° in length, joining Procyon and the head of Serpens.

Assuming the Dunecht arch to have been also part of a great circle, its highest point must have been 8° 50′ east of the meridian, at an altitude of 62° 24′ above the southern horizon. The Magnetic Survey of Profs. Rücker and Thorpe gives the point to which the dipping-needle is directed as 19° 49′ E.; altitude 71° 3′, for 1891·69.

A letter signed "Wigtownshire" in the *Scotsman* of September 14, dated September 12, says:—"There appeared here last night, between nine and ten, a very bright, luminous arch, reaching from south-west to north-east. It extended directly over the zenith from horizon to horizon, and formed a very interesting spectacle while it lasted, which was only about half an hour. It seemed to be of electric origin from its wavy motion, and was slightly tinged pink at the eastern point just above the horizon. . . ."

Assuming the correctness of the dates on which the arch was observed—and of the Dunecht date I am quite certain—it seems that this rare phenomenon was visible on two successive nights.

RALPH COPELAND.

Royal Observatory, Edinburgh, September 21.

LAST Friday, the 11th, my attention was called at 9 p.m. to a most remarkable appearance in the sky. It consisted of a luminous band stretching from the eastern horizon to the west, and passing a little to the south of the zenith. It was first seen here at 8.20, and began as a luminous ray coming up from the west, but when I first saw it, it had extended as described from west to east. It was like a straight tail of a large comet with its head below the horizon, or the track of the beam from a powerful electric search light. Its eastern end lay a little to the south of the Pleiades, which were just rising; and in the west it passed through Corona Borealis. The night was a brilliant starlight one, and small stars could be seen through the luminous band. It was seen in the Co. Kildare, 50 miles from here, and there it passed through the zenith also, which would show that it was at a great altitude. It gradually faded away, and was gone at 9.30. It would be of interest to know if it was observed in other parts of the country.

W. E. WILSON.

Daramona, Streete, Co. Westmeath, September 16.

SOME NOTES ON THE FRANKFORT INTERNATIONAL ELECTRICAL EXHIBITION.

I.

ON arriving in Frankfort one finds oneself in a lofty, palatial railway station, compared with which King's Cross looks mean and Victoria Station is a shanty. This new terminus at Frankfort is not, as with us, an hotel with trains whistling and shunting in the back premises; it is essentially a railway station, standing proudly alone at the western extremity of the town. And the practical Englishman is as much impressed by the completeness of its internal arrangements as by the anti-Ruskin lesson it teaches, that architectural skill when fitly applied to a railway station can produce as noble an edifice as when bestowed on a temple.

Leaving the railway station all is changed. We are on the outskirts of the town, amid unfinished houses, heaps of bricks, vacant plots strewn with rubbish, and the restless hammering of the house contractor. The Exhibition is close at hand, composed at first sight mainly of wooden hoardings, temporary structures, "restaurations," and *bier hallen:* it is the Chalk Farm fair again of our early youth, or Chicago in 1873, a month after the great fire. Presenting at the entrance a letter bearing the magic pass-words "Prüfungs Commission der Internationalen Electrotechnischen Ausstellung," we are ushered past the barrier with bows, and find ourselves surrounded on all sides by shows—Siemens and Halske's Miniature Theatre, admission 2½*d.*; Electrical Ballet, admission 1*s.*, 2*s.*, and 3*s.*; Diving Pavilion, seats 5*d.*, standing room 2½*d.*; Electrical Race Course, 2½*d.*; Siemens and Halske's Dancing Flames, 2½*d.*; and so on, all over the Exhibition grounds. Have we come all these miles, at an invitation conveyed to us through the English Foreign Office, merely to visit a collection of what are literally twopenny-halfpenny shows?

We try one of them, the Miniature Theatre, passing in by the stage door, through the courtesy of Messrs. Siemens' representative, and thus avoiding the crowd of people that flocks in at every one of the many afternoon and evening performances. In view of the audience are 48 handles, which work a large puppet show, but a puppet show without puppets, without music, without acting, without even a joke. Turning any one of 36 of these handles towards the left turns on a group of little white or red or blue incandescent lamps placed at the sides, at the top, and at the bottom of the little stage, but hidden by the scenery from the audience. Turning any one of these handles to the right also turns on the respective set of lamps, but now their brightness can be gradually diminished by revolving one of the remaining 12 handles, which gradually introduces resistance into the particular circuit. For example, either the red, or the white, or the blue lamps behind any side wing, top drop, or set piece, can be separately turned on, or all can be turned on and the brightness of the lamps of any one colour varied independently of the brightness of the remainder.

A bell tinkles, and the curtain rises, showing a pretty set scene of a Swiss village with mountains in the background. It is late in the afternoon. The attendant slowly revolves one of the resistance handles—the daylight wanes, the shadows grow long, the sun sets, and the snowy peaks of the mountains are ruddy with the Alpine glow. The effect is so lifelike and so beautiful that a spontaneous gasp of admiration is forced from the audience.

Then the stage grows gradually dark, lights are seen at the cottage windows, but the night is stormy, for the attendant now works the handles rapidly, as does the organist the stops when performing one of Bach's fugues: lightning plays on the hills, now a blinding flash lights up the road, the houses, and the waterfall; but the flashes grow less vivid, and one sees, or thinks one sees, the storm blowing away over the mountain tops. Presently the moon rises, the audience feel the quiet of the bright moonlight night, then the dawn, and finally the sunshine bathes the scene with light.

Since the opening of the Exhibition many theatrical managers, we were told, had ordered complete sets of this electric apparatus; and no wonder, for on it can be played a symphony in the music of colour.

We next went to see Messrs. Siemens and Halske's "dancing flames," the seats at this show being also well filled with a twopence-halfpenny paying audience. First, Koenig's manometric flames were described and shown in action; then Dr. Froelich's method of working them from a distance, the elastic membrane of the little gas-bag being pushed in and out, not directly by the air puffs, but by the motion of the ferrotyped iron disc of a telephone, the current through which was varied by speaking to a microphone. Next were shown some experiments, extremely interesting to the electrician, for illustrating graphically how self-induction, mutual induction, capacity, &c., affected the current produced by an alternate current dynamo.

We presume that the considerable number of people who, having paid for their entrance to the Electrical Exhibition, are willing to form group after group and pay an extra fivepence at the many performances that are given daily of these two shows by Messrs. Siemens and Halske, are not wholly ignorant of what they are paying to see. Probably, therefore, the continued attraction which such shows have for audiences drawn from the people is only another proof of the fact that science, and a love of science, have permeated to a much lower stratum of the nation in Germany than in England.

Numerous must be the Germans not much above the level of the sightseers at a village fair who have already listened to the explanation of Dr. Froelich's method for exhibiting these alternate current phenomena, and yet the method is novel to the majority of the English scientific visitors. For it was only some three months ago, when Prof. Perry showed his new steam-engine indicator to the Physical Society of London, that the President suggested how he thought it possible that that instrument might be converted into an oscillating telephone with a mirror on its iron disc, and used for projecting on a screen the current curve of an alternate current dynamo. But nobody at the meeting was apparently aware that Dr. Froelich had been employing a telephone with a mirror on its disc for this very object—such is the resistance to the spread of ideas introduced by difference of language.

The apparatus employed by Dr. Froelich is as follows:—A large telephone iron disc has a small piece of looking-glass stuck on it eccentrically, and at the back is a horse-shoe permanent magnet, the soft iron pole-pieces of which are wound with a coil carrying the current produced by an alternate current dynamo. The iron disc is therefore pulled more or less by the magnet, depending on the strength and direction of the current passing round its poles. A beam of light from an electric lamp is reflected from this mirror on to a screen, and as the alternating current flows round the magnet a vertical line of light is formed on the screen, the position of the spot of light on this line being at any moment a measure of the strength and direction of the current produced by the machine. At least, this will be the case if the natural period of vibration of the telephone plate be very small or very large compared with the periodic time of the current—a condition we presume Dr. Froelich has attended to.

To produce a motion of the spot of light at right angles to the former line, Dr. Froelich does not cause the telephone to be moved backwards and forwards with an oscillatory motion, by the rotation of the dynamo armature, as suggested at the Physical Society of London; but before the beam of light reaches the screen, he causes it to suffer a second reflection from one of a series of small plane vertical mirrors, arranged around the surface of a cylinder parallel to its axis. By suitable worm-gearing, the quick rotation of the dynamo causes a somewhat slow rotation of this cylinder, but quick enough to produce an apparently continuous horizontal beam of light along the screen if there be no current flowing—that is, if the mirror on the telephone plate be at rest. Hence, the combination of the vertical and horizontal motions of the beam produces a curve which shows the shape of the current-wave extending over some four or five periods.

The effect of adding self-induction or mutual induction or capacity to the circuit is instantly seen by the change in the shape of the current-curve on the screen, and the change of phase is also evident from the shifting of the whole series of waves sideways. The comparison between the current waves in the primary and secondary circuits of a transformer is also very prettily illustrated.

This lecture concluded with an exhibition of an apparatus that has been constructed for Dr. Froelich for the examination of compound sounds. On a shaft, turning at a uniform velocity, are eight little alternate current dynamos, and by pressing down a piano key, which closes the circuit of the particular dynamo, a current is sent round the soft iron pole-pieces of the horse-shoe permanent magnet at the back of a telephone disc. The number of pole-pieces and armature-coils on the respective dynamos are such that, on pressing down the keys in succession, the telephone emits the notes of an ordinary musical octave, and by pressing down two or more the compound sound is heard.

An Englishman finds it somewhat exasperating, if he desires to see the whole Exhibition, to have to be constantly taking out his purse to make small payments for entrance here and entrance there; but, as half the receipts for the shows go to the Exhibition authorities, they will be saved from the financial *fiasco* that attended the Edinburgh Exhibition of last year, for that Exhibition had to be finally declared bankrupt, even after all the money guaranteed by the promoters had been called up. Further, the shows are themselves illustrations of the application of electricity to industry and art: the mere bazaar element, that has been so prominent a feature at some of the Exhibitions held at Earl's Court, is practically non-existent at the Frankfort International Electrical Exhibition.

International, however, the Exhibition is but in name, the comparatively small exhibits of one or two English and American firms only serving as a reminder of the magnificent collections of electrical machinery and apparatus England and America could have contributed. As a display, however, of the part Germany is playing in the development of electrical industry, the Frankfort Exhibition is most interesting.

Two separate buildings are devoted respectively to electrical railway signalling and to telegraphic and telephonic exhibits. The Government have contributed an interesting collection of historical telegraphic apparatus, from which it may be seen that the signalling instruments have been going through the same sort of evolutionary changes in Germany as in England, with this difference, however, that our apparatus has reached a much later stage of development than theirs. The German telegraph wires have been well erected, although less attention than would satisfy an English telegraph engineer has been paid in obtaining that perfect symmetry in the hanging of the wires which is necessary to avoid contacts being produced between them as they are swayed backwards and forwards by the wind. The underground wiring is especially good, but the methods of testing and signalling are antiquated, and the routine of the Telegraph Department generally is fettered with red tape.

There is one detail, however, in connection with the German Post Office, that forces itself on the admiration of the foreigner. If you desire to send money, you hand in the sum at the post-office, with a postcard costing 2½*d.*, which you address to your correspondent with details of the sum sent, and receive a receipt in exchange. But you need write no letter, send no postal order nor receipt, nor trouble your correspondent to go to the post-office; the postman delivers to your correspondent at his house or office your postcard, and in return for half of it hands him at once in cash the sum of money sent.

The display of telephonic apparatus at the Exhibition is large and complete, but owing to the activity of the commercial traveller of the day in keeping English engineers acquainted with practically all that is being done abroad, there is little that strikes the English telephone engineer as new. A new telephone exchange switch-board, constructed by Messrs. Mix and Genest, contains, however, a point of novelty, and a switch-board of this description has just been adopted at the Berlin Telephone Exchange.

The general arrangement of an exchange switch-board is as follows:—The wires from all the subscribers are brought to all the clerks at the exchange, so that it is possible for any clerk to connect any subscriber with any other, to enable the two subscribers to talk to one another. The calls, however, from certain subscribers only are received by any particular clerk; for example, of all the wires coming to clerk A, only those from, say, 1 to 100 are provided with drop shutters, so that if any subscriber from 1 to 100 rings up the exchange, one of the drop shutters in front of clerk A will fall, whereas if a subscriber from 200 to 300 rings up the exchange, it will be a drop shutter in front of clerk C that will fall. Each clerk, therefore, deals with the calls from a certain set of subscribers only, but this clerk may have to connect any one of this set of subscribers with any other of the same set or with any subscriber of any of the other sets; since, of course, any subscriber to the exchange has the right to be put in communication with any other.

Suppose, now, that clerk A receives a request from subscriber 85 to be put in communication with subscriber 560, the first thing to find out is whether the line of subscriber 560 is free, or whether it has been already connected with some other subscriber by one of the other clerks. This is usually ascertained by means of what is known as a "testing wire," which permeates all the switch-boards of all the clerks, and enables any clerk to see whether any line coming into the exchange is free or not. But in a large exchange the running of this testing wire throughout all the switch-boards necessitates the employment of many miles of wire, and it is to avoid this that Messrs. Mix and Genest have adopted the following new device:—

The ends of the plugs which the clerk presses into the various holes, or "spring jacks" as they are technically called, for the purpose of connecting one subscriber with another, are made electrically in two parts, the tip of the plug being insulated from the remainder by a piece of ebonite; a couple of cells are joined up at the exchange to each pair of plugs, in such a way that on inserting the tip of the second of a pair of plugs into a spring jack, an instantaneous current passes, deflecting the needle of a galvanoscope if the second line be free. For example, clerk A receives a call from subscriber 85 to connect him with subscriber 560: he inserts one of a pair of plugs into the spring jack 85, he then inserts the second plug into spring jack 560, and as the top of this second plug enters the spring jack there will be an instantaneous swing of clerk A's galvanoscope if line 560 be free, in which case the clerk pushes the plug home, and completes the connection between subscribers 85 and 560. If, however, the needle of the galvanoscope does not deflect, the clerk knows that line 560 is occupied, having been connected up by one of the other clerks, and instead of pushing home the plug he pulls it out, and tells subscriber 85 to wait, as line 560 is engaged.

Long-distance telephony is admirably illustrated by the opera at Munich being heard every evening with marvellous clearness at the Frankfort Exhibition, some 200 miles away.

The most striking feature of the Exhibition—indeed, the exhibit that has brought many a foreigner hundreds of miles to Frankfort—is the electrical transmission of power from Lauffen, over a distance of 109 miles. No measurements have yet been made by the jury of the exact amount of power that is received, or of the efficiency of the transmission; but as over 1000 sixteen-candle lamps are daily fed by the current, as well as an electro-motor pumping up water to form a large artificial waterfall, the actual power received must be something like 100 or 110 horse.

The plans had to be rapidly formed, for it was not until May 1 that it was definitely decided to carry out the experiment. The transformers have, on the one hand, been duplicated, from an anxious dread on the part of each firm of contractors that the other would not have finished their work in time; while, on the other hand, the insulators of the proper size are yet only partly ready, and many are defective from too hurried baking. Permission to carry the wires had to be obtained from the four Governments of Baden, Hesse, Würtemburg, and Prussia, and every step of construction had to be taken under the depressing influence of cavilling criticism. But in spite of all these difficulties, it has been conclusively proved that, by means of three overhead bare copper wires, each only 0·158 inch in thickness, supported on poles such as are used for ordinary telegraph lines, it is possible to deliver some 110 horse-power at a distance of nearly 110 miles from the water stream where the power is produced; and further, that this may be done without excessive loss by actually maintaining a potential difference of some 18,000 volts between each pair of wires.

The result is of international importance. The methods that have been employed (and which will be fully described) will probably not be copied in detail on a future occasion; there are doubtless faults which the cautious engineer can criticize; but the broad fact still stands out prominently, that, by an experiment as bold in conception as it has been successful in its realization, the Allgemeine Electricitäts Gesellschaft of Berlin, in conjunction with the Oerlikon Works of Zürich, have made the thoughtful realize that towns like Milan, which are within 30, 40, or 50 miles of vast water-power, may become the industrial centres of the future. It is, indeed, as if it had been shown that such towns stood on an inexhaustible field of smokeless, dustless coal.

(*To be continued.*)

SOME POINTS IN THE PHYSICS OF GOLF.

II.

IN my former paper (*Nature*, Aug. 28, 1890) the main conclusions were based to a great extent upon the results of mere eye observations, often of a very uncertain and puzzling kind. The data so obtained were unfortunately *not* those required for a direct investigation, so that my processes were necessarily of a tentative character. During and since the last College session I have been endeavouring to obtain some of the more important data in a direct manner. I am thus in a somewhat more favourable position than before but, as will soon appear, the new information I have obtained has complicated rather than simplified the singular problem of the flight of a golf-ball.

One point, however, which is both curious and important, has been clearly made out :—*hammering has no effect* (or, to speak more correctly, *only an inconsiderable effect*) *on the coefficient of restitution of a golf-ball.* This conclusion, which may have to be modified if the striking surface be not plane, had for some time appeared to me as almost certainly correct, and I have recently verified it by means of the Impact apparatus with which I have been working for some years. I procured from St. Andrews a number of balls of the same material and make, half of them only being hammered, the others plain. The results obtained from a hammered, and from an unhammered, ball did not differ much more from one another than did those of a number of successive impacts on one and the same ball. [In the *Badminton Library* volume on Golf, Mr. Hutchinson quotes a statement of mine which appears at first sight diametrically opposed to this experimental result; and thus puts me in the position *de nier ce qui est et d'expliquer ce qui n'est pas.* But he has omitted to mention that my statement was expressly based on the allegation that a hammered ball had been definitely found to acquire greater speed than an unhammered one. This seemed to me even at the time very doubtful, and I now know that it is incorrect.] Thus it is clear that the undoubtedly beneficial effects of hammering must be explained in some totally different way. There is another, and even more direct, mode of arriving at the same conclusion. To this I proceed, but unfortunately the new point of view introduces difficulties in comparison with which all that has hitherto been attempted is mere child's play. In short, it will be seen that the problem of a golf-ball's flight is one of very serious difficulty.

In my former article I took no account of the *rotation* of the ball, treating the problem in fact as a case of the motion of a particle in a medium resisting as the square of the speed. The solution I then gave was only approximate, and limited by the assumption that the cosine of the inclination of the path to the horizon might be treated as unity throughout. The illustrations and extensions given were founded on the same basis as was the solution of the simpler problem. Shortly after it was published I made, by the help of Bashforth's tables, a more exact determination. The data I thus arrived at were (in Bashforth's notation)

$$\lambda = 1 \cdot 9, \quad u_0 = 131 \text{ feet-seconds}, \quad \phi = 13^\circ \cdot 5.$$

From these the tables give at once

Range of Carry...	=	542 feet
Maximum Height	=	58 ,,
Horizontal Distance of Highest Point from Tee	=	350 ,,
Initial Speed	=	480 feet-seconds
Terminal ,, ...	=	80 ,,
Terminal Inclination	=	$38^\circ \cdot 5$.

As a contrast, take $\lambda = 1 \cdot 1$, so that $u_0 = 100$ feet-seconds. To obtain the observed range we must take $\phi = 23^\circ \cdot 25$, which is considerably too great. The other numbers then become

Range of Carry...	=	543 feet
Maximum Height	=	100 ,,
Horizontal Distance of Highest Point from Tee	=	350 ,,
Initial Speed	=	393 feet-seconds
Terminal ,, ...	=	80 ,,
Terminal Inclination	=	$54^\circ \cdot 6$

The first numbers are in remarkable accordance with the numerical details of really good drives which I obtained from Mr. Hodge; and, were there no other crucial test to be satisfied, the problem might have been regarded as solved to at least a first approximation. But I felt very suspicious of the sufficiency of such a solution; especially as it made no place (as it were) for the possibility of a path in part straight, or even occasionally concave upwards, which I have certainly seen in many of the very best drives. And my doubts were fully justified when I calculated from Bashforth's tables the time of flight under the above conditions. For they give 1·51s. for the first, and 2·13s. for the second, part of the path:—3·6 seconds in all; while the observed time of flight in a really good drive is *always* over 6 seconds, and sometimes quite as much as 7. This I have recently verified for myself with great care in the competition for the Victoria Jubilee Cup, where one of the unsuccessful players distinguished himself by really magnificent driving. The time of flight in the second of the above forms of path is about 4·8 seconds.

The initial speed in the first estimate seems to be excessive, as will appear from the experiments to be described below. This, of course, is one mode of explaining how the time of flight is so much underrated. But, if we keep to Bashforth's value of the coefficient of resistance, it is impossible to reduce the initial speed (while preserving the observed range) without increasing the angle of projection and, with it, the greatest height reached. The second set of numbers conclusively proves this. On the other hand if, with the view of reducing the initial speed and thus increasing the time of flight, we assume a smaller resistance, we may keep range, height, and initial angle, nearly as observed; but we shift the vertex of the path unduly towards the mid-range. The only way, it would therefore seem, of reconciling the results of calculation with the observed data, is to assume that for some reason the effects of gravity are at least partially counteracted. This, in still air, can only be a rotation due to undercutting.

During last winter I made a considerable number of experiments with the view of determining the initial speed by the help of a ballistic pendulum, but the results of these cannot be regarded as very satisfactory. My pendulum was a species of stiff but light lattice-girder constructed of thin, broadish, laths. This hung from hard steel knife-edges set well apart, and supported a mass of moist clay of about 100 lbs. The clay was plastered into a nearly cubical wooden frame, and swung just clear of the floor. The ball was driven into it from a distance of about six feet, and as near as possible to the centre of one face. The effective length of the corresponding simple pendulum was about 10 feet, and the utmost deflection obtained (measured on the floor) was about two inches. From these data I deduced an initial speed of about 300 feet per second only. But the experiments were never quite satisfactory, as the player (however skilful) could not free himself entirely from apprehension of the consequences of an ill-directed drive. In fact, several rather unpleasant accidents occurred during the trials, especially in the earlier stages; when the pendulum was mounted in a stone cellar, and without the hangings and the paddings which were employed in the later work. Although the clay was so stiff as to preserve its form under gravity, the ball (when it struck the face near the centre) always penetrated to a depth of more than one diameter, and splashed fragments of the clay to a considerable distance. These were usually replaced, and the surface levelled for a fresh experiment, as soon as the ball was dug out. The speed of 300 feet per second, thus measured, may be taken as an inferior limit to the initial speed in a really fine drive.

It thus appears that the resources of mere particle dynamics are quite insufficient for the adequate solution of the problem of long driving; though, of course, they fully meet all questions connected with mere approach shots; and that the rotation of the ball must play at least as essential a part in the grandest feature of the game, as it has long been known to do in those most distressing peculiarities called heeling, toeing, slicing, &c. But when this is once recognized, it is only the beginning of sorrows; for even the approximate treatment of the eddies produced by the rotation appears to be at present beyond our powers.

In order that the path of the ball may be (for a short time) approximately straight, still more if it is to be concave upwards, the downward acceleration due to gravity must be neutralized by the effects of a rotation due to *undercutting*. [Of course enormous speed could produce the approximately straight path, but not the concavity.] Hence the necessity for a tee, unless the turf be exceptionally soft, in order that the club may impinge on the lower part of the ball. Hence also one important use of hammering, viz. that the undercut ball may take as much angular velocity as possible:—the other being that the spin, so acquired, may tell as much as possible during the flight. The gist of the matter is thus seen to be:—For steady flight the ball must have rotation of some kind. The best mode, that of a rifle-ball, is of course unattainable. The others produce respectively heeling, toeing, dooking, and soaring. Of these the last, alone, is not necessarily disastrous; and it is therefore to be adopted.

I have not hitherto succeeded in my attempts to apply even approximate calculation to this altered set of conditions:—but it is easy to see, without calculation, that the longer the path of the ball retains nearly its initial inclination to the horizon (even if, in achieving this, it should have to expend part of its energy of translation along with that of rotation, and thus diminish the range) the longer will be the time of its flight during the carry.

And, as a practical deduction from these principles, it would appear that to secure the longest possible carry the ball should be struck so as to take on considerable spin:—so that the ideal driver should be in truth a Bulger, but with the important variation that its bulge should be of considerable curvature and in a *vertical*, not a horizontal plane. The height of the most prominent part of the face (above the horn) must of course be less than the radius of the ball. How much less can be found only by trial. And, in addressing the ball, the player must stand directly opposite to it. Such clubs, however, could be profitably used only by really good players:—men who can hit with what part of the club they please. The reckless swipers of the present generation, who slash away anyhow, and (with ordinary clubs) manage occasionally to make a really "tall" drive, will probably smash the proposed form of club on the very first appearance of topping. As to those who propel the ball by "skittling" rather than driving, any change *must* be an improvement, so that they should welcome the proposed novelty. The matter is a very simple one. A few touches skilfully applied with a rough file, and the new system rises at once out of the old.

There is one other point on which opinion seems to be so unsettled that an allusion may be made to it here:—the effects of weather on the carry of a ball. Of course, other circumstances being the same, the only direct effect is on the coefficient of resistance. If this be taken as proportional (roughly) to the density of the air, it may vary, in this climate, to somewhere about ten per cent. of its average amount, by increase or by diminution. It has its greatest value, and the drive is accordingly shortest, on a dry cold winter day with an exceptionally high barometer. The longest drive will of course be when the air is as warm and moist as possible and the barometer very low.

P. G. TAIT.

HOOKER'S "ICONES PLANTARUM."

THE recent issue of the fourth part of vol. xx. of the entire work completes the volume, and closes the third series, with a total of two thousand plates. This useful, and now indispensable, publication was commenced by the late Sir William Hooker in 1837, and the first volume was dedicated to the late George Bentham, who is described in the dedication as an "ardent promoter, not less by his patronage than by his writings, of botany and horticulture." Sir William Hooker started the "Icones" to illustrate some of the numerous novelties in the collections which were pouring into his herbarium from various parts of the world, especially from the southern hemisphere, at that period. With a few exceptions by Harvey, Gardner, and others, the drawings and descriptions were by Hooker himself, and a volume, containing one hundred plates, appeared annually, or nearly so. The first series closed with the fourth volume in 1841. At this date the founder was already Director of Kew Gardens, and he continued the work to the tenth volume, which terminated the second series. Two or three of the later volumes of this series were illustrated by the then rising botanical artist, W. H. Fitch. In the tenth volume we find a dedication of the whole ten volumes to George Bentham, in much the same words as the first. This was in 1854. After an interval of thirteen years, the third series was commenced, under the editorship of Dr. J. D. (now Sir Joseph) Hooker; and G. Bentham, D. Oliver, and J. G. Baker were contributors. Mr. Bentham, we believe, financed the undertaking. This, the eleventh volume, was not completed until 1871; but it is a most interesting volume, illustrated by Fitch, and containing among other things many of the endemic plants of St. Helena. The second volume of this series, the twelfth of the whole, was also illustrated by Fitch, and is valuable for the figures of curious new genera founded by Bentham and Hooker when elaborating their "Genera Plantarum."

On the completion of this volume, in 1876, a difficulty arose, consequent on the retirement of the artist, though there was no actual interruption in the appearance of the parts. But it was impossible to replace an artist like Fitch. Indeed, the only alternative was to train a person to do the work. This was not so easily accomplished; there were failures, and so high a standard of excellence has not since been reached. Nevertheless, the present artist gives as good drawings as could be expected from dried, flat specimens, and the botanical details are usually as full as is necessary, if not all that could be desired.

Since Mr. Bentham's death, in 1884, the work has proceeded with greater rapidity, and is now appearing at the rate of a volume per year. It is now published at the expense of the Bentham Trustees,[1] and sold at about half the former price; and since his retirement Prof. D. Oliver has undertaken the editorship. Under such favourable auspices, together with the abundance of material in the Kew Herbarium, it is confidently hoped that the interesting character of the work will be fully maintained, and that the mechanical production of it will be improved, resulting in a larger sale. The later volumes

[1] Of a fund bequeathed by Bentham for the advancement of botanical science.

contain a large number of Chinese novelties. One part of the last volume is devoted to the Stapeliæ of South Africa. The seventeenth volume is wholly devoted to new ferns; and the first volume of what it is intended to call the fourth series will consist entirely of orchids. Three parts of this have already appeared.

ON VAN DER WAALS'S TREATMENT OF LAPLACE'S PRESSURE IN THE VIRIAL EQUATION: A LETTER TO PROF. TAIT.

MY DEAR PROF. TAIT,—In Part IV. of your "Foundations of the Kinetic Theory of Gases,"[1] you take exception to the manner in which Van der Waals has introduced Laplace's intrinsic pressure K into the equation of virial. "I do not profess to be able fully to comprehend the arguments by which Van der Waals attempts to justify the mode in which he obtains the above equation. Their nature is somewhat as follows:—He repeats a good deal of Laplace's capillary work, in which the existence of a large, but unknown, internal molecular pressure is established, entirely from a statical point of view. He then gives reasons (which seem, on the whole, satisfactory from this point of view) for assuming that the magnitude of this force is as the square of the density of the aggregate of particles considered. But his justification of the introduction of the term a/v^2 into an account already closed, as it were, escapes me. He seems to treat the surface-skin of the group of particles as if it were an additional bounding-surface, exerting an additional and enormous pressure on the contents. Even were this justifiable, nothing could justify the multiplying of this term by $(v - \beta)$ instead of by v alone. But the whole procedure is erroneous. If one begins with the virial equation, one must keep strictly to the assumptions made in obtaining it, and consequently *everything* connected with molecular force, whether of attraction or of elastic resistance, must be extracted from the term $\Sigma(Rr)$."

With the last sentence all will agree; but it seemed to me when I first read Van der Waals's essay that his treatment of Laplace's pressure was satisfactory, and on reperusal it still appears to me to conform to the requirements above laid down. As the point is of importance, it may be well to examine it somewhat closely. The question is as to the effect in the virial equation of a mutual attraction between the parts of the fluid, whose range is small compared with the dimensions of bodies, but large in comparison with molecular distances.

The problem thus presented may be attacked in two ways. The first, to which I will recur, is that followed by Van der Waals; but the second is more immediately connected with that form of the equation which you had in view in the passage above quoted.

In the notation of Van der Waals (equation 8)

$$\tfrac{1}{2}\Sigma mV^2 = \tfrac{1}{2}\Sigma f\rho - \tfrac{1}{2}\Sigma Rr\cos(R, r),$$

where V denotes the velocity of a particle m, which is situated at a distance r from the origin, and is acted upon by a force R, while (R, r) denotes the angle between the directions of R and r. The intermediate term is to be omitted if R be the total force acting upon m. It represents the effect of such forces, f, as act mutually between two particles at distances from one another equal to ρ. In the summation the force between two particles is to be reckoned once only, and the forces accounted for in the second term are, of course, to be excluded in the third term.

In the present application we will suppose all the mutual forces accounted for in the second term, and that the only external forces operative are due to the pressure of the containing vessel. No one disputes that the effect of the external pressure is given by

$$-\tfrac{1}{2}\Sigma Rr\cos(R, r) = \tfrac{3}{2}pv;$$

so that

$$\tfrac{1}{2}\Sigma mV^2 = \tfrac{3}{2}pv + \tfrac{1}{2}\Sigma\rho\phi(\rho),$$

if with Laplace we represent by $\phi(\rho)$ the force between two particles at distance ρ. The last term is now easily reckoned upon Laplace's principles. For one particle in the interior we have

$$\tfrac{1}{2}\cdot 4\pi\int_0^\infty \phi(\rho)\rho^3 d\rho,$$

and this, as Laplace showed,[1] is equal to 3K. The second summation over the volume gives $3Kv$, but this must be halved. Otherwise each force would be reckoned twice. Hence

$$\tfrac{1}{2}\Sigma mV^2 = \tfrac{3}{2}pv + \tfrac{3}{2}Kv$$
$$= \tfrac{3}{2}v(p + K),$$

showing that the effect of such forces as Laplace supposed to operate is represented by the addition to p, the pressure exerted by the walls of the vessel, of the intrinsic pressure K. In the above process the particles situated near the surface are legitimately neglected in comparison with those in the interior.

Van der Waals's own process starts from the original form of the virial equation—

$$\tfrac{1}{2}\Sigma mV^2 = -\tfrac{1}{2}\Sigma Rr\cos(R, r),$$

where R now refers to the *whole* force operative upon any particle; and it appears to me equally legitimate. For all particles in the interior of the fluid R vanishes in virtue of the symmetry, so that the reckoning is limited to a surface stratum whose thickness is equal to the range of the forces. Upon this stratum act normally both the pressure of the vessel and the attraction of the interior fluid. The integrated effect of the latter throughout the stratum is equal to the intrinsic pressure, and, on account of the thinness of the stratum, it enters into the equations in precisely the same way as the external pressure exerted by the vessel. The effect of Laplace's forces is thus represented by adding K to p, in accordance with the assertion of Van der Waals.

I am in hopes that, upon reconsideration, you will be able to admit that this conclusion is correct. Otherwise, I shall wish to hear more fully the nature of your objection, as the matter is of such importance that it ought not longer to remain in doubt.

Believe me yours very truly,

RAYLEIGH.

L'Abbaye de St. Jacut-de-la-Mer, September 7.

[1] Ed. Trans., vol. xxxvi., Part 2, p. 261.

[1] See also *Phil. Mag.*, October 1890, p. 292.

NOTES.

THE French Association for the Advancement of Science met at Marseilles on September 17, under the presidency of M. P. P. Dehérain, who chose as the subject of his address the part played by chemistry and physiology in agriculture. The meeting comes to an end to-day. There were general excursions on Sunday to Arles, and on Tuesday to Aix; and it is proposed that to-morrow, the 25th, there shall be a final excursion to the Mediterranean coast.

THE Congress of German Naturalists and Physicians was opened at Halle on Monday by Prof. His, of Leipzig. The meeting was attended by 1215 persons, including many distinguished foreign physicians and men of science and 280 ladies.

THE Helmholtz celebration, deferred from August 31, is now fixed for November 2. After the ceremony the delegates and others will dine together at the Hotel Kaiserhof.

BY the death of August von Pelzeln, which took place on the 2nd inst. at Ober-Döbling, near Vienna, Europe has lost one of her foremost ornithologists. He had been in failing health for some years, and had recently retired, after forty years' service, from his post of Custos of the Imperial Museum at Vienna, where he had charge of the collections of Mammalia and birds. Von Pelzeln will be always celebrated in the memory of zoologists by his important essays on the collections in the Vienna Museum, but his most enduring work will be found in the famous "Ornithologie Brasiliens," wherein he gave a detailed account of the collections made by the great traveller Natterer in the early part of the present century. Only last year he published in the *Annalen des k.k. naturhistorischen Hofmuseums*, an account of the formation of the collections of Mammalia and birds in the Imperial Cabinet, which is a very valuable historical record. The amiability of his character and his great knowledge of zoology had raised up for Von Pelzeln a host of friends in every country, and the news of his death will be received with wide-spread regret.

A REUTER telegram from New York announces the death of Prof. William Ferrel, the meteorologist.

THE Royal Academy of Sciences at Lisbon send official notice of the decease of their Secretary, José Maria Latino Coelho, who died on the 29th ult. at Cintra, at the age of sixty-six. Besides his Secretaryship of the Académie Royale des Sciences, Prof. Coelho held the post of Director of the Mineralogical Section of the Museum at the École Polytechnique de Lisbonne.

THE death of M. Wilken, the well-known Dutch ethnologist, has excited much regret in Holland, where his scientific work was greatly appreciated. He was forty-four years of age, and had spent some time as a Government official in the Dutch East Indies, where he had ample opportunities for carrying on his favourite studies.

PROF. K. GOEBEL has been appointed Professor of Botany in the University, and Director of the Botanic Garden at Munich, in the place of the late Carl v. Nägeli.

THE Photographic Society of Great Britain announce the holding of an exhibition, which will be open from September 28 to November 12.

THE most interesting part of the Royal Horticultural Society's exhibition on Tuesday was a series of the so-called carnivorous and insect-eating plants. It was hoped that the display of this series would tend to correct some very mistaken ideas which are said to be current on the subject. According to Mr. Weathers, the Assistant Secretary of the Royal Horticultural Society, some persons, relying on what they have heard, will assert that "these plants can easily dispose of a beefsteak or mutton chop if their digestive organs are in thorough repair."

THE annual meeting of the Federated Institution of Mining Engineers was held on Tuesday at the Mason College, Birmingham, and was attended by about 120 members. Mr. T. W. Embleton, of Leeds, presided. In the report it was stated that the Council had not yet undertaken any special inquiry connected with the objects of the Institution, but their attention had been directed to the question of safe explosives for use in mines, the mechanical ventilation of mines, and other subjects. By the permission of the Durham Coal-owners' Association and the Durham Miners' Association, a report upon the fumes produced in mines by roburite, tonite, and gunpowder had been printed in the Transactions. The North of England Institution had appointed a committee to examine and report upon the so-called "flameless" explosives for use in mines. A paper sketching the geology of the Birmingham district was read by Prof. Lapworth. A paper was also submitted by Messrs. W. F. Clark and H. W. Hughes, in which the local method of working the thick coal was described to the visitors, and the peculiarities of the South Staffordshire coal-fields were described in technical detail. Mr. Arthur Sopwith supplied some similar information with reference to the North Staffordshire portion of the coal-field. These two papers were taken as read, and the discussion was deferred until the members of the Institution had visited the principal Staffordshire pits.

A REPORT for the year ending May 31 last, by Mr. G. J. Swanston, the Assistant Secretary of the Marine Department of the Board of Trade, upon the colour tests used in the examination of candidates for masters' and mates' certificates in the British mercantile marine has been issued as a Parliamentary paper. The number of persons who presented themselves for examination for masters' and mates' certificates of competency under Form "Examination 2" amounted to 4688, being an increase of 26 over the previous year, when 4662 were examined. In the past year 31 persons were rejected for their inability to distinguish colours, as compared with 23 rejected in the previous year. The number of persons examined in colours only under Form "Examination *2a*" amounted to 601. Of these, 32 were rejected, being an increase of over 1·8 per cent. as compared with the previous year, when, out of 839 candidates examined, 29 were rejected. A few of those who failed to pass succeeded afterwards in satisfying the examiners. One man, who, on March 3, described a green card as drab, drab as green, pink glass as salmon and green, standard green as blue, bottle green as red, and neutral as green, passed a fortnight later, having apparently learned to distinguish the colours in the intervening period. The mode of conducting the colour-test examination described in the Report for the year 1887 is still in operation; but Mr. Swanston notes the fact that the whole subject of colour-vision and the best mode of conducting the examinations are now being investigated by a Committee appointed by the Royal Society.

ON his return from Japan, sixteen years ago, Prof. Rein, the well-known authority on Japanese art and industry, planted in the Botanical Garden at Frankfort some specimens of the lacquer-tree (*Rhus vernicifera*), from which the Japanese obtain the juice employed in the production of their famous lacquer work. According to the *Times*, there are now at Frankfort thirty-four healthy specimens of the lacquer-tree, 30 feet high and 2 feet in girth a yard from the ground; and the young trees, which have sprung from the original tree's seed, are in a flourishing condition. It seems to be proved, therefore, that the lacquer-tree is capable of being cultivated in Europe, and it only remains to be seen whether the juice is affected by the changed conditions. The *Times* says that, to ascertain this, Prof. Rein has tapped the Frankfort trees, and has sent some of the juice to Japan, where it will be used by Japanese artists in lacquer work, who will report on its fitness for lacquering. In the meantime, some of the most eminent German chemists are analyzing samples of the juice taken from the trees at Frankfort, and samples of the juice sent from Japan; and should their reports and the reports from Japan be favourable, it is probable that the tree will be largely planted in public parks and other places in Germany. In course of time a skilled worker in lacquer would be brought over from Japan to teach a selected number of workmen the art of lacquering wood, and in this way it is hoped that a new art and craft may be introduced into Europe. Prof. Rein has been conferring with the authorities at Kew as to the results of his experiment.

THE Hydrographic Department of the Admiralty has just published full details of the determinations of the latitudes and longitudes of six stations on the west coast of Africa—namely, Port Nolloth, Mossamedes, Benguela, St. Paul de Loanda, São Thomé, and Bonny. The observations were made in 1889 by Commander T. F. Pullen, R.N., and Mr. W. H. Finlay, under the direction of Dr. Gill, of the Cape Observatory. Whilst stationed at Bonny, Commander Pullen succumbed to malarial fever, and Dr. Gill has since taken charge of the reductions. The observations would not have been possible but for the courtesy of the officials of the Eastern and South African Telegraph Company, who placed their cables at the disposal of the observers.

Neptunia for July gives a description of the frigate *Scilla*, set apart by the Italian Government for the hydrographic exploration of the Mediterranean, and of its scientific fittings and instruments. By the end of September the *Scilla* was expected to be at work along the Italian possessions in the Red Sea, investigating the fauna and flora, and the temperature at different depths.

DR. A. ALCOCK, the Surgeon-Naturalist of the Marine Survey of India, is able to give a most favourable report of the work done in natural history on board the *Investigator* during the year ending March 1, 1891. The deep-sea researches made great progress. Not only has the work of collection been much more successful since the use of the reversible trawl and wire-rope, but the collections themselves are becoming better arranged; so that should it ever be decided to report upon them, group for group, in systematic detail, there will be abundance of material all sorted ready to the hand. Dr. Alcock is most anxious that such a report should at some time be undertaken; for apart from the Marine Survey of India nothing whatever, he thinks, is likely to be made known of the life of the depths of the Indian Seas, and of the physical and chemical characters of the deposits now being laid down on the bottom of those seas. Further, there are good reasons for supposing that an economic return would follow from the careful investigation of the little-known semi-bathybial fauna of Indian waters, and from a comparison between it and the semi-bathybial faunæ of the Mediterranean Sea on the one hand and the Japanese Seas on the other.

WE have received from Messrs. Philip and Son a new orrery for finding roughly the positions of the sun, moon, and planets for any hour of the year, and their times of rising, southing, and setting. In general appearance it resembles their well-known planisphere, but, in addition, it is provided with two index arms graduated in degrees of declination—one for the sun, and the other for the moon or planet. The operations are simple, but the instructions given scarcely do justice to the arrangements for carrying them out. An almanac is, of course, a necessary accompaniment to the orrery. We can recommend it to young students of astronomy.

A BOTANICAL Club for California has been instituted under the presidency of Dr. H. W. Harkness.

WE learn from the *Botanical Gazette* that Prof. J. M. Coulter has been spending the summer in studying the Cactaceæ of the borders of the United States and Mexico, under the direction of the Department of Agriculture at Washington; and that an expedition has been organized to investigate the flora of Mount Orizaba, Mexico, under the superintendence of Mr. H. E. Seaton.

A QUARTERLY Review of Geological Science in Italy will shortly appear at Rome, edited by Sigg. M. Cermenati and A. Tellini.

MR. CHARLES TODD, in his Report on the Rainfall in South Australia and the Northern Territory during 1890, says that without doubt "the feature" of the year was the extraordinary rainfall (especially in the first three months) over the eastern and north-eastern portions of the continent, which continued throughout the whole year, more or less, in New South Wales, and, whilst giving that colony the wettest year on record, caused some stations to register over 100 inches.

THE Pilot Chart of the North Atlantic Ocean for September states that the most important storm of the month was the hurricane that devastated the island of Martinique on the evening of the 18th, causing the loss of 378 lives. The storm seems to have been of comparatively small diameter, and it probably originated south-east of the island, which it passed directly over, on a west-north-west track towards San Domingo. It recurved over the eastern Bahamas, and thence moved north-east close to Bermuda; where at noon of the 27th the wind blew with hurricane force from north-north-west. The weather, the same as in this country, was unsettled and rainy over the North Atlantic generally, especially off the Atlantic coast of the United States, and a considerable amount of fog has been reported. A submarine earthquake was experienced at 10h. 30m. a.m. on August 23, in latitude 36° 44′ N., longitude 59° 47′ W., by the s.s. *Robert Harrowing*; Captain Hughson reports that a strange commotion of the sea increased until the decks were filled with water. At 1h. p.m. the sea suddenly fell calm.

COLORADO apparently intends to be well represented at the great Chicago Exhibition. Besides the mineral, agricultural, and educational exhibits, the flora and fauna of the State will be shown in great completeness. Already more than 1000 specimens of plants have been pressed; nearly 200 varieties of fruit have been duplicated in wax, and more than 2000 species of insects have been mounted.

RETURNS have been collected in Prussia, showing the extent to which buildings belonging to the State, or entitled to State subsidy for rebuilding or repair, were damaged by lightning from the year 1877 to 1886. The number of buildings to which the returns relate is 53,502. Of these, 264 were struck during the period in question, or about five for every 1000 buildings in ten years; and in 81 cases a fire resulted. The following facts, given originally in the *Reichsanzeiger*, are reproduced in the current number of the *Board of Trade Journal*:—Of the 264 buildings struck, 107 had towers, and in six cases only the tower escaped being struck. Of the total number of buildings struck, fifteen were fitted with conductors, and of these latter only one building escaped injury. In two cases the conductor was injured, and on one occasion the lightning passed from the conductor to an iron water pipe. In five cases they were so constructed as to be either dangerous or useless; in six cases they were not struck at all, being inadequate for the size of the building, from which it will be seen that conductors are a safeguard against lightning only when carefully constructed and repaired, and fitted in numbers according to the size of the building which it is intended to protect. The amount of injury wrought by lightning on the 53,502 houses was, on the whole, inconsiderable, being only 1,136,683 marks (£56,834), or 4306 marks (£215) for each casualty, or 21 marks (a guinea) per building in ten years, that is 2·1 marks (about 2*s.*) per building per annum.

SOME parts of Australia seem to be admirably suited for the growth of the olive. Mr. Principal Thompson, of Dookie, says in a recent report that 700 olive trees planted in that district are robust and healthy, and that they produce splendid oil. He strongly recommends the planting of the olive around vineyards and homesteads for shade and shelter, and to give a picturesque appearance to the rural home. Apart from the making of oil, he believes it would pay handsomely to grow olive berries to feed pigs alone. Last winter the pigs at Dookie (about 80 head) were allowed to eat up the fallen berries in the olive grove; they had no other food for upwards of two months, and throve amazingly, their skins having a peculiar shining appearance, characteristic of animals being well fed.

Tobacco is being cultivated with much success in the German part of New Guinea, and is said to be better than the tobacco produced in Sumatra. It is expected that there will be a great increase in the amount grown during the coming year.

According to M. d'Amagher, the Russian correspondent of the *Monde Economique*, a central Agricultural Institute is to be established in Russia. It will include several sections—agricultural, geological, meteorological, botanical, chemical, and technological; and branches will be formed in the provinces.

Unusually fine atmospheric effects were produced by the clear weather of the Mediterranean during the month of July. According to the *Mediterranean Naturalist*, the new monthly periodical issued in Malta, the phenomenon of irregular diffraction was especially shown by the raising of the line of sight to such an extent that objects at great distances, at other times completely concealed from view, were apparently raised so much above their true position as to be clearly discernible from the shores of Malta and Gozo. The cliffs of the coast-line, and the undulatory contour of the mountains of Sicily, were to be seen distinctly with the naked eye on July 11 and 12, while the outlines of Etna stood boldly out against the clear azure sky. Although more than 100 miles away, the form of the mountain was perfectly recognizable.

The honey of the Malta bees has long been noted both for its purity and for its delicious flavour. A writer in the *Mediterranean Naturalist* says the flavour is largely due to the extensive crops of sulla (clover) that are annually raised throughout the islands, from which the bees derive the largest proportion of their material. It is estimated that to collect one pound of honey from clover, 62,000 heads of clover must be deprived of nectar, and 3,750,000 visits must be made by the bees.

Some excellent directions for the collection, preparation, and preservation of birds' eggs and nests have been put together by Mr. C. Bendire, and published by the United States Nationa Museum. He begins his counsels by telling the would-be collector that unless he intends to make an especial study of oology, and has a higher aim than the mere desire to take and accumulate as large a number of specimens as possible regardless of their proper identification, he had better leave nests and eggs alone. The mere accumulation of specimens, Mr. Bendire points out, is the least important object of the true oologist. The principal aim of the collector should be to make careful observations on the habits, call-notes, song, the character of the food, mode and length of incubation, and the actions of the species generally from the beginning of the mating season to the time the young are able to leave the nest.

At one of the meetings of the Wellington Philosophical Society in 1885, Sir Walter Buller, F.R.S., exhibited a series of the so-called wandering albatross, and expressed his belief that there were two species under the common name of *Diomedea exulans*, one of them being highly variable in plumage, and the other distinguished by its larger size and by the constancy of its white head and neck. But, although that was his conviction, he did not feel justified in setting up the new species and giving it a distinctive name until he could produce incontestable evidence of its existence. From a paper read by him before the same Society in February last, and published in the new volume of the Transactions of the New Zealand Institute, we learn that he had lately had an opportunity of examining sixteen beautiful specimens of both sexes and of all ages, and that as the result of his study of these specimens he had no hesitation in speaking of a new species. "It is undoubtedly," he says, "the noblest member of this group, both as to size and beauty, and I have therefore named it *Diomedea regia*." He exhibited before the Wellington Society a series of both species, and in the course of some remarks on them stated that they keep quite apart from one another on their breeding-grounds, and do not commingle "except when sailing and soaring over the mighty deep, where a community of interest and a common pursuit bring many members of this great family together."

In the paper in which he deals with the species called by him *Diomedea regia*, Sir Walter Buller refers to a remarkable characteristic of the wandering albatross—a characteristic which has been carefully studied by Mr. Harris. At a certain time of the year, between February and June—Mr. Harris cannot exactly say when—the old birds leave their young and go to sea, and do not return until October, when they arrive in large numbers. During their absence the young birds never leave the breeding-ground. Immediately after the return of the old birds, each pair goes to its old nest, and, after a little fondling of the young one, turns it out, and prepares the nest for the next brood. The deserted young ones are in good condition, and very lively, frequently being seen off their nests exercising their wings; and, when the old birds come back, a young bird will often remain outside the nest and nibble at the head of the old one, until the feathers between the beak and the eye are removed, and the skin made quite sore. The young birds do not go far from land until the following year, when they accompany the old ones to sea. When the young are left in the nest at the close of the breeding-season, they are so immensely fat that Sir Walter Buller thinks they can subsist for months without food of any kind. Captain Fairchild has described to Sir Walter from personal observation the coming home of the wandering albatross, and the peremptory manner in which the young bird in possession is ordered to quit the nest, so as to make room for its successor.

The habits of the kingfisner (*Halcyon vagans*) formed the subject of an interesting paper read some time ago by Mr. J. W. Hall before the Auckland Institute, and now printed in the Institute's Proceedings. He raised the question, Is it customary for the kingfisher to capture live birds? Last winter he saw one with a live white-eye in its mouth. The tree the kingfisher was perched upon was not many yards distant from him, and he distinctly saw the little wings flutter convulsively as the kingfisher was preparing to beat its prey against the branch. So it could not have been a dead bird casually picked up. Perhaps this, he said, was an application of the *lex talionis*, for, besides being mercilessly persecuted by the small boys with their catapults, the kingfisher was not infrequently captured by the common hawk. But sometimes the hawk does not come off best. One day at Parawai (Thames) a hawk sailed round the bend of a hill, followed (accidentally, he supposed) by a kingfisher. There at once arose a great outcry, and the hawk came again in sight, bearing the kingfisher in its talons. But, nothing daunted, the kingfisher with its pickaxe of a bill pegged away at the breast and abdomen of its captor to such good effect that the hawk was glad to liberate its prey, whereupon the kingfisher flew away apparently but little the worse for the encounter, and carrying with it, he need hardly say, the full sympathy of the onlookers. A friend of the author had seen a kingfisher dive under water to escape the pursuit of a hawk.

Mr. J. Crawford, State Geologist and Mineralogist of Nicaragua, visited in 1888 the Amerrique Indians, from whose ancestral name "America" may have been derived; and he has lately submitted to the Boston Society of Natural History some interesting notes about them. They occupy a hilly region in the gold-mining part of the district of La Libertad, Nicaragua, where there are "true fissures," each containing gold in sufficient quantities to give profits to the mine and mill owners now "operating" them. A few melted masses of gold, weighing from half an ounce to two ounces each, pierced with holes, and in form supposed to have been made and used as ornaments before the Spanish occupation, have been discovered in the district; and Mr. Crawford regards it as a fair inference that the Amerrique Indians who dwelt in that part of Nicaragua at the time of its discovery by Columbus, September 1502, picked up and occasionally mined, melted, and used gold for sacred or ornamental purposes. The Amerrique Indians are usually well formed, 6 feet 6 inches to 6 feet 8 inches tall; and they are active, and appear to be strong and healthy. Nevertheless, they are dying out rapidly. Probably not more than 275 or 300 of them are now living. They live in dim pathless forests, and their occupation is to find in the woods various species of trees (*Siphonia*, *Castilloa*, &c.) They deeply scarify these, collect the exuding emulsion, and separate the contained elastic ("India") rubber; and this "India" rubber they carry on their backs more than 100 miles to sell to merchants in Rama or at the mouth of Rio Matagalpa. They have cleared some patches of ground, and plant corn by making holes in the soil with pointed sticks. They believe that with allied tribes they had in very ancient times a mighty prophet or cacique, who appeared suddenly, full grown, in their territory, and that to him many tribes of Indians gave allegiance. The impalpable form of this ancient chief has been seen by very old Indians proudly walking and gesticulating on the top of Mesa Totumbla. He is buried in, or returns by day to, a deep cavern in this Mesa (a mass of gneiss); and he indicates, by gestures, that he will one day collect the Indians into a great army, and lead them in person to many victories. Mr. Crawford found his way into the cavern, and discovered in it three crania of Indians with other bones of their bodies. These were sent in 1889 to the Paris Exhibition, and were afterwards transferred to the U.S. National Museum. A few crude beads or ornaments, evidently earlier than the Spanish occupation of Nicaragua, were also found.

THE following are the arrangements for lectures during October at the Royal Victoria Hall:—October 6, Prof. T. Hudson Beare, the steam-engine, with experiments; October 13, Rev. Canon Browne, the invasion of England and Battle of Hastings, with illustrations from Bayeux tapestry; October 20, Mr. J. R. Green, flowers and their helpers; and October 27, Rev. E. Hill, the Channel Islands.

AT a meeting held last year by the students of the Kindergarten department of the New York College for the Training of Teachers, various papers were read on the principles and methods of the Kindergarten. These papers have now been issued as one of the educational monographs of the New York College. Miss A. Brooks, who contributes an introduction, says the School Board of New York City is considering plans for the introduction of the Kindergarten system into its schools; and a movement begun by the New York Kindergarten Association is destined, she thinks, "to accomplish great things for the neglected children of the city."

"EGYPTIAN SCIENCE," by N. E. Johnson, is the title of a work which will shortly be published by Messrs. Griffith, Farran, and Co.

THE Durham College of Science, Newcastle-upon-Tyne, has issued its Calendar for the session of 1891–92. This College represents the faculties of science and engineering in the University of Durham, and thus constitutes an important portion of the University of the north of England. But it does not restrict its work to science and engineering; it fulfils all the functions of a University College.[1]

THE following works will shortly be published by Messrs. Crosby Lockwood and Son:—"The Mechanical Engineer's Pocket-book of Tables, Formulæ, Rules, and Data," a handy book of reference for daily use in engineering practice, by D. Kinnear Clark; "The Metallurgy of Argentiferous Lead," a practical treatise on the smelting of silver-lead ores, and the refining of lead bullion, including reports on various smelting establishments, and descriptions of modern furnaces and plants in Europe and America, by M. Eissler; "Engineering Chemistry," a practical treatise for the use of analytical chemists, engineers, iron masters, iron founders, students, and others, comprising methods of analysis and valuation of the principal materials used in engineering work, with numerous analyses, examples, and suggestions, by H. Joshua Phillips; "A Handbook of Brewing," a practical treatise for the use of brewers and their pupils, by Herbert Edwards Wright; "Condensed Machines," a selection of formulæ, rules, tables, and data, for the use of engineering students, science classes, &c., in accordance with the requirements of the Science and Art Department, by W. G. Crawford Hughes; "Milling," a treatise on machines, appliances, and processes employed in the shaping of metals by rotary cutters, including information on making and grinding the cutters, by Paul N. Hasluck, with upwards of 300 engravings; "Star Groups," a student's guide to the constellations, by J. Ellard Gore, with thirty maps; "Lessons in Commerce," by Prof. R. Gambaro, of the Royal High Commercial School of Genoa, edited and revised by James Gault, Professor of Commerce and Commercial Law in King's College, London.

AMONG the books announced by Messrs. George Philip and Son are the following:—"Delagoa Bay: its Natives and Natural History," by Rose Monteiro, with 20 original illustrations, after the author's sketches and from the natural objects, by A. B. and E. C. Woodward; "Paraguay: its History, Commerce, and Resources," by Dr. E. Bourgade, with 13 illustrations and a large coloured map; "Makers of Modern Thought," by D. Nasmith, Q.C.; "The Teacher's Hand-book of Slöjd," as practised and taught at Nääs, by Otto Salomon, Director of the Nääs Seminarium, with over 130 illustrations; "Hughes's Class-book of Modern Geography," an entirely new and completely revised edition, much enlarged by J. Francon Williams; "Geography of the British Colonies and Foreign Possessions," by the Rev. J. P. Faunthorpe, new and revised edition; "Systematic Atlas," for higher school and general use, a series of physical and political maps of all the countries of the world, with diagrams and illustrations of astronomical and physical geography, specially drawn by E. G. Ravenstein; "The Handy Volume Atlas of Astronomy," a series of 72 plates, with notes and index, by Sir Robert Stawell Ball, F.R.S.; "The Handy Volume Atlas of London," a series of 64 maps, with notes, compendium, directory, and complete index; "Atlas of Modern Geography," new and enlarged edition.

THE additions to the Zoological Society's Gardens during the past week include two Macaque Monkeys (*Macacus cynomolgus*) from India, presented respectively by Mr. G. H. Sasse and Mrs. Gregorey; two Sykes's Monkeys (*Cercopithecus albigularis*) from East Africa, presented by Mr. F. Pardage; one Mozambique Monkey (*Cercopithecus rufo viridis*), one Garnett's Galago (*Galago garnetti*) from East Africa, one Blotched Genet (*Genetta tigrina*), one Ostrich (*Struthio camelus*) from East Central Africa, presented by Mr. Freith Anstruther; one Coypu (*Myopotamus coypus*) from South America, presented by Mr. Spencer H. Curtis; one Golden Eagle (*Aquila chrysaëtus*), European, presented by Mr. Herbert Bray; one —— Sand Grouse (*Pterocles* ——) from South Africa, presented by Mr. Max Michaelis; two Trocary Pigeons (*Columba trocary*) from Madeira, received from Dr. F. J. Hicks; one —— Elaps (*Elaps* ——) from Australia, presented by Mr. E. H. Meek;

one Rhomb-marked Snake (*Psammophis rhombeatus*), four Crossed Snakes (*Psammophis crucifer*), one Hygian Snake (*Elaps hygiæ*), two —— Snakes (*Dasypeltis scabra*) from South Africa, presented by Messrs. Herbert Melville and Claude Beddington; one Smooth Snake (*Coronella lævis*), two Common Snakes (*Tropidonotus natrix*) from Oxfordshire, presented by Mr. A. W. S. Fisher; one Otter (*Lutra vulgaris*) from South Wales, received in exchange; two White-tailed Sea Eagles (*Haliaëtus albicillay's*) from Norway, three Indian Python (*Python molurus*) from India, deposited; one Macaque Monkey (*Macacus cynomolgus*) from India, one Pardine Genet (*Genetta pardina*) from West Africa, purchased; one Vinaceous Turtle Dove (*Turtur vinaceus*), bred in the Menagerie.

OUR ASTRONOMICAL COLUMN.

LIGHTNING SPECTRA.—Mr. W. E. Wood, of Washington, has continued his observations of lightning spectra for the purpose of determining the origin of some of the lines previously recorded by him (NATURE, vol. xlii. p. 377). The result is that he is now able to say, in the *Sidereal Messenger* for August:—"Lightning spectra present but the characteristic lines of oxygen, hydrogen, nitrogen, and carbonic acid, and—what was puzzling to me—the line of the vapour of sodium. The absorption bands which I find in lightning spectra I think might be produced by the moisture in the air, a large quantity being present during thunderstorms." It is suggested that the sodium line owes its presence to the existence of meteoritic *débris* in the atmosphere.

A NEW ASTEROID.—The 315th asteroid was discovered by Charlois on September 1.

THE INTERNATIONAL GEOLOGICAL CONGRESS: WASHINGTON MEETING.

THE fifth meeting of the International Geological Congress, being the first ever held in America, was held at the Columbian University, Washington, from August 26 to September 1, with an attendance of sixty or seventy foreigners, from Austria-Hungary, Canada, Chili, France, Germany, Great Britain, Mexico, Peru, Roumania, Russia, Sweden, and Switzerland, and about two hundred members from the United States. The papers and discussions were generally in English, though French and German were to some extent spoken. French has been the language of all the previous Congresses.

Profs. James Hall and James D. Dana were elected Honorary Presidents, and J. S. Newbery Acting President. Owing to the absence of the latter, the chair was filled in turn by several of the Vice-Presidents.

FIRST DAY.—After the election of officers, as nominated by the bureau, Prof. Joseph Le Conte, as senior Vice-President, took the chair, and delivered the opening address, in which he said that the idea of an International Congress was born in America in 1876. Previous meetings have been held at Paris in 1878, Bologna in 1881, Berlin in 1885, and London in 1888. He briefly stated the purposes of this Congress, which were afterwards carried out—namely, to discuss classification of the Pleistocene rocks, of correlation, and of map notation. He compared the maps of Europe and America, showing the complexity of the former and the simplicity of the latter. He then considered some points in American geology:—(1) The general continuity of the record. (2) The prevalence of extensive faults, ranging from 100 to 2000 feet, and extending over great distances. (3) Peculiarities of mountain structure. Prof. Gilbert has discovered a new type of mountains formed by uptilted strata. The Sierra Nevada is an illustration. (4) Extensive lava floods, covering areas from 10,000 to 100,000 square miles in extent, and from 2000 to 4000 feet deep. No such floods are found elsewhere. Those of India are the nearest approximation; but in Europe the lava beds are small and much cut up. (5) The great continental movement, commencing in the later Tertiary, and terminating in the beginning of the Quaternary, which has caused changes of level amounting to 2500 or 3000 feet on both sides of the continent. (6) The ice-sheet of the glacial epoch was first and most completely demonstrated in America.

Other addresses were delivered by Mr. Hubbard, Chairman of the Local Committee; Mr. Noble, Secretary of the Interior, who has official control and supervision of the Geological Survey of the United States; Prof. Hughes of England, Prof. Gaudry of France, and Major Powell, Chief of the Geological Survey.

SECOND DAY.—The entire day was occupied by a discussion on classification of the glacial Pleistocene deposits. Prof. T. C. Chamberlin opened the discussion by stating that classification might be made on three grounds: (1) structural; (2) chronological; (3) genetic. The first was very easy, being an obvious division into assorted and unassorted drift. The second was extremely difficult, and could not be accurately made till after a full determination of the third. He accordingly proposed the following general classes: (1) formations produced by the direct action of Pleistocene glaciers; (2) formations produced by the combined action of Pleistocene glaciers and accompanying glacial drainage; (3) formations produced by glacial waters after their issuance from Pleistocene glaciers; (4) formations produced by floating ice derived from Pleistocene glaciers; (5) formations produced by shore ice and ice floes due to low Pleistocene temperature, but independent of glacier action; (6) formations produced by winds acting on Pleistocene glacial and glacio-fluvial deposits under the peculiar conditions of glaciation.

This paper was discussed very thoroughly. Prof. T. McK. Hughes pointed out that the classification suggested by Prof. Chamberlin was purely genetic. He then explained the abundance of striated boulders in one part of the glacial deposits and their absence in another. If the supply of material (that is, of rock bosses above the ice) ceases at any point, then all the boulders will gradually sink through the ice and become glaciated at the bottom. Prof. Hughes also thought that two distinct types of ridges formed of glacial material were confused under the names—kames, osars, and eskar. He also explained the "pitted plains" as due to an unusual interruption between the hills or ridges of eskar character. He expressed his opinion that the glacial period was a continuous one, in England at least, except for slight changes due to unimportant oscillations.

Mr. McGee mentioned the importance of land forms in interpreting geological processes. Any primary geological classification must be genetic. He discussed in detail the following scheme of classification of Pleistocene deposits:—

Classification of Pleistocene Formations and Land Forms.

A. Aqueous:
  1. Below base level.
    a. Marine.
    b. Estuarine.
    c. Lacustral.
  2. At base level.
    a. Littoral.
    b. Marsh.
    c. Alluvial (certain terraces, &c.).
  3. Above base level.
    a. Torrential.
    b. Talus (including playas).
B. Glacial:
  1. Direct (Chamberlin's Class I.).
  2. Indirect (Chamberlin's Classes II. to V., in part).
C. Aqueo-Glacial (Chamberlin's Classes II. to V., in part).
D. Eolic (Chamberlin's Class (?) VI.).
E. Volcanic:
  1. Direct.
    a. Lava sheets.
    b. Cinder cones.
    c. Tuffs, lapilli sheets, &c.
  2. Indirect.
    a. Ash beds.
    b. Lapilli sheets.

Prof. Chamberlin, in closing the discussion, said that there was great difficulty in applying a chronological classification, and that such a classification might even act as a barrier to observation and to the recognition of the truth. Chronological classification is the ultimate goal of glacial studies, but it is something for which we are not as yet prepared. Red, oxidized sub-soils are not developed in northern latitudes. Organic deposits between glacial layers are abundant in the West, but do not belong to a single horizon. Many facts of erosion and physical geology indicate that the Glacial epoch in America was widely differentiated and of long duration. How many distinct periods it embraced we do not as yet know.

Prof. Cope said an abundant tropical fauna is found in the "Equus beds," which, if they be of interglacial age, indicates at this time a very warm climate. This fauna is succeeded by a truly boreal fauna. In this is contained material for a chronological subdivision of Pleistocene deposits.

THIRD DAY.—The President announced as the subject for discussion, the correlation of geological formations.

Mr. Gilbert opened this discussion by presenting a general classification of methods of correlation.

Strata are locally classified by superposition in chronologic sequences. Geologic correlation is the chronology of beds not in visible sequence. For convenience in discussion, methods of correlation are classed in ten groups, of which six are physical and four biotic.

Physical Methods of Correlation.

(1) Through visible continuity. The outcrop of a bed is traced from point to point, and the different parts are thus correlated one with another.

(2) Strata are correlated on account of lithologic similarity. This method, once widely prevalent, is used where the distances are small.

(3) Correlation by the similarity of lithologic sequence has great and important use where the localities compared fall within the same geologic province, but is not safely used in passing from province to province.

(4) Physical breaks, or unconformities, have a limited use, especially in conjunction with other methods. The practice of employing them in the case of localities wide apart is viewed with suspicion.

(5) Deposits are also correlated with their simultaneous relations to some physical event—for example, a beach with the lake beds it encircles; a base level plane with a contiguous subaqueous deposit; and alluvial, littoral, and subaqueous deposits standing in proper topographic relation. In the Pleistocene, glacial deposits are widely correlated with reference to a climatic episode assumed to arise from some general cause.

(6) Deposits are correlated through comparison of changes they have experienced from geologic processes supposed to be continuous. Newer and older drift deposits in different regions are correlated according to the relative extent of weathering and erosion; induration and metamorphism afford presumptive evidence of age, but yield to evidence of other character. Metamorphism holds prominent place in the correlation of pre-Cambrian rocks where most methods are inapplicable.

These physical methods are qualified by the geographic distribution of geologic processes of change and of geologic climates.

Biotic Methods of Correlation.

(7) A newly-discovered fauna or flora is compared with a standard series of faunas and floras by means of the species it holds in common with them severally.

(8) It is also compared by means of representative forms, or through genera and families.

(7*a*) and (8*a*) These comparisons are strengthened if two or more faunas in sequence are found to be systematically related to the faunas of a standard series.

(9) Two faunas or floras otherwise related are compared in age through their relation to the present life of their localities. This method was applied by Lyell to Tertiary rocks.

(10) Faunas are correlated by means of their relation to climatic episodes taken in connection with station. For example, boreal shells found in latitudes below their present range are referred to glacial time.

In general the limitations to accurate correlation by biotic methods arise from the facts of geographic distribution. Correlations at short range are better than those at long range.

Biotic correlation by means of fossils of different kinds may have different value. In general, the value of a species for the purposes of correlation is inversely as its range in time, and directly as its range in space. The value of a biotic group depends (1) on the range of its species in time and space; (2) on the extent to which its representatives are preserved.

Prof. K. von Zittel spoke in reference to the biotic methods, and gave his opinion of the relative value of plants and animals for purposes of correlation. He regarded plants as relatively unimportant. Among animals, those which are marine, lacustrine, and land animals may be distinguished. Of these classes marine invertebrates are most valuable for purposes of correlation. The vertebrates change rapidly, but are frequently altogether wanting. For instance, no vertebrates occur in the Alpine beds corresponding in age to those which contain the mammalian fauna of the Paris basin. In certain lacustrine deposits invertebrates may be absent, and in such cases the vertebrate fauna is the surest guide.

Baron de Geer emphasized the importance of a numerical comparison between different species. The actual counting of individuals in a given formation is of great value.

Prof. Marsh expressed his agreement in general with the conclusions communicated by Prof. von Zittel, but would give special weight to vertebrate fossils. In the Mesozoic and Tertiary beds of the Rocky Mountains he had found that the vertebrates offer the surest guide for correlation. This is in part because invertebrates are either wanting or are lacustrine. Prof. Marsh in 1877 named a sequence of horizons after the most characteristic vertebrate genus in each which is confined exclusively to it. He presented an outline of such classification brought down to date, with a section to illustrate vertebrate life in America.

Mr. C. D. Walcott spoke of the value of plants for purposes of geologic correlation.

Prof. T. McK. Hughes spoke of the present and growing tendency towards a natural classification. The evidence is complex, and includes a considerable variety of diverse relations. He pointed out exceptions to the normal conclusions deduced from superposition, lithological character, and similarity of sequence. We must have a system of criteria so varied that if one or more fails others can be employed. All classes of evidence are useful, both positive, negative, and circumstantial.

Major J. W. Powell spoke of the necessity of specialization on the part of geologists engaged in the work of correlation. The evidence derived from physical and biotic facts might apparently disagree. But that a satisfactory result may be reached, these two classes of evidence must be brought into harmony. He cited an example from his own experience, of how an identification of synchronous formations might be made over a wide area through a union of physical and biotic methods.

Mr. W. J. McGee remarked that in the coastal plain of the United States physical correlation alone is employed. The bases accord with those outlined by Mr. Gilbert, with certain minor modifications and an important addition, as follows:—

For local discrimination and correlation	Visible continuity; Lithologic similarity; Similarity of sequence.
For correlation throughout the province... ...	Physical breaks viewed as indices of geography and topography.
For correlation with contiguous provinces ...	Relation to physical events, including continental movements, transportation of materials, land sculpture, &c.
For general correlation...	Homogeny or identity of origin.

By correlation upon these bases the physical history of a considerable fraction of the continent may be so definitely ascertained as to permit fairly accurate mapping of the geography, and even the topography of each episode in continent growth. After these episodes are clearly defined, and the fossils found in the formations are studied, it will be possible definitely to ascertain the geographic distribution of organisms during each episode; then palæontology may be placed on a new and higher plane.

Prof. W. M. Davis showed that it was possible to decipher geological history not only through the records of deposition, but also by processes of degradation. As an example of this method he explained a topographical section from the city of New York westward. In this we have evidence of the existence of an ancient *peneplain*, or base-level lowland of Cretaceous age. This surface was subsequently elevated (more toward the west than toward the east) at the end of Cretaceous, or at the beginning of Tertiary time. It has since been dissected by the excavation of more recent valleys. The Hudson Valley lowland was cited as an example of this recent dissection.

Prof. E. W. Claypole considered that the different methods of geologic correlation differed very greatly in their value. It is improbable that the plant or mammalian record will ever equal in its perfection that of the marine invertebrate fauna. The marine fauna is to the geologist what a primary triangulation is to the geodesist. It marks out the main divisions, which are subsequently further subdivided through the aid of other fossils, such as plants and vertebrates.

Prof. C. R. Van Hise spoke of the methods of correlation employed for pre-Cambrian rocks, which occur in widely separated areas and are devoid of fossils. Physical data only are available for correlating these formations. Experience has shown that, among all physical methods, unconformity is by far the most important. Other physical criteria, such as the degree of induration, metamorphism, and relation to eruptives, are valuable for the subdivision of single areas, but cannot be safely used in identifying synchronous formations in widely-separated areas. The idea that lithological character is any direct proof of geological age has retarded the scientific subdivision of pre-Cambrian rocks. The researches of Pumpelly and others in the eastern United States have demonstrated that Silurian, Devonian, and even Carboniferous deposits might become, under certain physical conditions, as highly crystalline as much more ancient rocks of the West. For this reason it has been found necessary to abandon such terms as *Huronian* and *Keweenawan*. Evidences of life are not lacking in pre-Cambrian rocks, and it is to be hoped that the palæontologist will succeed in differentiating several separate formations below the Cambrian, as the Cambrian itself was differentiated from the base of the Silurian.

FOURTH DAY.—Prof. E. W. Hilgard laid stress upon the importance of the abundance or scarcity of species in the correlation of strata. He thinks some quantitative estimation of the species should be made. He is of the opinion, also, that, as compared with marine fauna, plants have but little value for purposes of correlation owing to their local distribution, their accidental proximity to water, transportation, and preservation. Plants can be so used only after large areas are worked over.

Prof. Lester F. Ward continued the discussion. He developed two of the more general principles of correlation by means of fossil plants, as follows :—

(1) That the great types of vegetation are characteristic of the great epochs in geology.

This principle is applicable in comparing deposits of widely different age when the stratigraphy is indecisive. For example, even a small fragment of a Carboniferous plant proves conclusively that the rocks in which it occurs are palæozoic, or a single dicotyledonous leaf proves that they must be as late as the Cretaceous.

(2) That for deposits not thus widely different in age, as, for example, within the same geologic system or series, ample material is necessary to fix their position by means of fossil plants.

Neglecting this principle has led to the greater part of the mistakes of palæobotanists, and has done most to bring palæobotany into disrepute. Geologists have expected too much of them, and they, in turn, have done violence to the truth in attempting to satisfy extravagant demands. On the other hand, where the material is ample, fossil plants have often corrected the mistakes of stratigraphical geologists, and solved problems concerning geologic age, which seemed impossible of settlement by any other class of evidence.

Prof. Henry S. Williams laid stress upon the relations of species to the conditions of deposition. The abundance of a species varies with environment, and a study of correlation should embrace a study of these conditions. Sandstones deposited near shore may have a fauna different from that of a limestone deposited off shore at the same time, and a change of fauna may be induced by a change of the conditions of deposition. The age of beds should be determined by comparing species of the same genera rather than by comparing those of different genera. There are centres of abundance which exhibit great variability in their characters; outside of these centres the species exhibit varieties which may be called extra-limital, and which are not typical though they have often been published as types.

Prof. Charles Barrois said that there was no general basis, either biologic or lithologic, for the correlation of the pre-Cambrian rocks of Europe with those of North America ; even the terms applied to these rocks were liable to be misunderstood. Certainly the divisions used in France cannot be correlated with those now used in the United States. General correlation cannot, as yet, be based upon nonconformities ; autopsy is the only basis upon which a comparison can be instituted. He pointed out certain parallelisms between the histories of the crystalline schists of America, as illustrated by Mr. Pumpelly, and the gneissic rocks of Brest, where the Cambrian slates are altered to gneisses of Archæan aspect, while the alternating fossiliferous quartzites are changed to crystalline quartz. Geologists must see the beds together in order to reach a common understanding of the crystalline rocks.

Prof. E. D. Cope discussed the question from a general point of view with especial reference to the value of vertebrates for purposes of correlation, particularly for inter-continental correlation. He pointed out that there is a marked difference in the present verebrate faunas of continents, and that the variation of such forms must be sought in vertical rather than in horizontal ranges. Such study shows that we have had invasions of a given region by a fauna from without ; for example, a South American fauna invaded North America at one time and then retreated, while a North American fauna once invaded South America, and traces of it still remain in that country. He is inclined to believe that certain vertebrate forms did not spread over the earth from a single place of origin, but that they originated at different places upon the earth. We have parallelism in separate places, but the parallelism is defective in the Laramie.

Mr. G. K. Gilbert was of the opinion that many methods of correlation must be used. He doubted the trustworthiness of the correlation of non-fossiliferous rocks by comparative change, even locally. He thought the abundance and scarcity of fossil forms comparable with lithologic differences, and considered the simple occurrence of a species as valuable for purposes of correlation as its abundance.

FIFTH DAY.—Subject for discussion : map-colouring and cartography.

Major J. W. Powell exhibited charts illustrating the colour system used by the U.S. Geological Survey, explained the methods of using the colours, and gave the reasons for them. The colours assigned to rocks of different ages are as follows :—

Period.	Period colour.	Mark.
1. Neocene	Orange	N.
2 Eocene	Yellow	E.
3. Cretaceous	Yellow-green	K.
4. Jura-Trias	Blue-green	J.
5. Carboniferous	Blue	C.
6. Devonian	Violet	D.
7. Silurian	Purple	S.
8. Cambrian	Pink	Ꞓ.
9. Algonkian	Red	A.

The colours are used to designate geologic periods, patterns of these colours designate formations ; minor divisions are usually relegated to the text. The number of patterns for designating formations can be indefinitely enlarged, but follow a definite system.

Mr. Joseph Willcox showed that in the scheme described by Major Powell the colours were not evenly distributed through the chromatic scale.

Prof. C. R. Van Hise pointed out that Archæan rocks are shown by a brown underprint, and that metamorphic rocks of known age are given the colour of the corresponding unaltered rocks.

Major Powell explained that it was not attempted to select colours equally distributed through the chromatic scale, but to use those that may be most readily recognized.

Mr. H. M. Cadell asked why black and gray were not used.

Major Powell replied that blue was used in place of the dark shades for the Carboniferous ; that dark colours are misleading in regard to the occurrence of coal, which occurs in the Cretaceous and Tertiary as well as in the Carboniferous.

Mr. Christie found the black colour very inconvenient, because it often made the details of the map covered by such colours illegible.

Mr. H. M. Cadell said that the maps of the Geological Survey of Great Britain were coloured by hand, and that the system used by the U.S. Geological Survey could not for this reason be economically employed.

Major Powell explained that the U.S. Survey system is very economical when the colour patterns are transferred to stones.

Prof. T. McK. Hughes thought it very difficult to devise a scheme that will meet the demands of everyone. Some reference must be had to the permanence of the colours, the readiness with which they can be applied, and the distinctness with which they show what is desired. He thinks the fittest scheme must survive.

In the afternoon, brief lectures were given by Prof. Chamberlin, Mr. Gilbert, Major Powell, and Mr. Emmons upon the geology of the country to be traversed by the long excursion.

Sixth Day.—A Committee on International Bibliography was appointed.

The Secretary announced that Messrs. Golier and Schmidt convey an invitation from the Swiss Government to hold the sixth International Congress, in 1894, in Switzerland. Mr. Golier delivered an address in which he presented the invitation, and the Congress unanimously accepted it. The following Swiss members were appointed a local committee, with power to add to their number and to appoint the time and place of meeting: viz. Messrs. Heim, Renevier, Lang, Balzer, Schmidt, and Golier. On the motion of Prof. Pumpelly, a vote of thanks was passed to the Swiss Government and delegation. It is thought that Berne will be selected as the place of meeting.

The Geological Survey of Russia sent an invitation to hold the seventh Congress in Russia. The Czar joined in the invitation. Prof. Tschernychew made the formal presentation of the subject to the Congress. A vote of thanks to the Survey and the Czar was passed, and the Secretary of the Congress was authorized to send a despatch by cable, transmitting the vote.

The President of the Congress, Prof. Le Conte, delivered a brief closing address, summarizing the work of the session, and after passing several votes of thanks the Congress adjourned.

THE SOCIETY OF FRIENDS OF ASTRONOMY AND COSMIC PHYSICS.

The Society of Friends of Astronomy and Cosmic Physics, founded May 19, 1891, has been formed with a view to the organization of systematic activity and co-operation in research in the subjects named. It is intended to embrace, chiefly, workers in astronomical science in Germany, Austro-Hungary, Switzerland, and other neighbouring countries, and natives of these countries in the colonies and elsewhere. Members of other nationalities are, however, offered a welcome.

The head centre of the Society is Berlin. The subscription is 5 marks.

Communications are invited from individual members, which will be published together with the notices of meetings and other business of the Society. These publications will bear the title "Mittheilungen der Vereinigung von Freunden der Astronomie und kosmischen Physik"; they will be numbered consecutively, and will be supplied to all members gratis, but will not be issued at regular or stated intervals.

These communications will form at present the only direct publication of the Society, until it is formed on a more substantial financial basis and consists of a larger number of members (in the first four weeks the number rose from 50 to over 100). Contemporaries are at liberty to borrow any matters of interest contained in the Society's communications, of course acknowledging the source from which they are derived.

Endeavours will be made to keep the Society carefully within the limits in which alone it can be successfully active, leaving on one side other closely related branches: for instance, those of the Meteorological and Photographic Societies; but, nevertheless, endeavouring to preserve the closest amity and co-operation with the related Societies.

The Astronomische Gesellschaft, founded in Germany in 1863, is regarded by the new Society as the principal Society, whose office it is to foster astronomical research throughout the whole earth. The new Society bears the same relation to this international association as do those Astronomical Societies already established in England, France, Russia, and North America.

The principal object of these smaller societies is to collect observations made in the largest possible number of districts, inasmuch as researches in astronomy and cosmic physics are very largely dependent on the state of the weather, and the relation of the place of observation to the phenomena in the heavens.

In the new Society the following branches of work have been selected:—(1) Observations of the sun; (2) of the moon and surface of the planets; (3) of the intensity and colour of the light of the stars and of the Milky Way; (4) of the zodiacal light and meteors; (5) of the polar light, magnetism of the earth, earth currents, and air electricity; (6) of the clouds and halos, and thunder and lightning (care being taken in the two last groups not to encroach upon the ground already covered by the Meteorological and Photographic Societies).

Each of these groups is presided over by a member of the Society whose attention is especially directed to the respective subject. The duty of these Presidents is to organize the correspondence, hold branch meetings, and preserve the connection which binds each group to all the others.

The Society will endeavour to further the organization of all these researches, not merely by the publication of communications and by correspondence, but also by advice and aid in the providing of apparatus, especially of suitable optic, electric, and magnetic measuring instruments, charts, books, &c.

The statutes of the Society will be sent post free on application to the Secretary, Herrn Cand. G. Witt, Berlin, N.W., Invalidenstrasse 57.

The President of the Society is at present Prof. Dr. R. Lehmann-Filhés, Berlin, W., Wichmannstrasse 11*a*.

The Committee consists of the six members presiding over the several groups of research.

The Librarian of the Society is Herr Dr. P. Schwahn, Berlin, N.W., Invalidenstrasse 57; and the Treasurer, to whom subscriptions should be sent, Herr Rendant Bruck, Berlin, N.W., Invalidenstrasse 57.

THE PROTECTIVE DEVICE OF AN ANNELID.

Amongst a gathering of small Serpulids, &c., received from Mr. Sinel, of Jersey, I find some interesting little worms related to the Sabellidæ. They build a thin membrane-like tube, about one-seventieth of an inch in diameter, coated externally with flat translucent particles of sand. Its lower end is closed, and embedded in sponge or other growths, but the upper end is free, and, when the head of the inmate is protruded, stands about a quarter of an inch high in the water. On this head are two branchial tufts, each having five branches beset with a double row of long ciliated filaments. When all are fully expanded they curve backwards, and cover an area of about one-tenth of an inch in diameter. The branches decrease in size from the inner to the outer pairs, and at the back of the longest but one in each tuft, near its base, is a chocolate or

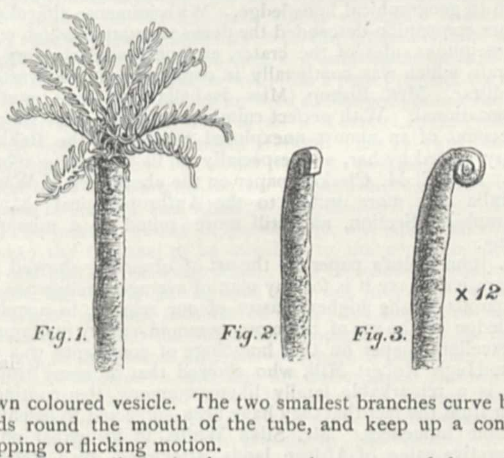

Fig. 1. Fig. 2. Fig. 3. × 12

brown coloured vesicle. The two smallest branches curve backwards round the mouth of the tube, and keep up a constant whipping or flicking motion.

But the peculiarity is, that, upon the retreat of the animal, the mouth of the tube not only instantly closes flatly and tightly by collapse of the sides, but the tube itself, beginning at the tip, proceeds to coil up like a spiral spring, looking very much like a young fern-frond. This is, of course, an effectual protection against the intrusion of enemies, and the coiling and uncoiling, which I have witnessed many times, is a most curious sight.

Fig. 1 shows the branchial tufts expanded. Fig. 2, tube beginning to coil up. Fig. 3, tube partly coiled up—a process which is sometimes continued much further. I do not know whether this annelid has previously been noticed or described, but, if so, I shall feel obliged to any of your readers who can refer me to a description. ARNOLD T. WATSON.

Sheffield, August 19.

GEOGRAPHY AT THE BRITISH ASSOCIATION.

THERE was at least one very satisfactory feature about the Geographical Section at the Cardiff meeting. It has been the practice in all the other Sections to appoint as Presidents men who have gained a high reputation as specialists in their own departments. For some reason this practice has not been followed in the Geographical Section. True, in past years we have had such men as Murchison, Markham, Galton, General J. T. Walker; but too often the President of this Section, while eminent as a soldier, or a colonial Governor, or as a Society man, has known as much about geography as "the man in the street." It must be admitted that this has in part arisen from the fact that scientific geographers in England could have been counted on the fingers of one hand. Happily, through the recent efforts of the Royal Geographical Society, this is ceasing to be the case, and when the Chairs at Oxford and Cambridge, and the other influences which are at work, have had time to produce results, geography, in one or other of its aspects, may become as much of a career in England as it is in Germany. It was regarded as to some extent a triumph, and an earnest of what is coming, that the President of the Section at Cardiff was a geographer pure and simple. Mr. E. G. Ravenstein has long been regarded as the one scientific cartographer in the United Kingdom (where he has been naturalized for many years); and as a geographer, in the best sense of the term, he is not surpassed. It was natural that in his address he should deal with the progress of the subject in which he is master. His address, while ostensibly dealing with cartography, really showed the growth of our conception of the earth's surface, and indicated the most profitable aspects in which we may deal with that department of knowledge whose business it is to investigate.

Amid a good deal that was trivial, and notwithstanding the usual modicum of sensation, Section E did some solid work at Cardiff. The fact is that the only incident which could be regarded as sensational was the appearance on the platform of Mrs. French Sheldon, evidently suffering greatly from the accident with which she met on her return from Kilimanjaro. But Mrs. Sheldon was able to tell us some things about the people in East Africa that had never come within the ken of the male traveller. Moreover her account of the curious crater lake Chala, at the south-east foot of Kilimanjaro, was a real contribution to geographical knowledge. With immense difficulty she and her companion descended the dense vegetation which covers the precipitous sides of the crater, and navigated the tiny lake on a raft, which was continually in danger from the swarms of crocodiles. Mrs. Bishop (Miss Isabella Bird) was anything but sensational. With perfect calmness and clearness she gave an account of an almost unexplored portion of the Bakhtiari country visited by her, and especially of its interesting inhabitants. Miss E. M. Clerke's paper on the aborigines of Western Australia was more suited to the Anthropological than the Geographical Section, and still more suited to a missionary meeting.

Mr. John Coles's paper on the art of observing showed how comparatively easy it is for any man of average intelligence, and even pupils in the higher classes of our schools, to acquire a knowledge of the use of the more common survey instruments. An excellent paper on the homology of continents was read by Dr. Hugh Robert Mill, who showed that in many respects there is a remarkable family likeness among the continents, arising from the fact that they have been subjected to essentially the same influences. Mr. Silva White, in his paper on the comparative value of African lands, attempted, by a statistical method, to indicate the lines of least resistance against the European domination in Africa. Mr. Miller Christy gave an elaborate and highly instructive paper on the absence of trees from prairies; his conclusion being that the main cause of the treelessness of American prairies has been forest fires. The paper was highly suggestive, showing, as it did, that if proper measures were taken even our great deserts might be made to blossom as the rose.

The greater part of one morning was devoted to a discussion on acclimatization, introduced in a valuable paper by Dr. Robert Felkin. The author showed that there are two schools of thought, the one regarding acclimatization as impossible, the other more sanguine and pronouncing it possible. Probably the truth will be found to be a mean between the two. In considering the subject, it is necessary to specify, first, the various nations who are to be acclimatized, and secondly, the places where they are to be located. As regards the first point, the national characteristics, habits, customs, and environment must be taken into account, and with respect to the second, the nature of the country, its climatology, its inhabitants, their mortality and endemic diseases must be brought under survey. The next point is to classify the various European nations, and it becomes evident that they can only become readily acclimatized in the temperate zone, where climatic and other conditions are approximately akin to their present habitat. In reference to Europeans becoming acclimatized in the tropics, what are those factors which prevent it, or which must be overcome before it is possible? They are as follows: heat, cold, damp, various endemic diseases, especially malaria, and those constitutional conditions induced by climate which either destroy the immigrants or diminish their fertility after one or two generations. Progress has been made during recent years in enabling persons to reside longer and to enjoy greater health in the tropics. What probability is there that science will accomplish still more in rendering acclimatization possible for Europeans in tropical countries? It must be said that both Dr. Felkin and those who followed him in the discussion occasionally lost sight of the real point at issue. The adaptation of a European to tropical conditions for a few years is one thing; the acclimatization of a race in a climate totally different from that which has been its inheritance is another. About the former there need be now no difficulty: what scanty experience we have leads to the conclusion that the latter is practically impossible. What we really want are experiments continued over three or four generations.

Colonel Holdich, of the Indian Survey, gave some valuable hints in his paper on the application of Indian geographical survey methods to Africa. An outline of the methods proposed may be summarized as—(1) The adoption of a rapid system of triangulation along the most important lines for first survey. (2) The extension of a graphic system of mapping from these lines by means chiefly of native labour. The most important lines for first survey are the international boundary lines. Until lately England has been peculiarly free from the necessity of demarcating or maintaining national boundaries. Even India offers but a comparatively short line for defence. The new partition of Africa largely increases her responsibilities in this respect, though there may be no immediate cause for action. There is, however, a great necessity for a topographical acquaintance with the boundaries adopted. Only a small portion of them apparently follow permanent natural features, the rest being defined by rivers, &c. It would appear, then, advantageous to commence triangulation along the boundary lines. This is, however, so far a national or international question, and consequently in these preliminary stages of survey State assistance might very well be expected, and Imperial resources drawn upon for carrying it out. (1) What are these resources? (2) What is the nature of surveys already existing in Africa? (3) What is the nature of the survey we ought to build up? Replying to (2) and (3), we find that if a continuous and comprehensive scheme is to be adopted, with unity of design for all the scattered districts of the African colonial system, nothing has been done as yet which would assist us in carrying out our scheme. This scheme should be largely borrowed from experiences in Asia. A consideration of it shows, in reply to (1), to what extent Imperial survey resources might be utilized during the processes of laying out the preliminary lines of triangulation. From this triangulation the extension of topography would thereafter probably depend on private enterprise. Then followed a short consideration of the general topographical processes as carried out by natives of India, of the value of such native labour, and of the possibility of raising survey establishments in Africa similar to those which have done such excellent work in Asia.

The subject of reform in our Ordnance Survey was again introduced this year in an elaborate paper by Mr. H. T. Crook, who was strongly supported by a number of speakers. Mr. Crook pointed out many defects in the large-scale maps. Some of them are notoriously behind date; they are issued in a most inconvenient form; they are far too expensive; they are difficult to obtain outside of London. The Committee of this Section sent a strongly-worded resolution to the Council of the Association, recommending, among other things, that the Directorship of the Survey, instead of being merely a staff appointment, should be made a permanent office. Unfortunately, the resolution submitted to the General Committee omitted this and other important points, so that in its final form it does not amount to much.

Mr. James Thomson's paper on photography applied to exploration contained suggestions of great practical value. He showed the value of the camera, not only in recording geographical features and types of people, but even as an adjunct to regular surveys.

The subject of geographical education was introduced in a short paper by Mr. J. Scott Keltie, who spoke of the results which had followed the action initiated by the Royal Geographical Society a few years ago. Advances have been made in many directions; Chairs have been established in Oxford and Cambridge; and a higher conception of geography and of its practical utility has begun to prevail. Happily, the attempt to obtain the Section's approval for the foundation of a local Geographical Society in Cardiff failed.

Among other papers worthy of mention were two by Colonel H. Tanner, of the Indian Survey—one on a new method of Bar-Subtense surveying, and a second on some of the principal tribes of the Himalayas.

MECHANICS AT THE BRITISH ASSOCIATION.

IN Section G, Mr. T. Forster Brown, an engineer well known in the locality in connection with mining industry, was the President. There was an average list of papers, but the discussions were not so full as is sometimes the case in this Section. As a consequence, the sittings were got through with more than ordinary speed; there being no meeting on the Saturday, and the whole business of the Section was completed by two o'clock on the Tuesday of the meeting. The President's address was given as usual on the Thursday, and referred to mechanical details in connection with mining. In character with the meeting it was brief. The usual vote of thanks having been moved and seconded, Prof. Osborne Reynolds proceeded to read the third Report of the Committee appointed to investigate the action of waves and currents on the beds and foreshores of estuaries by means of working models. It will be remembered that this Committee arose out of a paper read by Prof. Osborne Reynolds at the last Manchester meeting of the Association; and this, in turn, arose out of the investigations made upon a working model of the Mersey estuary in connection with the then proposed Manchester Ship Canal operations. The further investigations referred to in the last report have been conducted on the same system as previously described. The chief object of this series has been to obtain further information as to the final condition of equilibrium with long tidal rivers entering the head of a V-shaped estuary; to obtain more complete verification of the value of the criterion of similarity; to investigate the effect of tides in the generator diverging from simple harmonic tides; and to determine the comparative effect of tides varying from spring to neap. It would be impossible in this brief report of the proceedings of the Section to give an idea of the results at which the Committee arrived, or rather the results shown by the experiments, more especially without the aid of the diagrams by which the Report was illustrated.

The next business was the reading of a paper by Mr. G. Chatterton, in which a sewer was described that has lately been constructed to carry off the sewerage of a neighbouring district, and thus relieve the River Taff of some of its present foul burden. The sewer, no doubt, is a meritorious engineering work, but not one of magnitude or especial novelty. The most notable point is that the Taff has to be crossed seven times, and this is effected by means of inverted syphons which go below the river bed. The principle, of course, is not new. The chief interest was in the speech made by Mr. Baldwin Latham during the discussion, in the course of which the speaker exclaimed against the "faddists" who maintain that what is taken from the earth should be returned to the earth. Mr. Latham is of opinion that what is taken from the earth should be given to the sea. The ocean, he says, was given to the engineer as a receptacle of sewage—presumably among other functions. Moreover, Mr. Latham tells us that it is more profitable to put sewage in the sea than to keep it on the land. It encourages the growth of marine fauna; and it is, so Mr. Latham says, a well-known fact that where there is most sewage there are most fish. As there were no "faddists" present, Mr. Latham had it all his own way.

Mr. L. F. Vernon Harcourt's paper described the engineering operations carried on in the neighbouring River Usk and the harbour of Newport. This paper, again, did not bring forward any points of particular novelty. Mr. Vernon Harcourt is proceeding on the now fairly well recognized lines of increasing the tidal flow. Mr. Abernethy spoke in the discussion, and told the Section how he had once resigned his position in connection with the Swansea Harbour Board because it was proposed to canalize the river. The question might, we think, have been discussed with advantage—although, perhaps, not in connection with the rivers referred to—how far volume of ebb and flow, as compared with velocity, is the ruling factor.

Mr. W. Key, of Glasgow, described the system of ventilation and heating which he had introduced in the Victoria Infirmary, Glasgow. Here, again, we have no new theories enunciated, but the paper was none the less valuable on that account—perhaps more valuable. Mr. Key has taken recognized principles, selecting and arranging in a common-sense manner, and put them into practical shape. The consequence is, we hear, that the atmosphere in the Infirmary is as sweet as that outside—in fact, more so; for, whilst there may be fog in the street and mist on the hill-side, the wards are dry and clear. The circulation of air is by rotary fans driven from a gas-engine. A point upon which Mr. Key strongly insists is a screen down which water is constantly trickling, and which is automatically flushed at intervals. This has the effect of converting dust and other floating particles into mud. The air is heated over steam-pipes in the winter. Admission is 5 feet above ground, and eduction is from the floor-level, so that dust passes off, the air current assisting gravitation.

On the second day's sitting, Friday, August 21, the chief interest was absorbed by Sir Edward Reed's paper, in which he gave certain particulars of the Channel tubular railway, which he proposes some day to construct, supposing the Fates are propitious. If one may believe the eminent engineers who took part in the discussion, the Fates never will be propitious, for Sir Edward violates the first and cardinal rule of engineering enterprise in propounding a scheme that cannot pay. Sir Edward says his double tube, which is to be laid on the bottom of the sea—it is not a tunnel—will cost 12 to 14 millions. Sir Benjamin Baker says that Sir Edward must double his figures, and even then he will not have money enough. It has been stated on the highest authority that the Channel traffic would not pay interest on a million and a quarter spent on harbours; and, if this be the case, there would be a poor prospect for those who would subscribe money for even a Channel Tunnel, far more a tubular railway, and most of all a Channel Bridge, such as Messrs. Schneider and Hersent propose. Sir Edward's scheme is sufficiently heroic. He would construct two mammoth tubes, of steel plate and concrete, 20 feet in diameter. The tubes would be made in lengths, and when two lengths were completed they would be joined together in parallel, 50 feet apart, and floated out into the Channel to be attached to the completed length. The first part of the construction, near the shore, would not be difficult, but if ever Sir Edward gets out into deep water, say 200 feet, he will find troubles enough. All work is to be done above water. Thus the end of the completed part of the double tube will be kept afloat until a fresh length is joined on. Then that will be allowed to sink, and the last attached part will form the end of the completed part. In this way, so long as the work of construction is in progress, the part of the tubes last completed will slope up from the sea bottom to the surface, so that the next length may be attached. The scheme is splendid in its disregard of difficulties. It is worthy of the fervid genius of Jules Verne.

Prof. W. Robinson next read a paper on petroleum engines. It would appear that this description of motor is likely to come to the front, if one may judge from the fact that their manufacture is being taken up by some important engineering firms. Priestman Bros., of Hull, have been at work on the problem for the last year or two, and it is chiefly of the Priestman engine that Prof. Robinson speaks. Crossley Bros., of Manchester, who have made such a brilliant success with the Otto gas engine, have now taken up the subject, and are making an oil engine; whilst the big agricultural engineering firm, Hornsby's, of Grantham, have also turned their attention in this direction. There have also been efforts made by foreign engineers. A petroleum engine works generally on the same principle as a gas engine, but the chief trouble, we believe, hitherto has been to get over the clogging of parts. This supplies the chief feature in the Priestman design, in which there is a spray maker specially designed to get over this trouble. A jet of oil is first broken up by compressed air, and the spray is then further mixed with air, heated by the hot products of combustion. To cleanse the air it is drawn through cotton wool, which naturally has to be renewed from time to time. The proportions of air and oil vapour are arranged to give an explosive charge, and a regular explosion is obtained every cycle by means of an electric spark. The cylinders are water-jacketted. Messrs. Priestman have fitted a pair of their oil engines into a small launch, which is said to have answered well. Whether petroleum used explosively in an engine afloat will ever oust our tried but very imperfect servant steam—as the gas engine is superseding the steam engine in so many positions ashore—is a very open question. Certainly it is a great temptation to get rid of the heavy and bulky boiler, which takes up so much room in a boat, but much remains to be done before we can arrive at the more logical method of generating heat energy in the place where it has to be used. It may be that that terrible exhaustion of our coal-fields, about which we heard so much at the meeting of the Association, will be indefinitely postponed by the using of petroleum or other hydrocarbon as a source of motive power. But that is another story.

Mr. Beauchamp Tower described some improvements in detail which he has introduced in the design of that beautiful piece of mechanism by which he has secured to us, by means of gyroscopically-controlled hydraulic gear, a steady platform at sea; and Prof. A. C. Elliott read a paper on the transmission of power by compressed air. Dr. William Anderson described his revolving water purifier; and Mr. Faija gave a long account of many points in connection with Portland cement. These were all the papers read on Friday.

On Saturday there was no meeting in Section G, and Monday was, according to custom, devoted to electrical matters. Mr. W. H. Preece opened the proceedings with a long paper, or rather lecture, on the London and Paris telephone, in the course of which he was enthusiastic upon the success which had been obtained. He is sanguine that before long we shall be able to talk between London and Berlin. Of course, he improved the occasion by insisting on the necessity of metallic returns, a point upon which all will agree with him except shareholders in telephone companies. Naturally, also, Mr. Preece did not fail to hint how much better off the British public would have been had telephone exchange been left in the hands of the Post Office. No doubt, if all the telephones were now transferred to Mr. Preece's guidance, we should sooner have metallic returns, and Christian patience would be less exercised; but the question may arise whether we should have had any telephones at all now if Government monopoly had not been broken through. With Mr. Preece as the controlling factor, we should answer "Yes." But there are other sorts of Government officials than Mr. Preece.

Mr. Bennett's paper on the telephoning of great cities referred mostly to the arrangement of details of exchange.

Prof. G. Forbes read a long paper, in which he gave an account of recent progress in the use of electric motors. It was of an interesting nature, and dealt largely with the advance that has been made in America. We trust Mr. Forbes is better acquainted with Transatlantic electrical practice than he is with one branch, at least, of British practice; for when he said, as we understood him, that there are no electrical cranes in England, he was certainly wide of the mark.

Papers by Mr. N. Watts, on electric fire-damp indicators, and by J. A. Timmis, on electric lighting in trains, were also on the list.

On Tuesday, August 25, Section G held its last sitting, and there was a varied selection of papers. The first was a contribution by Mr. A. R. Bennett, in which he advocated a system of house-to-house parcels distribution, which would certainly be very convenient if it could be carried out. He proposes tunnels under the street with miniature electric railways. That would be a difficult thing to arrange in any of our cities, the space being so occupied by gas- and water-pipes, sewers, electric wires, hydraulic mains, and many other things, were the tunnels simply to be run straight away with only stations at distant points; but Mr. Bennett proposes to make this a house-to-house service, each subscriber having his own siding. The tube would be rectangular, with two lines of rails one above the other. By means of semaphores at the central station, worked electrically by the passage of the train, so that the operator can always tell where the train is, and by further electrical connection he is able to shunt the train into the subscriber's own siding. When one subscriber wants to send a parcel to another, he procures a truck, and despatches this through the tunnel to the central station, from whence the operator forwards it to the right address. There is even an arrangement for unloading automatically, and the truck can then be brought back by the operator without the intervention of the subscriber. The idea is fascinating, and we may say that it appears quite practicable; but it will not come yet. Some day, when we determine to pull down and rearrange London—as manufacturers throw aside obsolete but perfectly sound machinery to gain the economy of some newer designs—Mr. Bennett's electrical exchange may come in; and then the blessing it will be to the community will be incalculable. We can have a five minutes collection and delivery of letters; butcher-boys will no longer whistle at the side door, and the baker will cease to scribble on the gate-post.

Mr. W. Worby Beaumont next read a paper on internal and external work of evaporation. This is one of a series of monographs which the author has prepared on this subject, but the matter is too abstruse for us to deal with in this very brief account of the four days' meeting. Were we to attempt to abstract the paper, it might lead us into controversial matter.

Major R. de Villamil's paper on the action of screw-propellers was a praiseworthy effort to accomplish the apparently hopeless task of lifting the practice of designing the screw-propeller from the region of empiricism—where it has always dwelt—to the domain of pure science. We fear, however, in spite of it, that the marine engineer will still adhere to the ancient rule-of-thumb by which alone he is now guided. It is curious that the man who has done most to improve the design of the screw-propeller was essentially non-scientific. He made his chief discovery in an endeavour to do one thing, but produced the reverse result. When Griffith first used the spherical boss, he was trying to produce a retarding effect, but found, on trial, that he had added greatly to the efficiency of the screw.

Mr. Beaumont also read a paper on the screw-propeller. He described a method of reversing the direction of thrust by means of feathering-blades, on the well-known Bevis principle. The advantages claimed were that, as the engines and screw would be always running in one direction, there would be no momentum of moving parts to be overcome when it was desired to go from ahead to astern, or *vice versâ*, and therefore there would be less danger of breakage of the mechanism. The proposal was somewhat roughly handled in the discussion which followed, but we think that Mr. Beaumont fairly held his own in his reply. The most valid objection appeared to be that of Mr. Heard, who pointed out that the pressure on a given area of the blade was by no means constant throughout each revolution, and the disturbance would cause the joints of the mechanism to wear. For this reason there would be introduced an undesirable and even dangerous play on the pins after the apparatus had been in use some time.

A paper upon non-conducting coverings for steam-boilers having been read, the business of Section G was brought to a close with the usual votes of thanks.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

THE proceedings began with the President's address, after which Prof. R. K. Douglas read a paper on the social and religious ideas of the Chinese as illustrated in the ideographic characters of the language. After a short introduction, showing that the Chinese ideographic characters are picture-writings, the author gave an account of the earliest or hieroglyphic form of the writing, the development of this resulting in the ideographic characters. The social habits of the people and their domestic life were illustrated by a number of ideograms descriptive of their household arrangements and relationships. The author traced in the written characters the ideas associated with men and women, their virtues and their failings; the notions connected with marriage; and the evidences of pastoral as well as of agricultural habits among the people. The paper concluded with references to the coinage of the country as described in the ideograms employed to represent its various forms.

The following papers were also read: on recent progress in the analysis of vowel-sounds, by Dr. R. J. Lloyd; family life of the Haidas (Queen Charlotte Islands), by the Rev. Charles Harrison; and the Report of the North-Western Tribes of Canada Committee. This last is again the work of Dr. Franz Boas in the interesting ethnological field of British Columbia. It consists of two parts, the first being devoted to the Bilqula, a people inhabiting a limited tract in the vicinity of Dean Inlet and Bentinck Arms, the second dealing with the physical characteristics of the tribes of the North-west coast region.

Prof. Max Müller then made some remarks on the work of Major J. W. Powell, Director of the U.S. Bureau of Ethnology. He said that he had just received the proof-sheets of a most important publication on the classification of the Indian languages spoken in America. It is a splendid piece of workmanship from Major Powell, the indefatigable Director of the American Bureau of Ethnology. The publications of that Bureau count amongst the most valuable contributions to anthropological science, and they reflect the highest credit, not only on Major Powell and his fellow-workers, but also on the American Government, which has sanctioned a very large outlay for the prosecution of these studies. There is no stint in the way these volumes are brought out, and most of the papers contained in them inspire the student with that confidence which can only be produced by honest, conscientious, and truly scholarlike work. Our American friends have perceived that it is a national duty to preserve as much as can still be preserved of the languages and thoughts of the indigenous races who were the earliest dwellers on American soil. They know that the study of what Prof. Max Müller ventured to call intellectual geology is quite as important as that of terrestrial geology, and that the study of the lower strata contains the key to a right understanding of the higher strata in the growth of the human mind. Coming generations will call us to account for having allowed the old world to vanish without trying to preserve its records. People who ask what can be the use of preserving the language of the Mohawks forget what we would give if some scholar at the time of Cato or Cæsar had written down, what many could then easily have done, a grammar of the Etruscan language. Some years ago the author had succeeded in persuading a Secretary of State for the Colonies that it was the duty of the English Government to publish a series of colonial records, containing trustworthy information on the languages, customs, laws, religions, and monuments of the races inhabiting the English colonies. Lord Granville saw that such an undertaking was a national duty, and that the necessary funds should be contributed by the various colonies. What a magnificent work this would have been! But while the American Government has pushed forward its work, Lord Granville's scheme expired in the pigeon-holes of the Colonial Office. America may well be proud of Major Powell, who would not allow the treasures collected by various scholars and Government officials to moulder and perish. He is a true enthusiast, not a man of mere impulse and good intentions, but a man of sustained effort in his work. He deserves the hearty thanks of the Association, and more especially of the Anthropological Section.

The whole of Friday morning was occupied by a paper by the Marquess of Bute, on the language of Teneriffe. The difficulties in the study of the language are due to the fact that the aboriginal words have been collected from *all* the islands without indicating their several origins, so that the Teneriffe words were not at first easily distinguished. Students hitherto have held three opinions as to this language. The first is that of Dr. Glas, who considered the language American (and the people African); the second, advanced by Sir Edmund Scory, classed the language and people as Berber; while the third holds that the Teneriffians were of Aryan origin.

Dr. Edward B. Tylor read a paper on the limits of savage religion. It has lately become clear by the inquiries of anthropologists that the world-famous Great Spirit of the North American Indians arose from the teachings of the Jesuit missionaries in Canada early in the seventeenth century. This and analogous names for a Supreme Deity, unknown previously to native belief, have since spread over North America, amalgamating with native doctrines and ceremonial rites into highly interesting but perplexing combinations. The mistaken attribution to barbaric races of theological beliefs really belonging to the cultured world, as well as the development among these races of new religious formations under cultured influence, are due to several causes, which it is the object of this paper to examine: (1) direct adoption from foreign teachers; (2) the exaggeration of genuine native deities of a lower order into a god or devil; (3) the conversion of native words, denoting a whole class of minor spiritual beings, such as ghosts or demons, into individual names, alleged to be those of a Supreme Good Deity or a rival Evil Deity.

Mr. H. Ling Roth read a paper on *couvade*, in which he gave an account of the distribution of this curious custom, and showed that the savage believes that there is some hidden link which binds the new-born child to its father, and he argued that the practice of *couvade* is to prevent the father bewitching his child.

In a paper by Mr. S. E. Peal, on the *morong* and other customs of the natives of Asam, the author shows that this institution of the *morong*, or club-house for the unmarried, is very widely distributed over the whole of the Indo-Pacific region, and he argues that it is, in fact, a relic of pre-marriage communism. Moreover, this custom being so often found associated with others of a distinctly non-Aryan character, such as juming, tattooing, blackening the teeth, building on piles, head-hunting, &c., has led him to suspect former racial affinity, even among such widely different types as Papuan and Mongol, Dravidian and Sawaiori.

A paper by the Rev. B. Danks, on the burial customs of New Britain, was read.

In a paper on the worship of meteorites, Prof. H. A. Newton, on Monday, gave a series of accounts of divine honours having been paid to meteoric stones in early times, and of myths and traditions pointing to such worship. Particular attention was directed to the indications of such worship that are found in Greek and Roman history and literature.

Dr. Garson read a paper on some human remains found in Yorkshire. He dealt principally with a round barrow in which skeletons with very long skulls had been found. These skulls were much longer and narrower than the heads of the existing inhabitants of this country, and corresponded with those of the Iberians. The average height of the persons whose skeletons were found in this barrow was a little over 5 feet 3 inches. The discovery of flint and the absence of iron implements showed that the burial took place before the use of metals. The Iberian people were short, had dark hair, straight noses, flat foreheads, and no ear-lobes. It was a race quite distinct from the Celtic type, which afterwards came in and drove them further westwards into forests and swamps.

A paper by Miss Buckland was read, on points of contact between Old World myths and customs and the Navajo myth entitled "The Mountain Chant." The author drew attention to the numerous points in which this myth reproduces customs and beliefs of the Old World. Among these were mentioned the singular prohibition of food in the abode of spirits, such as appears in the classical story of Persephone, but which is found slightly modified in the fairy folk-lore of Europe, in Aino and Japanese tales, and in New Zealand. Miss Buckland points out the great contrast between the bloodless Navajo rites and the sanguinary ceremonies of the ancient Mexicans, and the great dissimilarity in the forms of the Navajo and Mexican gods, as denoting an entirely different origin for the two religions, incompatible with the belief commonly entertained of the wholly indigenous character of American culture; and she urges that the Navajo rites point unmistakably to an Eastern origin.

A paper by the Rev. James Macdonald, on East Central African customs, was read. The customs dealt with ranged over the whole domestic and social life of the people.

The following papers were also read:—Prof. G. Hartwell Jones, barbaric Greece and Italy; J. E. Budgett Meakin, the Berbers of Morocco; Dr. J. S. Phené, a comparison of ancient Welsh customs, devices, and commerce with those of contemporary nations; W. M. Adams, the first sea-wanderings of the English race. The Report of the Prehistoric Inhabitants Committee, and the Report of the Elbolton Cave Committee, were also read.

On Tuesday, Dr. Garson read a paper on M. Bertillon's method of criminal anthropometry, in which he described the plan now adopted by the French police for the identification of criminals.

Dr. S. A. K. Strahan read a paper on instinctive criminality, its true character and rational treatment. The instinctive criminal belongs to a decaying race, and is only met with in families whose other members show signs of degradation; in fact, instinctive criminality is but one of the many known signs of family decay. Not only is criminality hereditary, but it is interchangeable with other degenerate conditions, such as idiocy, epilepsy, suicide, insanity, scrofula, &c., and it is a mere chance whether the insanity or drunkenness, say, of the parent, will appear as such in the child, or be transmuted in transmission to one or other of the above-mentioned degenerate conditions. Alcoholism is the most fruitful source of instinctive criminality, but insanity, epilepsy, and suicide are often transmuted to crime in passing to the children. Senility and immaturity of parents are also fruitful sources of crime in the enfeebled descendants, as is proved by the statistics of Marro, Korosi, and others. The present system of treatment has proved a disastrous failure; short periods of punishment can have no effect upon the instinctive criminal, either curative or deterrent. Everything points in the direction of prolonged or indefinite confinement in industrial penitentiaries. This system has been tried with success in America, and life-long detention has not been found by any means necessary.

Nicobar pottery, by E. H. Man. In this paper Mr. Man stated that the little island of Chowra has held for generations a monopoly of the manufacture; and the entire work of preparing the clay, as well as of moulding and firing the finished utensil, devolves on the females of the community. The inhabitants of the island appear to guard their art jealously, and the value of trade-marks is recognized. No vessels are made especially by the Nicobarese for funeral purposes, but cooking pots are among the personal and household requisites which are laid on a grave after an interment. They have no knowledge of any implement answering the purpose of a "potter's wheel."

The following communications were also received:—E. Seward, on the formation of a record of the prehistoric and ancient remains of Glamorganshire; Dr. J. S. Phené, on recent Hittite discoveries; Mrs. S. S. Allison, account of the Similkameen Indians of British Columbia; Report of the Anthropometric Laboratory Committee; Report of the Anthropological Notes and Queries Committee; and the Report of the Indian Committee.

SCIENTIFIC SERIALS.

The *American Meteorological Journal* for September contains the concluding part of an article on mountain meteorology, by A. L. Rotch. The subjects specially treated of are wind and temperature in connection with atmospheric pressure, as observed chiefly at the Blue Hill Observatory. The wind velocity is found to be two-thirds greater there than at Boston, about 500 feet lower, but the difference changes for various hours of the day. At low levels the wind force generally increases from the early morning until the afternoon, but the conditions are reversed at higher levels. This fact was pointed out by Prof. Hellmann in 1875, when studying the Mount Washington observations, and the same fact has since been observed at Ben Nevis and other Observatories. The wind has also a vertical as well as a horizontal motion, which has amounted to seven miles an hour in a storm. The normal temperature at the summit of Blue Hill is 2° lower than at the base, giving a decrease of 1° for each 220 feet of ascent, but inversions frequently occur, when the temperature of the base is lower than at the summit. Instances of this are given, together with records obtained during balloon ascents.—The aspiration psychrometer and its use in balloons, by Dr. R. Assmann. Such an instrument was first used by Welsh in 1853, but it was not fully adapted to use in balloons. The apparatus invented and described by Dr. Assmann, which is intended to register the changes, which ordinary thermometers do not show quickly enough, is made by Fuess, of Berlin. The aspirator may be driven by a small electric motor, instead of by clockwork.—The Bergen Point tornado, by W. A. Eddy. The track was about nine miles south-west of New York City, on June 16 last. The tornado was preceded and followed by showers of large hailstones, and extended only for about two miles.—The hot winds of California, by Lieutenant J. P. Finley. The period during which these winds occur is from May to September; the thermometer has been known to reach 118° in the shade, and the winds generally occur during entire absence of clouds.—Altitude and hay fever, by Dr. W. J. Herdman. Special attention is drawn to the curative influence of mountain stations.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, September 14.—M. Duchartre in the chair.—Recent discussions on the subject of cyclones, by M. H. Faye.—A contribution to the botanical history of the truffle—*Kammé*, from Damas (*Terfezia Claveryi*), by M. A. Chatin. A description of a new species of truffle—the white truffle of the desert, known in Syria under the name *Kammé*. It has a wide range, the same species as this found near Damas having been also seen in the desert 400 miles south of Biskra. It forms an important article of food.—On the incandescence of platinum wires under water, by M. Paquelin. A mixture of hydrocarbon vapours and air is led over a specially arranged platinum apparatus, which becomes heated almost to its fusion point, and will then remain luminous if suddenly plunged into water.—Observations of the Comet Wolf, 1884 III., made by the *coudé* equatorial (0·36 m.) of the Lyons Observatory, by M. G. Le Cadet.—On the yeast of wine, by M. A. Rommier. Experiments made on the production of wines from vines of the same stock grown in different districts lead to the conclusion that the ferments producing the characteristic bouquet in wines of different districts, are peculiar to those districts and are not carried to new districts readily by the transplantation of the vines.—On the determinism of sexuality in *Hydatina senta*, by M. Maupas.

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