THURSDAY, JUNE 4, 1908.

SCIENCE IN FOLKLORE.

Folklore as a Historical Science. By G. L. Gomme. Pp. xvi+371. (London: Methuen and Co., n.d.) Price 7*s.* 6*d.* net.

AS its title leads us to suppose, this interesting volume is a plea for the recognition of folklore as a historical science. Seeing that the barrier between history and folklore is still unbroken, in spite of the efforts of Miss Harrison, Dr. Frazer, and others, the author has resolved to destroy it once for all, and has endeavoured to convince us that historical fact is often the essence of tradition, and that we must look to folklore for most if not all our light on the early stages of the psychological, social, and political development of modern man. In support of his argument, and by way of illustration, he has drawn on his vast store of instances, and discussed legends attached to places and historical persons, folk-tales such as Catskin, Faithful John, &c., which imply savage social conditions, and tribal laws and rules, rhythmical if not in verse, which have been handed down by word of mouth and preserved in historical times. Yet, in spite of the proofs at his command, he fears that the historians may refuse to admit the value of folklore as evidence, and believing that a change in their attitude must be preceded by a change in the attitude of the folklorists themselves, he urges on the latter a more rigid scrutiny of their data, and a more judicious use of the comparative method, than has been customary hitherto. Not only must they ascertain the position of each item of folklore in the culture area in which it is found, but must try to determine its correct relation to other items in that area, taking heed to compare like quantities alone. Only thus can they hope to discover the underlying facts, and to offer the historians materials they can use.

After indicating the relation of folklore to history, and the system to be followed by the folklorists, he discusses in the last half of the volume the aspects under which they must regard it, and the conditions they must take into account if their labour is to end in a real increase of knowledge.

The explanation of the folklore of a people should be sought, as Mr. Gomme thinks, in its anthropological history, especially in the stage of its development known as totemism, and as this is a topic on which opinion is divided he discusses it at considerable length. From totemistic survivals he passes on to speak of those which can be subjected to sociological and ethnological tests, and shows that certain differences in folklore are to be accounted for as the results of different race origins or a different social organisation. In discussing European folklore he emphasises the need of bearing in mind the introduction of a foreign religion, viz. Christianity, and the manner in which it affected and was affected by the existing beliefs.

For want of space we are unable to criticise the work in detail, and must content ourselves with a few general observations. Most of its readers will allow that folklore should be treated as a science, and that the principles of its study have been correctly laid down by the author. They will commend him, too, for rejecting the methods of the destructive school and laying stress on the value of popular beliefs. The scepticism of Voltaire and his followers was a natural reaction from mediæval credulity, and was bound to precede any real advance in historical writing. Our scholars of to-day are differently placed; as research has become closer and more extensive, their respect for tradition has been increased in many cases rather than diminished; they are no longer content to doubt; they must separate the truth from the overlying falsehood. In the light of our fuller knowledge, Voltaire's treatment of the myth of Romulus and Remus, for example, seems partial and unscientific; Mr. Gomme, in discussing, for instance, the story of the Frog Prince or the descriptions of Britain by classical writers, greatly surpasses him in breadth and acumen. To our mind, however, his conservative tendency is nowhere more happily expressed than in his refusal to dismiss as superstition the attempts of our savage ancestors to account for natural phenomena. He shows with admirable insight that their mental process was the same as that of their cultured descendants—"primitive myth is primitive science"—and the mistakes they made were but the natural outcome of severely accurate reasoning from insufficient data.

Yet, sensible as we are of his largeness of view and the excellence of his methods, we are not altogether satisfied as to the truth of his main contention; we are far from certain that "the gap in the heart of things" is not too wide to be bridged over by folklore. His analysis of the various folk-tales is masterly and suggestive, but he leaves us unconvinced that his results are worthy of his pains, that the data of folklore are matter for the historian, and not, as hitherto supposed, for the philosopher. It is only just to say that these doubts may not be felt by all, not to mention that they may be lessened or removed by his promised volume on "Folklore in Early British History." Be that as it may, we are less inclined to quarrel with him for mistaking the uses of folklore than for his attitude on certain other points, than, to take one instance, for his somewhat cavalier treatment of the mythologists. It is one thing to say that the key to folklore is anthropology; it is another to suggest that there are no traces of national gods among the European peoples, and that the objects of adoration were always of the tribe. Even if the European sky-god is a fabrication of "the Cambridge professor," even if Lud on the Thames and Nod on the Severn were distinct until the Romans united them, he is hardly justified in such sweeping generalisations; he has still to account for, *e.g.*, the cult of Lug in regions so far apart as Leyden and Lyons and County Wicklow, as well as at a host of intermediate places. It is possible that we shall receive greater satisfaction from the new volume; so far it cannot be allowed that the author has said the last word on the subject.

The book requires no praise from us. It is enough to say that it sustains Mr. Gomme's high reputation as a folklorist, and that those who devote time to its study will be amply rewarded. It possesses an additional source of interest in its well-chosen illustrations. "The Two Scenes from the Life of St. Guthlac" bring before us with peculiar vividness the unseen world as it presented itself to some of our forefathers

A ZOOLOGIST AS ÆSTHETE.

Ästhetik der Tierwelt. By Karl Möbius. Pp. v + 128; 3 plates and 195 figs. (Jena: G. Fischer, 1908.) Price 6 marks.

AS director of the great zoological museum in Berlin, the late Prof. Möbius was naturally led to consider the æsthetic value of the various forms of animal life as well as their scientific interest. From time to time he published brief essays discussing different types of animals from the æsthetic point of view, and as he found the inquiry very profitable—increasing his delight in the animal creation—he gathered his reflections together in the beautifully illustrated book before us, which bears the pleasant title "Ästhetik der Tierwelt."

Certain animals cannot be seen without being greatly admired, others are regarded with complacency but without enthusiasm, others with entire indifference, and yet others with repugnance—which is often affectation. Prof. Möbius sought to discover some of the reasons for this diverse æsthetic value that animals seem to have, and his *a priori* method led him to judgments which it would be of great interest to test statistically, by collecting opinions from, say, 5000 of each of the following groups:—country children, men in the street, well-dressed women, naturalists, and artists. It is notoriously difficult, however, to get a frank expression of æsthetic emotion (especially in regard to animals), to allow for conventional prejudice and posing, for sheer uneducatedness of vision, and for entirely artificial associations which lead many people to recoil from forms of life which the artist admires. We find in this book many statements like this:—"Die Fledermäuse findet niemand schön," and the author tried to show that this universal disapprobation is justified according to certain canons of æsthetic criticism. So much the worse for these canons, it seems to us, not that we can believe in the universal disapprobation of bats.

Prof. Möbius pointed out that our æsthetic judgments as to animals rest on a complex objective and subjective basis; he went on to discuss the general qualities of a beautiful living creature—it must be a unity, it must be harmonious, it must have individuality, and so on. We regret that the illustrious author did not expand his reflections on these matters, instead of giving so much space to comparing the relative merits of crab and lobster, or analysing the alleged "Hässlichkeit" of hippopotamus and giraffe. It seems to us that just as we are pleased by a piece of carving, rude though it may be, which expresses the craftsman's mood, and shows him to be even a little bit of a creator, so, but infinitely more, are we pleased by the individuality of organisms—every one its own artist—no one of which uses its materials quite in the same way. An interesting short chapter is devoted to the æsthetic value of animals as parts of a landscape; thus what is not impressive in isolation gets its value in its natural setting. This is well illustrated by reference to the associations seen on a coral beach at low tide.

The volume attempts an analysis of beauty in animal architecture, but the treatment seems to us too dogmatic and aprioristic. We demand symmetry, it is said, yet what delights us more than a lop-sided shell from the shore? A Campanularian is not so beautiful as a Corallium, because the number of its tentacles is a distracting conundrum. A centipede makes us tired, it is said, with its monotony, "Man sieht nichts Neues, wird ermüdet und gelangweilt," whereas to many people a centipede quickly moving among the bark is in its way just as beautiful as a peacock. Spiders are not so much appreciated as butterflies, because their body has only two main parts, and the æsthetic unity is spoilt by the distractions of the abdomen when we are contemplating the cephalothorax, and *vice versâ*. It is unconventional for an animal to be broader than it is long, and, therefore, to use one of the author's examples, Geryon must take a back seat when Gammarus appears. But when it comes to ranking Peripatus among the animals with "langweilende Wiederholung," and putting Nymphon among the unsatisfactory because it lacks sufficient central mass to rivet the eye, we cannot but disagree. We may take shelter behind the eirenic maxim, "De gustibus non disputandum est," but we are not afraid of the responsibility of stating a counter-thesis, with which we think most artists will agree, that no natural animals are ugly or "hässlich" in the sense of being out of proportion or out of harmony, or "bad colour." It seems to us that the only ugly animals are such as prize pigs, on which man has laid violent hands. One of the delights of animal coloration is the daring as well as the subtlety of the experiments, but is any result ever a failure in the sense that a picture or a picture-hat may be? J. A. T.

FUNDAMENTAL PRINCIPLES OF CHEMISTRY.

Stoichiometry. By Prof. Sydney Young, F.R.S.; with an Introduction to the Study of Physical Chemistry by Sir William Ramsay, K.C.B., F.R.S. Pp. lxxi + 381. (London: Longmans, Green and Co., 1908.) Price 7*s.* 6*d.* net.

THIS volume, as its unfamiliar title implies, is concerned with the fundamental principles of chemistry, and so forms logically the first of the "Text-Books of Physical Chemistry" edited by Sir William Ramsay; the introduction, which has appeared before, is appropriately reprinted in this volume. We are pleased to see that five more volumes of the series are in preparation.

Recent research on atomic and molecular weights, of which Prof. Young gives a clear and simple account, has proceeded mainly in two directions. D.

Berthelot, Lord Rayleigh, Leduc, Guye and his co-workers, from the study of gases have been able by a nice combination of exact theory and experiment to bring independent evidence as to the molecular weight of gases; at the same time, Morley, T. W. Richards, and others at Harvard have considerably increased the accuracy with which the more important atomic, or rather combining, weights are known. Prof. Young's own researches have been closely related to the former investigations.

The problem in the deduction of accurate atomic and molecular weights from the properties of gases is the precise application of Avogadro's hypothesis; that is, it is necessary to know the relative volumes (at o° and one atmosphere) of the gas under consideration and oxygen, which contain equal numbers of molecules. When these volumes are known, the weight of the molecule of the gas can be found at once from its density relative to that of oxygen. Berthelot assumes that Avogadro's hypothesis is strictly true when gases are at small pressures; to apply this assumption, pv has been observed at a small pressure and at one atmosphere for several gases, including oxygen. Guye uses the principle of corresponding states; for example, argon and oxygen have approximately the same critical pressure and temperature, so he assumes that equal volumes of these two gases (at o° and one atmosphere) have the same number of molecules; and finally, the values of a and b in van der Waals's equation have been used directly to find the Avogadro volumes. The atomic weight of nitrogen obtained in this way is 14·01, as opposed to the formerly accepted 14·04; there is plenty of evidence that the smaller value is the more accurate one.

As was to be expected, the treatment of change of state, van der Waals's theory, the vaporisation of mixed liquids, &c. (where so much of the best work is that of Prof. Young himself), is at once clear, precise, and interesting.

The first chapter, of twelve pages, on "The Fundamental Laws of Chemical Combination," which also includes Dalton's atomic theory, seems to us entirely unsatisfactory, and falls much below the standard of the rest of the book. These fundamental subjects receive the usual inadequate treatment which mars so many elementary text-books of chemistry. The definition of an element, as a substance not decomposable *at will*, is artificial, and merely avoids the difficulties raised by the well-verified spontaneous change of radium into helium. Our complaint, however, is with the presentment of the laws of chemical combination. When a generalisation is raised to the dignity of being called a law, surely the value of science as a method of thought demands, (1) the definition of the law in clear and precise language, (2) a statement of the observations (with their accuracy) upon which the law is based? None of these is done for the law of definite proportions. It is high time the "law" of multiple proportions was omitted from text-books. The statement of it criticised ends with the words "vary in the different compounds according to very simple numerical proportions." Consider $C_{60}H_{122}$ and C_8H_{14} (*i.e.* $C_{60}H_{105}$); can the ratio 122 : 105 be called "very simple numerically"? Few pairs of compounds obey the "law." Though Dalton's atomic theory was only accepted by chemists generally after half a century of controversy, and is at present rejected by a few, in the two pages devoted to it in "Stoichiometry" the difficulties of the theory are not even mentioned. It is to be hoped that these blemishes may be removed in a future edition from a book which gives such an up-to-date and adequate account of a large part of physical chemistry, and is one of the volumes most needed of a valuable series. T. H. L.

NEWTON'S PHILOSOPHY.

La Philosophie de Newton. By Dr. Léon Bloch. Pp. 642. (Paris: F. Alcan, 1908.) Price 10 francs.

THE subject of this book is Newton's "philosophy" in the large sense in which Newton himself understood that word, not in the narrower sense which is now usual. The author passes in review practically the whole of Newton's contributions to science, giving in each case their antecedents, their method, and their outcome. His historical accounts of previous discoveries, with the consequent estimates of Newton's contribution, are usually excellent, and in his exposition of Newton's ideas he is in general very faithful to his original.

M. Bloch's successive chapters, dealing with different parts of Newton's work, have a certain similarity of structure. They generally begin with Descartes, and show the element of arbitrary hypothesis in his views. Then, after some account of intermediate writers, they point out how Newton proceeded by the right inductive methods, collecting his laws and definitions from facts, and verifying their consequences by experiments. The hypotheses which he objected to, it is said, were not hypotheses used as such, but hypotheses used as though they were known to be true. It was still customary to object to a new theory, based on observation and experiment, not that it failed to explain the facts, but that it contradicted the maxims of the illustrious So-and-So. This attitude seems strange to us, because it has so completely died out in science. But it still survives in philosophy, where emphatic assertion is one of the accepted methods of proof; and from this analogy we can understand Newton's attitude and the progress it involved. M. Bloch's scheme involves some unnecessary repetitions, and one gets a little tired of the merits of induction. But substantially what he says on this subject seems just. While attributing to Bacon a great influence in forming Newton's ideas of method, he explains the two respects in which Newton surpassed Bacon's precepts, namely, that his methods were quantitative, and that he realised the part which deduction plays in induction.

Where the book is least satisfactory is on the side of logical analysis. Thus in regard to fluxions, he points out, very justly, how Newton conceived a fluxion physically, and how he often inferred the existence of limits, in problems where his mathematical apparatus was insufficient to prove it, from the fact that he was dealing with physical problems which

must have definite solutions. But M. Bloch does not adequately discuss the postulates involved, or consider how, from a modern point of view, one could justify practically a procedure such as Newton's. He seems more or less unaware of the gulf which nowadays separates the pure mathematician's account of the calculus from the physicist's use of it, and therefore cannot deal thoroughly with the very interesting question as to how this gulf is to be bridged. To take another illustration; he gives an account of Newton's views on absolute space, time, and motion, and quotes the experiment of the rotating bucket of water, by which absolute rotations are to be discovered. But instead of endeavouring, after the example of many previous writers, to refute in detail the inferences drawn by Newton from this experiment, he contents himself with pointing out the dynamical irrelevance of absolute *translation*, and extending this by means of generalities to absolute *rotation*. The truth seems to be that he, in common with many moderns, is here indulging in an hypothesis of just that kind which Newton endeavoured to avoid: absolute rotation is impossible *a priori*; therefore, if the facts require it, so much the worse for the facts.

There are an unusual number of misprints, and some of them seem to be among the references. In spite of blemishes, however, the book is careful and erudite, and on the historical side very useful.

OUR BOOK SHELF.

The Common Bacterial Infections of the Digestive Tract and the Intoxications arising from Them. By Prof. C. A. Herter. Pp. xii+360. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1907.) Price 6*s.* 6*d.* net.

THIS book forms a valuable summary of our knowledge of many of the bacterial infections of the digestive tract, and of the conditions resulting therefrom—valuable alike to the bacteriologist, the chemist, and the clinician. It commences with a review of the normal bacterial flora of the digestive tract, and the significance of the presence of bacteria is first discussed. It is shown that the intestinal bacteria are not required to carry on the ordinary digestive processes and normal nutrition, and the conclusion is formulated that the chief significance of the obligatory intestinal bacteria lies in their potential capacity for checking the development of other types of organisms capable of doing injury.

An interesting section deals with the differences in the bacterial flora of the intestine in nurslings and in bottle-fed infants; the number of bacteria is found to be considerably greater in the latter, and a majority of the organisms present are Gram-negative instead of Gram-positive, as is the case in nurslings. Another feature of interest which is well brought out is that in old age a greater number of putrefactive becteria are present than in youth. The origin and precise significance of this difference is not yet clear, but it suggests that intestinal infections stand in a causative relation to old age, an hypothesis recently advanced by Metchnikoff, and the author confidently states that the onset of senility may be distinctly accelerated through the development of intestinal infections in which putrefactive anaërobes are prominently represented. A number of details are given for the analysis of the intestinal contents, and of the significance of the data derived therefrom, together with hints as to treatment. R. T. HEWLETT.

National Antarctic Expedition, 1901-4. "The Charts of the *Discovery* Antarctic Expedition." By Lieut. G. F. A. Mulock. (London: Royal Geographical Society, 1908.)

THE charts illustrating the work of the National Antarctic Expedition, compiled by Lieut. G. F. A. Mulock, R.N., surveyor and cartographer to the expedition, have now been issued by the Geographical Society in the form of one of its supplementary publications. The series consists of a general chart of the Ross Sea and its coasts, and five on a larger scale showing the detailed geographical work of the expedition. The maps are clearly printed in three colours, the ice-coloured regions being shown in blue, the bare rocks in brown, and routes and altitudes in red; they are folded, and issued in a convenient cloth case, 10 inches high by 6¾ inches wide. They are accompanied by a short statement of eight pages recording the methods of survey and chief determinations, in which Lieut. Mulock gives credit to his colleagues for their contributions to the work, referring especially to Ferrar's survey of the Ferrar glacier, Bernacchi's determination of the longitude of the winter quarters, Dr. Wilson's sketches of the coast, and Lieut. Skelton's photographs.

The three charts of most interest are those including the Great Ice Barrier and the route of Captain Scott's remarkable sledge journey on to the plateau of southern Victoria Land. Lieut. Mulock retains the name the Great Ice Barrier, and adopts it for the whole ice sheet of which Ross discovered the northern face. Notes on the chart direct attention to the convincing evidence that the edge of this ice sheet is floating, and also of its recession at one place for twenty-three miles since it was discovered by Ross. Confidence in the latter fact is strengthened by Lieut. Mulock's testimony to the remarkable accuracy of Ross's positions. On a second chart the author shows the extension of Ross's Great Ice Barrier to the south, with the route of Scott and his two companions to their farthest south at the entrance to Shackleton Inlet, and of the face of the mountains on the western coast of that part of Antarctica.

Lieut. Mulock is to be congratulated on the skill and care with which he has incorporated all the observations of the expedition into this important series of charts, which are a most valuable addition to Antarctic cartography. J. W. G.

Archhelenis und Archinotis. Gesammelte Beiträge zur Geschichte der neotropischen Region. By Herman von Ihering. Pp. iv+350. (Leipzig: W. Engelmann, 1907.) Price 6 marks.

FEW and far between are the naturalists in South America. But there are exceptions even to this rule. Good work has been done of late years in Buenos Ayres and Parà, and the author of the present volume has not failed to avail himself of the abundant opportunities offered to him for research by the luxuriant fauna and flora of his adopted country. Dr. Herman von Ihering, the energetic director of the Museu Paulista at São Paulo, is well known to us in Europe by his essays on various subjects connected with the distribution of life in different parts of the world, particularly as regards the neotropical region. He has now collected these essays and reprinted them with additions in a uniform shape under the curious title which we give above. "Archhelenis" and "Archinotis" are names invented to designate the two principal continents which the author believes to

have existed in the age of the Chalk, as shown in the map at the end of the volume. Three corresponding names (*Archiplata*, *Archibrasilia*, and *Archiguiana*) are proposed for the ancient bosses from which the whole continent of South America appears to have been developed, and are explained according to the author's views in his essay on the palæogeography of that region.

Three chapters of Dr. von Ihering's volume treat of the geographical distribution of river-mussels, and are also of some importance, as the author is a leading authority on this subject. Written in 1890, they were translated into English and re-published in the *New Zealand Journal of Science*. The fresh-water molluscs of Chili show many points of affinity to those of New Zealand, and the author agrees with Captain Hutton's views that in the Lower Cretaceous period a large Pacific continent must have extended from New Guinea to Chili, and sent out a peninsula to include New Zealand.

Those who are engaged in the study of the difficult problems presented by palæogeography will do well to consult the memoirs collected by the author in the present volume.

The Moon, a Popular Treatise. By Garrett P. Serviss. Pp. xii+248; illustrated. (London: Sidney Appleton, 1908.) Price 6*s.* net.

IN describing the Yerkes photographs of the moon Mr. Serviss has had a pleasant task, and has performed it with pleasing results. The text involves a selenologist, a lady questioner, and the excellent photographs of the moon taken on successive evenings throughout an entire lunation by Mr. Wallace with the 12-inch telescope of the Yerkes Observatory. The author has managed to keep the questions in the background whilst making the answers very lucid and impressive. In an introductory chapter the dialogue turns on the distance, size, motions, &c., of our satellite; thenceforward it takes each photograph of the moon in turn, and gives a simple, straightforward account, in popular language, of the various features, introducing, at well-timed intervals, asides on geometrical, photometrical, and such-like questions. Then follows a chapter (iv) dealing with some of the larger individual features of the lunar surface, as shown on the large-scale photographs taken by Mr. Ritchey with the Yerkes 40-inch refractor.

The exquisite photographs—well reproduced—and the easily readable text of this volume should ensure it a welcome from all classes of readers, whether they be astronomers or not. There are twenty-one photographs in the first series and five of the enlarged portions, besides a number of diagrams in the text.

W. E. R.

The Apodous Holothurians. By H. L. Clark. Smithsonian Contributions to Knowledge. Part of vol. xxxv. Pp. 231. (Washington: Smithsonian Institution, 1907.)

THE author of this valuable memoir has had the advantage of studying more than two thousand specimens of the species included in the families Synaptidæ and Molpodadiidæ, and he has taken the opportunity of collecting together in the form of a handsome volume the information we possess concerning all the species of this interesting group. There are three coloured and ten monochrome plates of figures, illustrating the form and anatomy of the different species, of which several are original, and the others copied from the works of Semper, Theel, Sluiter, and other zoologists. Eight new genera are described, and a new generic name is proposed for an old genus. The monograph will undoubtedly be of great service to all those who are interested in the study of the Echinodermata.

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.]*

Elimination of Self-coloured Birds.

STATISTICAL data on the real value of colour markings in the survival of animals in the field are so uncommon that the publication of the following fragment may be excused.

At the Station for Experimental Evolution, about 300 chicks of from five to eight weeks of age on May 10 were running at large on a well-cropped pasture about three acres in area. For the most part, within the space of less than two hours, twenty-four of these were slaughtered by three crows which were caught in the midst of their work of chasing and killing the young poultry. A close estimate of the fowl as they ran at large shows that about 40 per cent. were of a white plumage, 40 per cent. black or nearly so, and 20 per cent. had a pencilled or striped marking more or less like that of the female jungle fowl or ordinary game. The interesting question arose, Was there any elimination on the ground of colour by the crows? Did any colour favour the escape from observation of any of the chicks?

Were there no selective elimination, expectation on the ground of chance is that of the twenty-four killed 9·6 would be white, 9·6 black, and about five pencilled. *Actually*, there were killed ten whites, thirteen blacks or prevailingly so, and one coarsely mottled grey and buff. No true pencilled bird was killed! The killed birds were largely Leghorns, Minorcas (both good fliers); the pencilled birds were partly games (good fliers), but mostly dark Brahmas (poor fliers). The race is not always to the swift! This fragment, then, so far as it goes, indicates that the self-colours of poultry, which have arisen under domestication, tend to be eliminated by the natural enemies of these birds, and the pencilled birds are relatively immune from attack because relatively inconspicuous.

CHAS. B. DAVENPORT.

Carnegie Institution of Washington, Station for Experimental Evolution, Cold Spring Harbour, N.Y.

"Barisàl Guns" in Western Australia.

IN NATURE of October 31, 1895, Sir George Darwin, in a letter on "barisàl guns," "mist pouffers," and allied noises, desires all those hearing such to record them from time to time. Recently an instance, which may be of this nature, came under my notice, the only apparent difference being that it was a single noise, and was not repeated several times.

It happened that in July, 1907, I was dispatched by the Government of Western Australia to a remote portion of the north-west of that State to carry out certain investigations. We were camped for two months on the Strelley River (lat. 20° S.)—which only runs in flood-time—sixty miles from Port Hedland, and the same distance from Marble Bar. The situation was a desert "spinifex" plain, with occasional low hillocks of granite boulders, and uninhabited, save by occasional sheep and cattle stations, between the two places mentioned. At approximately 8.35 p.m., mid-West Australian time, on Friday, August 9, I was lying in the tent when, in the words of my diary, "we suddenly heard a dull roar lasting several seconds, increasing in loudness and then decreasing. Everyone heard it and looked round. The sky was quite clear, and there were no signs of thunder clouds. There was no apparent tremor. I thought the noise came from the S.E., others from the N.E. Some suggested it was the rumble of a herd of cattle galloping over a clay pan with hollow ground beneath, as they hear similar noises in the Kimberley District (W. Australia). Mr. G. and I wonder if it is due to a volcanic eruption somewhere, as that of Krakatoa was heard not very far from here." Next day

"some men camped twenty miles west from here inquired if we had heard the rumble last night: it appears their Afghans jumped up and said 'buggy coming.' Whatever the sound was, it was not caused by cattle galloping."

The sound resembled a distant, prolonged peal of thunder or the discharge of a far-away piece of ordnance or mine explosion. The nearest working mines would be about sixty miles away, the sea about fifty miles, and it is needless to say there is no artillery within hundreds of miles. No noticeable meteor was seen by anyone, and had the noise been due to this, would it have been heard at places twenty miles apart? It might have been due to an earthquake, but no tremor was noticed.

I have heard from ear-witnesses of dull sounds resembling this being heard in the Kimberley district of this State. At the time, a black-fellow said, "Hill tumble down," and next day they found that great masses of rock had fallen. This might, perhaps, be accounted for in part by the unequal temperatures between day and night—the day very hot, the night very cool. Though the days in August were hot (about 90° F. in the shade) and the nights very cool (requiring several blankets in the early morning), the nearest hill to us was four miles at least away to the east.

Was this, then, an instance of the phenomenon known as "barisàl guns" on the Brahmaputra and "mist pouffers" off Belgium?

Mr. W. E. Cooke, the Government astronomer, to whom I forwarded an account of the phenomenon with the above inquiry, advised me to record it according to the wish of Sir George Darwin. J. BURTON CLELAND.

Department of Public Health, Perth,
W. Australia, April 16.

Welsh Saints and Astronomy.

THERE were in Anglesey two contemporary saints who were in the habit of meeting together at a spot mid-way between their respective abodes. One was called Seiriol Wyn, "Seiriol the White or Bright," the epithet signifying his coming from the east, the region of sunrise. He had his abode on Puffin Island, on the extreme east of Anglesey. The other saint was called Cybi, and because he travelled to meet his friend from the west he was called Cybi Velyn, "Cybi the Yellow." He lived on Holy Island, at Caer Gybi, "Cybi's Camp," the Welsh name of Holyhead. Their place of meeting was in the parish of Llandyvrydog, where there are two springs called Ffynnon Cybi and Ffynnon Seiriol, which are referred to by Matthew Arnold.

> "In the bare midst of Anglesey they show
> Two springs which close by one another play,
> And 'thirteen hundred years agone,' they say,
> 'Two saints met often where these waters flow.'"

Cybi, known in Cornish literature as Kebie, seems to have reached Wales from Cornwall. His wanderings and settlements are curiously coincident with the distribution of the cromlech areas in Wales. On further inquiry one finds that Cybi and Seiriol were regarded as astronomers, and that their places or settlements in Wales may be regarded as observatories.

In an ancient poem, to an extract from which I find the reference "Archaiol. vol. ii. p. 38," they are numbered among the "seven cousin saints," the others being Dewi, Beuno, Dingat, Cynvarch, and Deiniol. "Those are the seven . . . who have been in (or who entered) the Stone (of round form? 'graen grynder'), and the seven who numbered the stars." The expression "a fu'n y Maen," "who have been in the Stone," must be taken in the sense that they had entered a stone chamber or circle, and it is hard to find any meaning to the phrase unless a cromlech or stone circle is meant, especially when read in connection with numbering the stars. Thus it may fairly be taken that the leading saint-astronomers of Wales are spoken of as having made an astronomical use of stone monuments. This inference is confirmed by the fact that the Cybi churches in Wales, and most likely churches associated with the names of the other six saint-astronomers, preserve in their relation to adjoining churches the cromlech astronomy, especially the May-November year. JOHN GRIFFITH.

Meteors from κ Draconis in May.

ON May 31, 10h. 40m., I saw amid the gathering clouds nearly overhead a very short third-magnitude meteor close to its radiant at 193°+74°. I had never previously remarked any indication of this shower at the end of May or in June, though it seems continued in an intermittent manner from July to December, and on January 19, 1887, I recorded four meteors from 191°+72°. There is another winter shower near, viz., at 194°+67°, from which I saw seventeen meteors on December 18–28, 1886.

A bright, doubly observed meteor seen in 1893 by Corder and myself had a radiant at 186°+74°. This shower is one of the most interesting of those in the circumpolar region. It is, unfortunately, omitted in the diagram of Ursid radiants facing p. 292 in the Gen. Cat. Radiants, vol. liii. of the Memoirs.

The straggling constellation Draco contains many showers, and some of these are visible over long periods. Thus meteors continue to fall from a centre at about 261°+63° during the whole year.

Bristol, June 1. W. F. DENNING.

FORMATION OF GROUND- OR ANCHOR-ICE, AND OTHER NATURAL ICE.

THE formation of ice on the bottom of a river or stream has occasioned much comment and often scepticism in the minds of scientific men. Instead of ice forming on the surface of the water and growing downwards, we find, in circumstances now well understood, ice forming on the bottom and growing upwards. The phenomenon has been observed in all countries where ice is formed, and has been given various names. In Europe it is called ground-ice or bottom-ice (glace-du-fond, grund-eis), but we often find local names, such as ground-gru and lappered-ice. The term anchor-ice evidently originated in America, for the first record of its use seems to be by a writer in the "Encyclopædia Americana," published in 1831. The term is universally used in the United States and in Canada.

There are many early records of the appearance of ground-ice. It was seen by Hales in 1730 in the Thames. Ireland, in his "Picturesque Views" of the Thames, published in 1792, speaks of ground-ice, remarking, "the watermen frequently meet the ice meers or cakes of ice in their rise, and sometimes in the underside enclosing stones and gravel brought up by them ad imo." It was observed in the Elbe as early as 1788, in the Rhine at Strassburg in 1829, and in the Seine, by Arago, in 1830. So much interested was Arago in the ice that, for the benefit of the doubting savants of his time, he published in France, and in the *Edinburgh New Philosophical Journal* for 1833, an account of his observations. Other interesting papers on the same topic were published about that time. In the same Edinburgh journal we find, in 1834, a paper by the Rev. Mr. Eisdale. Two very interesting and instructive papers were published in the Phil. Trans. for 1835 and 1841 by the Rev. James Farquharson, F.R.S., of Alford, of his observations on the Don and the Leochal.

In Canada the formation of anchor-ice has been given much study, largely owing to its great abundance and economic aspect. For the same reason, much attention has been devoted to it in Russia by prominent engineers, notably by M. Leon Wladimirof in his study of the ice conditions in the Neva.

Nowhere can be witnessed a more wonderful sight of the delicate poising of the forces of nature than in a river like the St. Lawrence, with the advent of the winter season. In November, when the temperature of the water arrives at or near the freezing point, the manufacture of ice begins, and for a period of nearly

five months the temperature of the water remains almost stationary. During this time a tremendous struggle goes on between water and ice, growing more severe as the air temperature falls further from the freezing point. The outward calm of the ice-bound river gives no indication of the contest beneath, but it is only during the annual spring break-up that the volume of existing ice is realised. At that time the river frees itself from its icy burden in a few days by a mighty shove, which is viewed by thousands along the river shore at a safe distance from the relentless piling of great ice-blocks.

In all the quieter parts of the river, surface-ice forms into a sheet, and protects the water from excessive loss of heat. Wherever the water flows too swiftly for the surface sheet to form, the comparatively warm water is exposed to the winter weather with all its severity. Ice-crystals are produced all along its surface, and are carried under by the currents, to be whirled about for miles, until finally swept under the barrier-ice at the beginning of quiet water. There they rise and become attached to the under-side of the surface sheet, building downwards immense hanging dams, which form as effective a barrier to the flow of the river as so much rock. Winter floods and ice shoves are the result of this packing of the ice, and, in one part of the St. Lawrence, the damming is so complete as to change the course of the river every year. The natives call this fine ice "frazil," meaning cinder-ice, and this term has now come into general use in Canada.

During the ice survey of the river by the Montreal Flood Commission in 1886, it was revealed that the packing of the frazil extended to the bottom in many places, giving an unusual amount of solidity to the surface sheet. In one case, a depth of 80 feet of solidly packed frazil was measured. Hanging dams of the ice are observed to a greater or less extent for a distance of twelve miles below the barrier-ice at the foot of the Lachine Rapids, and the magnitude of the ice accumulation may be realised when it is stated that the winter level of so mighty a river as the St. Lawrence, which is two miles wide at Montreal, is twice as high as in summer.

A careful study of the winter river temperature by means of very delicate instruments has revealed the fact that the formation and growth of the ice is an accompaniment of a minute temperature depression in the water of the order of a few thousandths of a degree. When the temperature equilibrium of water and ice is upset by this minute amount, fresh ice-crystals are formed, and, being supercooled, adhere to anything in their path which is likewise supercooled. In this way large quantities of anchor-ice are formed on the stones and boulders over which the ice-laden water sweeps. The crystals themselves stick together and form frozen masses. When carried through the rack or screen at the intake of a power-house they freeze to it, and rapidly choke the free water-way. They stick to the turbines, and glue the wheels fast in a short time. When the temperature equilibrium of the river is restored, the ice no longer adheres, and a rise of a few thousandths of a degree above the freezing point changes the ice to a mass of a soft and spongy consistency, capable of passing easily through the most delicate machinery.

It may be said that the whole condition which determines the rapid formation of ice in its harmful adhesive condition hinges on this temperature balance in the water. Since this important fact has been recognised, effective means have been devised for the judicious application of heat about the vulnerable parts of a power-house during such time as supercooling exists. There is no need to melt the ice or to warm the total volume of water flowing, so long as the machinery itself is prevented from falling in temperature with the water. The ice is as effective as water in producing a head. What the engineer has to guard against is that the ice does not stick in its passage through the turbines.

Fig. 1 shows the interior of a penstock, or wheel-pit, after it has been completely blocked with frazil ice. At the time of this photograph the stop logs had been introduced at the rack, the water removed, and more than one-half the frazil-ice shovelled out. This condition is a result of the slight supercooling of the machinery by the water. Where artificial heat is used, conditions like this no longer occur.

The greatest factor for preventing this minute supercooling in the water is the absorption of the sun's radiant heat. During the sunny hours of the day no ice troubles are ever experienced, no matter how low the air temperature may be. Nocturnal radiation, on the other hand, is one of the most effective agencies in supercooling the water and objects immersed in it. Anchor-ice is formed by this means in large quantities, and it has been known to grow on the river bottom before the temperature of the water itself had reached the freezing point. During cold, clear nights

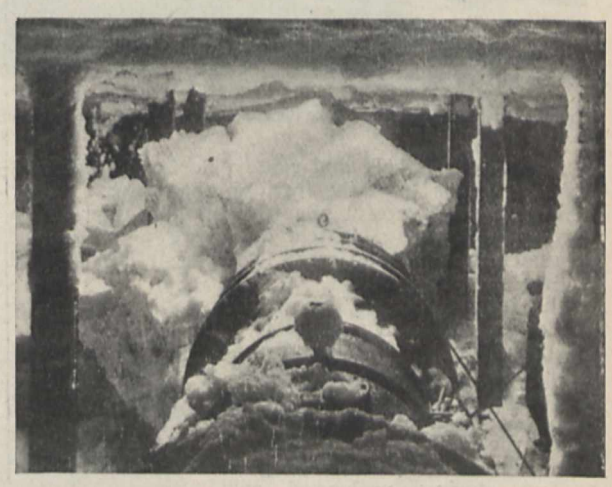

FIG. 1.—Interior of a penstock or wheel pit after the water has been removed, showing the accumulation of adhesive frazil ice.

anchor-ice forms in large quantities. When the air is cold enough to produce supercooling in the water, frazil crystals adhere readily to the anchor-ice and assist in building it up. On cloudy nights, anchor-ice does not usually form, unless the supercooling is great enough to bring the bottom of the river into a supercooled condition. A bridge is found to protect the river bottom from anchor-ice, and even in the severest weather the anchor-ice is always less thick under such a covering.

Anchor-ice is never found to grow under surface-ice. When produced previous to a surface sheet, which in some places does not form until the severest weather, the masses are detached by the natural heat of the earth, and rise to the under-side of the sheet. This has been observed extensively by M. Wladimirof, who has found in such cases an exact correspondence between the line of attached masses under the surface-ice and the river bottom.

Farquharson observed, in the small Scotch streams, that overhanging weeds protect the bottom from the frost, just as a tree will protect the ground from the dew or hoar-frost deposited at night.

The sun's rays are effective in detaching the anchor-ice from the bottom. On a clear morning in winter, as soon as the sun rises, the open surfaces of the St. Lawrence become dotted over with large masses of anchor-ice, which rise high out of the water by the impetus they attain, and sink back with a characteristic noise. Large boulders frozen to the masses are frequently brought up and carried in the currents.

FIG. 2.—Anchor-ice grown up from the rocks and protruding above the surface of the Ottawa river.

When the day is cold and cloudy, anchor-ice does not rise, but builds from the frazil in the water.

Boatmen are careful not to cross the river when anchor-ice is rising for fear of having a mass come up under the boat and carry it helplessly into a rapid or over a waterfall.

The limit of depth below the water-level where anchor-ice will form appears to be roughly about 40 feet, but in the clear waters of the Gulf of St. Lawrence it has been observed as deep as 70 feet. Twenty feet below the surface, anchor-ice will often attain a thickness of 5 or 6 feet during prolonged cold weather. When seen through the water, the growth resembles nothing more closely than the weeds that are found in the shallower portions in summer. Anchor-ice grows in arborescent forms, and with more abundance on dark-coloured rocks, although when it becomes very thick the radiation takes place chiefly from the ice-surface itself. During mild weather, especially with rain, practically all the anchor-ice is detached from the bottom, and this has been shown to accompany a slight temperature elevation in the water above the freezing point.

Fig. 2 shows an ice bridge on the Ottawa River in the process of formation. The anchor-ice may be seen protruding above the water in the shallower parts, and frazil-ice may be seen floating in the current.

Fig. 3 shows the spillway and waste weir of a large power station. Anchor-ice to which frazil has adhered may be seen under the water surface and in places protruding above. The thickness of ice on the crest was from 18 to 22 inches at the time the photograph was taken. In the background men may be seen with long rakes scraping the frazil-ice off the rack-bars or screen through which the water passes to the turbines.

When turbines are operated under very high heads, the supercooling of the water is corrected by the heat generated during the fall and the lowering of the normal freezing point by pressure. Power-houses so situated are seldom troubled with adhesive ice. Many power-houses are fortunately situated so that water is drawn from deep ice-covered channels, where frazil or anchor-ice cannot form, but for nearly all there are times, at the outset of cold weather, before the surface-ice forms, when trouble is encountered. For these and for all water-works situated below permanently open water, steam or electric heating must be resorted to at times, if interruption to the operation is to be avoided.

Through the good work of Mr. John Murphy, M.A.I.E.E., of the Department of Railways and Canals, Ottawa, practical and effective devices are now available for overcoming ice troubles, and in place of expensive auxiliary steam plants for carrying the load during the frazil season, with their corresponding large consumption of coal, a modest steam boiler, or a small amount of electrical energy—usually available in excess—proves an effective means of keeping the plant running smoothly.

To the practical superintendent of a power-house the idea of a thousandth of a degree has little meaning, and yet there is no doubt that the ice problem, as it is presented in the development of "white coal" in northern countries, depends on just such minute changes of temperature.

FIG. 3.—Spillway and waste weir of a power station showing anchor-ice. The thickness of ice on the crest of the spillway is from 18 to 22 inches.

It has been thought that the ice conditions in Canada might detract from the value of the vast water powers available for power purposes, but, from a scientific study of the conditions underlying the formation of ice, it is safe to say that no such bar exists.

H. T. BARNES.

TELEGRAPHIC PHOTOGRAPHY AND ELECTRIC VISION.

THE success achieved by Dr. A. Korn in the telegraphic transmission of photographs (NATURE, vol. lxxvi., p. 444) has been followed by a remarkable development of inventive activity in the same line. Among several new processes which have recently claimed public attention three of the most promising were described in detail at the April meeting of the Société Française de Physique. As in Dr. Korn's method, the reproduced picture is in all cases constituted by a close spiral line of varying intensity traced upon a photographic film, or other material, covering a cylinder which rotates synchronously with another cylinder in the transmitting instrument. The use of selenium for controlling the resistance of the circuit is, however, generally discarded, the requisite variations of current being effected by purely mechanical means; ordinary film negatives, therefore, cannot be used.

In M. E. Belin's process, which he calls "Téléstéréographie," the original picture is a thickly coated gelatin-bichromate print, which has the form of a relief, lights being represented by elevations of the surface, and shades by depressions. The print is wrapped around the transmitting cylinder, which rotates uniformly, and at the same time moves slowly in a direction parallel to its axis. A sapphire point attached to the short arm of a lever presses lightly upon the picture, and is caused to move in correspondence with the contour of the surface. At the end of the long arm of the lever is a contact piece which slides over the edges of a series of thin copper plates, separated by sheets of mica, and connected with resistance coils, the whole constituting a rheostat capable of interposing in the circuit a resistance ranging from 0 to 4000 ohms in 20 steps. The current, regulated in accordance with the undulations traversed by the sapphire point, passes at the receiving station through an aperiodic reflecting galvanometer, such as Blondel's oscillograph. A beam of light concentrated upon the galvanometer mirror is reflected to a convex lens so placed as to project an image of the mirror over a small hole in the side of a light-tight box, inside which rotates the receiving cylinder covered with a photographic film. Between the hole and the lens, and close to the latter, is inserted an "optical wedge," consisting of a sheet of glass tinted by gradations from perfect transparency at one end to opacity at the other. A slight deflection of the mirror displaces the reflected rays from the centre of the lens towards the edge, and causes them to pass through a different part of the optical wedge; thus the intensity of the projected image of the mirror, and therefore of the photographic action upon the film, is varied in correspondence with the strength of the current. Photographs measuring 13 cm. by 18 cm. were transmitted by this apparatus over a double-wire telephone line in 22 minutes.

For use in Carbonnelle's instrument, the "Téléautograveur," the photograph is submitted to a treatment, details of which are not published, whereby the electrical conductivity is varied locally, being greater in the shades than in the lights. The picture is mounted upon the transmitting cylinder, and a stylus bearing upon the surface is joined to one of the line-wires. The receiving cylinder is covered with a sheet of soft metal, gelatin or celluloid, or simply by several sheets of white paper separated by carbonic paper. The sheet is acted upon by a graving point attached to the diaphragm of a telephone, which is in circuit with the transmitting apparatus. This process is said to give very satisfactory results, and to be remarkably rapid, a portrait 9 cm. by 7 cm. having been reproduced over a distance of 90 kilometres in 88 seconds.

A picture adapted for transmission by M. Pascal Berjonneau's "Téléphotographe" is prepared as a cylindrical half-tone block, the surface consisting of a multitude of metallic points, the density of which varies with the lights and shades. The block rotates under a stylus in the usual way, regulating the current which passes over the line. At the receiving station a galvanometer actuates a shutter which allows more or less light to pass through a small aperture to the photographic film. It is claimed for this apparatus that it is the only one which can be operated satisfactorily on an ordinary telegraph line, all others requiring a telephone line with metallic return. The time occupied in sending a portrait from Paris to Enghien by a single wire is said to have been 247 seconds.

The problem of telegraphic photography is often associated in the popular mind with that of distant electric vision, or "seeing by electricity," as it has been called. According to a telegram from the Paris correspondent of the *Times*, dated April 28, the latter problem is now engaging the attention of M. Armengaud, president of the French Society of Aërial Navigation, who "firmly believes that within a year, as a consequence of the advance already made by his apparatus, we shall be watching one another across distances hundreds of miles apart." It may be doubted whether those who are bold enough to attempt any such feat adequately realise the difficulties which confront them. The telegram referred to seems to contemplate the transmission of optical images over an ordinary telegraph or telephone line by a method in which advantage is taken of visual persistence. A necessary condition would be that the sensitive substance—selenium or other photoelectric body—should pass at least ten times per second over every unit of the surface upon which the image to be transmitted is projected, while at the distant station electrical connection is established, also ten times per second, between the line wire and every individual element in succession of the apparatus illuminating the receiving screen; and the synchronism of the arrangement must be so perfect that at the moment when the sensitive substance occupies any given unit area on the surface of the transmitter, connection must be made with the corresponding unit in the receiver. The difficulty imposed by this condition depends chiefly upon the necessarily large number of the units of area to be dealt with. Suppose that the image is received upon a screen no greater than 2 inches square; if its definition is to be as perfect as that presented by the eye or by a good photograph, the number of elements required would amount to about 150,000, and the synchronised operations to a million and a half in every second. If we are satisfied with a definition equal to that of the coarse half-tone pictures to be found in some of the daily newspapers, the necessary number of elements might be reduced to 16,000, and that of the synchronised operations to 160,000 per second. Even this would be wildly impracticable, apart from other hardly less serious obstacles which would be encountered. The number of operations might, of course, be greatly diminished by employing an oscillating or rotating arm, carrying a row of sensitive selenium cells, as was proposed by Profs. Ayrton and Perry nearly thirty years ago. For a coarse-grained picture 2 inches square 120 of these might suffice; but such an arrangement would require 120 line wires, and would also introduce a new series of troubles.

But although the problem is apparently incapable of

solution upon the lines indicated, there is no reason beyond that of expense why vision should not be electrically extended over long distances. The only method which can be regarded as feasible (unless, indeed, M. Armengaud has made a revolutionary discovery) is that suggested by the structure of the eye itself; the essential condition is that every unit area of the transmitter screen should be in permanent and independent connection with the corresponding unit of the receiving screen. This idea would naturally present itself to anyone approaching the subject for the first time, but would probably be rejected in favour of something apparently more simple. Such an apparatus could, however, be constructed without any serious complexity apart from that arising from the mere multiplication of its components. I have made a rough estimate of the cost, assuming the stations to be 100 miles apart, the received picture to be 2 inches square, and the length of a unit to be 1/150 inch. Of each of the elementary working parts—selenium cells, luminosity-controlling devices, projection lenses for the receiver, and conducting wires—there would be 90,000. The selenium cells would be fixed on a surface about 8 feet square, upon which the picture would be projected by an achromatic lens (not necessarily of high quality) of 3 feet aperture. The receiving apparatus would occupy a space of about 4000 cubic feet, and the cable connecting the stations would have a diameter of 8 or 10 inches. The thing could probably be done for 1,250,000*l.*, but not for much less. By an application of the three-colour principle it would be possible to present the picture in natural colours, like that shown upon the focussing screen of a camera. The cost would in that case be multiplied by three.

SHELFORD BIDWELL.

ARISTOTLE AND NATURAL SELECTION.

A PASSAGE of Aristotle's "Physics," in which he alludes to the theory of natural selection, has been frequently quoted and almost as frequently misinterpreted. It may therefore be worth while to devote a short space to a careful consideration of its import.

The passage in question is in the "Physica Auscultatio," ii., 8, §§ 1–6. In it Aristotle begins by asserting the existence in nature of final causes (*ἕνεκά του αἰτίαι*). He next considers objections that may be brought against this view, as, for example, that rain falls simply in obedience to natural law (*ἐξ ἀνάγκης*) and not for the sake either of making the corn grow or of spoiling it when cut. So, too, the supposed objector proceeds, with the parts or organs of animals; what is to prevent us from saying that the teeth originate in their various forms of incisors and molars simply by the operation of natural law? That they are serviceable respectively for cutting and grinding is not purposeful, but coincidental (*οὐ τούτου ἕνεκα γενέσθαι, ἀλλὰ συμπεσεῖν*). The existence of these apparent adaptations, the objector adds, can be accounted for by the fact that, as Empedocles has pointed out, those organisms that are unfitted for their conditions do not survive, but perish.

It will be seen from the foregoing that Aristotle does not advance the theory of natural selection as part of his own explanation of adaptation in nature, but as a principle that might be used to reinforce an alternative view.

We may now turn to his answer. The objection, he replies, will not hold, because things that arise naturally (*φύσει*) always, or nearly always, come about thus; *i.e.*, like the teeth, already adapted and fit to survive; while beings such as the unadapted monsters imagined by Empedocles originate, if at all, by chance or spontaneously (*ἀπὸ τύχης καὶ τοῦ αὐτομάτου*), and are, Aristotle would say, outside the ordinarily observed course of nature. It cannot be alleged, he goes on to point out, that such phenomena as rain and warm weather are altogether dependent on chance or coincidence (*ἀπὸ τύχης οὐδ' ἀπὸ συμπτώματος*). Warm weather is the rule in the dog-days, and rain in winter. Everyone admits that things of this kind are in accordance with the ordinary course of nature; and if they occur in this regular way neither of themselves (like monsters) nor by mere coincidence (like unseasonable rain) it remains that they must exist for some purpose (*ταῦτ' ἕνεκά του ἂν εἴη*). It must then be concluded that final causes exist in reference to natural products (*ἔστιν ἄρα τὸ ἕνεκά του ἐν τοῖς φύσει γιγνομένοις καὶ οὖσιν*).

Whatever may be thought of Aristotle's argument, it is clear that his general object throughout this passage is to defend his doctrine of final causes (it is to be observed that he does not say that final causes are of universal operation). He is unable to fall in with the view of natural selection as propounded by Empedocles, because, as it appears to him, adaptations are produced ready-made; the non-adapted is not merely eliminated, but seldom comes into existence at all. He seems, however, to admit that for those who believe (as he does not) in a purely fortuitous origin of natural objects, the hypothesis of natural selection affords a feasible explanation of adapted structures.

The erroneous views that have been taken of this passage by various writers have been due, I think, to the general failure to recognise that the whole of sections 2, 3 and 4 are devoted to Aristotle's statement of a possible objection to his own opinion. Thus Gomperz ("Griechische Denker," xiv., pp. 103, 104; Leipzig, 1908), although he clearly states Aristotle's position with regard to the Empedoclean monsters, nevertheless quotes the sentence about the rain and the growing corn as if it gave Aristotle's own explanation instead of the plea of an opponent. Osborn ("From the Greeks to Darwin") falls into the same error; the author of a pamphlet (*Αἱ τῶν* Lamarck *καὶ* Darwin *Θεωρίαι παρὰ τῷ Ἀριστοτέλει*), lately published at Athens, has similarly missed the point; nor has Darwin himself escaped the like misapprehension, for which probably the translator on whom he relied was responsible ("Origin of Species," note to "Historical Sketch" in the later editions). On the other hand, the general drift of the passage was rightly appreciated by G. H. Lewes, though the confusion of ideas with which he taxes it belonged, perhaps, rather to his own mind than to that of Aristotle.

F. A. DIXEY.

NOTES.

WE notice with deep regret that Sir John Evans, K.C.B., F.R.S., died at his residence, Britwell, Berkhampsted, on Sunday, May 31, in his eighty-fifth year.

SIR GEORGE DARWIN, K.C.B., F.R.S., and Prof. E. B. Tylor, F.R.S., have been elected corresponding members of the Vienna Academy of Sciences.

THE twenty-fourth Congress of the Royal Sanitary Institute will be held at Cardiff on July 13–18, under the presidency of the Earl of Plymouth. In addition to sectional meetings, there will be a number of conferences on various aspects of sanitary science, among the subjects being spring cleaning and its sanitary significance, and the sorting and grouping of school children for educational purposes.

WE learn from the *Times* correspondent at St. Petersburg that on Monday, June 1, the Grand Duke Michael opened the International Congress on Navigation, which is being held for the first time in St. Petersburg. Three thousand delegates from all countries have assembled, including Sir John Murray, K.C.B., F.R.S. Regret is expressed by the organisers of the congress at the small representation of Great Britain.

UNDER the direction of Prof. Loomis, an exploring party will leave Amherst College, Mass., on June 12 to work in the western States. The party will first examine the Indian quarries in Converse County in search of stone implements, and will then look for horse, camel, and rhinoceros bones in the Lower Miocene in Nebraska. The party will then go southwards to the Upper Miocene of north-eastern Colorado, where it is expected to find the later stages of the same groups of animals. Prof. Lull, of the Yale Museum, will probably camp with this party, but will make an independent collection.

THE death is reported, in his fifty-seventh year, of Prof. Leslie Alexander Lee, who held the chair of biology in Bowdoin College, Maine, since 1876. In 1887 he was chief of the scientific staff on the voyage of the U.S. Fish Commission's steamer *Albatross* through the Strait of Magellan. The results of his work on this expedition were preserved in a large number of biological, geological, and ethnological memoirs published by the Smithsonian Institution. He was also director of the Bowdoin expedition to Labrador in 1891, when large collections were made, and the Grand Falls, 316 feet high, were rediscovered.

ON May 15 there was held in Cracow, at the Academy of Sciences, a celebration of the twenty-fifth anniversary of Prof. Olszewski's work on the liquefaction of gases, his first researches in that direction having been commenced during the spring of 1883 with the late Prof. Wróblewski. The celebration was an unofficial one, and only the members of the mathematical and natural history class of the academy took part in it. The president of the academy, Prof. Count Tarnowski, congratulated Prof. Olszewski in an address, after which an album containing photos of the members of the mathematical and natural history class was presented to him. As the intention of the academy to celebrate the work of its distinguished member was not publicly made known, only a few letters and telegrams reached him, including those of several learned societies in Warsaw and of the professors of chemistry and of physics in the University of Fribourg.

A POLL has just been taken by the Geological Society to ascertain the opinion of the fellows resident in the United Kingdom as to the admission of women to the society. The number of voting papers sent out was 870, and 477 replies were received. An analysis of the votes shows that 248 fellows were in favour of the admission of women as fellows and 217 against their admission, but of this number only 133 voted against the admission of women at all, the remaining eighty-four being in favour of their admission as associates. The fact that there was a majority of thirty-one in favour of the admission of women as fellows should be an encouraging sign to the increasing number of women who are taking up scientific work and in other ways contributing to the extension of natural knowledge.

THE council of the Institution of Civil Engineers proposes to award annually a prize, of the value of about 33*l*., to be called the Indian premium, to the author, being a corporate member of the institution in practice in India, of the best paper received during the year on a subject connected with Indian engineering. The council further proposes that the income of a legacy of 1000*l*. bequeathed by the late Mr. L. F. Vernon-Harcourt to the institution be applied, in general accordance with the testator's wishes, to provide for a biennial lecture on some subject relating to rivers, canals, or maritime engineering, to be delivered before meetings of students of the institution in London and before such of the provincial associations of students as the council may determine from time to time. The council recently accepted, on behalf of the institution, a legacy of 1000*l*., bequeathed by the late Mr. F. W. Webb, to be applied to establish a "Webb prize" for the best paper submitted to the institution on railway machinery, or upon some branch of railway machinery which may be prescribed.

THE thirteenth annual congress of the South-eastern Union of Scientific Societies will be held at Hastings on June 10–13 under the presidency of Sir Archibald Geikie, K.C.B., Sec.R.S., who will give his presidential address at the Royal Concert Hall, St. Leonards, on Wednesday, June 10, at 8 p.m. Papers are promised by Mr. E. A. Martin, on some considerations concerning dew-ponds; Messrs. Ruskin Butterfield and W. H. Bennett, a contribution to the spider fauna of the district round Hastings; Mr. W. H. Mullens, Gilbert White and Sussex; Mr. Edward Connold, local sponges; Mr. J. E. Ray, mediæval timbered houses of Sussex and Kent; Mr. Wintour F. Gwinnell, the reptile monsters of Mesozoic times, with especial reference to the iguanodon; Mr. Lewis Abbott, Pleistocene vertebrates of the south-east of England; Mr. W. M. Webb, Darwinism as applied to dress. There will be a loan museum under the superintendence of Mr. E. W. Swanton. Excursions, geological or antiquarian, will take place to Hastings Castle and Caves, and the salient physical features of the district, Battle Abbey, Rye, Bodiam Castle, and Dungeness. The local secretary is Mr. W. Ruskin Butterfield, Corporation Museum, Hastings, from whom tickets and all information can be obtained.

CAPTAIN EJNAR MIKKELSEN has returned, we learn from the *Times*, to Copenhagen after his two years' sojourn in the regions north of Alaska. The chief object of the expedition was to decide whether there is land to the north of Alaska or a deep sea. Captain Mikkelsen's ship arrived on September 17, 1906, at Flaxman Island, where she was soon frozen in. The whole of that autumn was spent in mapping the surrounding country and observing the tide. About forty miles from the coast the party found mountains from 10,000 feet to 12,000 feet in height, hitherto not marked on any map, and Mr. Leffingwell, the companion of Mr. Mikkelsen, undertook some geological researches. In March, 1907, Captain Mikkelsen, Mr. Leffingwell, and the mate started in three sledges with eighteen dogs on a trip over the ice towards the north. The thermometer showed −56° C.; nevertheless, they often came across big crevices among the ice floes. About fifty miles from shore they found water which they sounded to the depth of 800 metres without reaching bottom. Sixty miles further on no change was recorded, until at last, turning towards the south-east, they found bottom. They followed this edge of the continental shelf towards the east, but had soon to return owing to the strong current. Captain Mikkelsen was thus able to prove that deep water exists north of Alaska to a great distance.

ON May 31, in Rome, M. Delagrange made successful experiments with his aëroplane. According to the *Times* correspondent, at the request of M. Delagrange the Italian Society of Aviation prepared the ground in the Piazza d'Armi for an officially authenticated trial. The Piazza was marked with flags, the four sides measuring in all 1300 metres. At 5.40 a.m. M. Delagrange set his machine going. The aëroplane ran for fourteen seconds, and then rose easily, remaining in the air for the whole of the rest of the flight, and keeping a distance from the ground varying between three and five metres. The actual flight lasted for 15m. 26s., and during that time the aëroplane made the circuit of the marked course 9¾ times. The actual distance travelled, measured by the milometer of an automobile, which naturally took closer curves than the aëroplane, was more than 15 kilometres, or there was a flight through the air without touching ground of 15 kilometres in something more than 15 minutes. M. Delagrange steered and controlled the aëroplane with ease, and could have continued the flight if the power of the engine had permitted. The problem of stability has still to be solved; M. Voisin, who made the aëroplane, hopes to overcome instability by increasing the number of planes. Other trials were made in the evening, in one of which M. Delagrange travelled five times round the Piazza in six minutes at a height of between five and six metres. On June 1 a final trial was made in the presence of the Queen-Mother. In preventing a possible collision with the Royal stands, M. Delagrange stopped the aëroplane too suddenly, and it fell from a height of about four metres to the ground. The aëronaut was unhurt, but the aëroplane sustained slight damage.

JUST now, when consideration is being given to a proposal to effect an arrangement which shall ensure the utilisation of a larger number of hours of daylight in the summer time, it is not without interest to direct attention to a paper, which Mr. G. V. Hudson read before the New Zealand Institute in 1898, a copy of which the author has forwarded to us. The scheme differs from that now before a committee of the House of Commons in being of a more drastic character, and being free from the frequent irritating interferences with the regular record of time, which is one of the most objectionable features of the present Bill. Writing for the southern hemisphere, it was proposed to put the clock forward two hours on the first of October, and to put it back the same amount in the following March. Here the scheme has the merit of boldness, and if any breach in continuous time reckoning is to be tolerated, it may be excused on the ground that a considerable advantage is promised. In the paper are discussed the advantages and many of the objections with which we have become familiar from the evidence that has been given before the Parliamentary Committee, and sufficiently reported in the daily Press. There is no necessity to discuss these either as they appear in the original pamphlet or in a more modern dress. To substitute mid-European time as some of the witnesses have suggested is a noticeable improvement on the original plan, and one that would meet many objections. But, notwithstanding the amendment, it may be pointed out that, since the Bill does not contemplate any alteration of time as employed in navigation and nautical matters, one can conceive that in seaport towns, where the influence of shipping makes itself felt in the general conduct of business, very considerable confusion can arise. For instance, in most seaport towns a time signal is used for the convenience of vessels in port. That signal is also valuable to the public, and serves to regulate time. It seems that under the Bill the interests of one party must be sacrificed. Either the seaman or the public loses the time signal. It is easy to say that is a mere detail, but the whole objection to the scheme turns on details, and the final acceptance or rejection of the Bill will depend on the importance that details may acquire by accumulation.

THE Alliance Franco-Britannique, Littéraire, Scientifique, et Artistique, held a conversazione at the Grafton Galleries, Grafton Street, London, on May 28, in the course of which M. Yves Guyot delivered a lecture on "Les Rapports Intellectuels de la France et de l'Angleterre." Sir Archibald Geikie, K.C.B., F.R.S., chairman of the council, introduced the lecturer. Referring to French and English science, M. Yves Guyot said, from the point of view of pure science, the English have changed the French system of natural science completely. In France the theocratical conceptions of Cuvier's "Révolutions du Globe" were still held when in 1830–3 Charles Lyell substituted for them the real and conclusive theory of "actual causes." The Frenchmen Lamarck and St. Hilaire had anticipated evolution, but when in 1858 Darwin expounded the theory of the struggle of life he brought about a total transformation in the study of biology. Herbert Spencer boasted of having given a systematic explanation of the universe, and of having propounded the conditions of evolution. Almost all his works have been translated into French, and they have continued to exercise upon French thought the beneficent influence which all English thinkers since Locke have had over it. Almost all Frenchmen are sons of Plato, who are apt to take words for deeds. University literary teaching in France has encouraged this tendency. This method of procedure allows scope, on one hand, for all the subtleties of scholasticism, and on the other for all the literary and oratorical explanations which hide the emptiness of the idea under assertions and metaphors. The English mistrust generalisations, and make a constant appeal to facts. They have the primary qualification for all scientific research—honesty. They do not try to dazzle by sophistry; their objective is truth, and by their example they force the men of research in all countries to subordinate all other considerations to this end. Not only have they enriched the world with the experimental method, but they make everyone practise it conscientiously. Hence it is easy to recognise in France those authors, professors, publicists, and *savants* who have come under English influence. Later, M. Yves Guyot remarked that among the useful forms under which English influence has been exerted upon the French intellect, the first is scientific. Bacon against Plato, Newton against Descartes, Lyell against Cuvier; the movement was continued through Darwin and Herbert Spencer. It was confirmed also by Adam Smith. It is the inductive method as opposed to intuitive conceptions. It is reality opposed to the assertions and subtleties taught by the Greek sophists.

FROM the East Kent Scientific and Natural History Society we have to acknowledge the receipt of a copy of the report and transactions for 1907.

FISHES of the Rocky Mountain region form the subject of the only zoological paper—by Prof. T. D. A. Cockerell—in No. 3 of the fifth volume of the University of Colorado Studies. Extinct as well as living species are discussed, and it is pointed out that the contrast between the generic types respectively characteristic of the Gila and the Rio Grande basins suggests re-consideration of the theory of a recent depression of the continent in the region of southern New Mexico and Arizona.

THE second part of vol. xx. of the Proceedings of the Royal Society of Victoria contains two papers on the geology and palæontology of that colony, Prof. E. W. Skeats discussing the Palæozoic strata of Mooroodue, in the Mornington peninsula, while Mr. F. Chapman describes a number of new or little-known Victorian fossils. The same issue contains the first part of a paper by Miss Georgina Sweet on the anatomy of certain Australian amphibians, of which we have been favoured by the author with a separate copy.

To the May number of the Zoologist Mr. Charles Oldham contributes a paper on the birds frequenting the well-known "gullery" at Ravenglass, on the Cumberland coast. The most notable species nesting there are the black-headed gull and the common and the Sandwich tern, of which the last-named is more numerously represented than in any other of its few English breeding-places. The Sandwich terns breed in colonies of from five or six to fifty or more pairs. These colonies, often at some distance from one another, are chiefly in the southern part of the gullery, and most frequently on the dunes next the sea or the estuary. There the nests are grouped within a few inches of one another, sometimes hard by those of the common terns and the black-headed gulls. Unlike those of the latter, the nests are never in thick herbage, but take the form of mere shallow depressions, with or without a lining of bents, amid the sparse marram-grass.

THE first part of the third volume of the Journal of the Federated Malay States Museum is devoted to an account of the exploring expedition to Gunong Tahan, the great mountain to the northward of Pahang, undertaken in 1905 by Messrs. Wray and Robinson, followed by descriptions of the zoological collections. The narrative, which is illustrated by reproductions of photographs of the general scenery and the vegetation, shows that the explorers had to undergo some rough experiences, although the admirable arrangements made by the authorities in the matters of supply and carriage prevented the occurrence of any difficulties. The collections, so far at any rate as vertebrates are concerned, proved, perhaps, a little disappointing. The new mammals, for example, comprised only a couple of squirrels, one of which is merely a subspecies, and a bat, albeit of a rather rarely represented genus, while of new birds there were seven, among which a woodpecker (Gecinus), an owl (Heteroscops), and a Cissa are, like one of the squirrels, illustrated in coloured plates.

THE sensory reactions of the lancelet are discussed by Mr. G. H. Parker in vol. xliii., No. 16, of the Proceedings of the American Academy of Arts and Sciences. The creature, it seems, is but very slightly receptive to light, responding, indeed, to a rapid increase of illumination, but taking scarcely any notice of a corresponding decrease; the only known light-receiving organs are the eye-cups in the wall of the nerve-tube. Temperatures below 5° C. and above 39° C. are fatal to its existence. Mechanical stimulants affect the skin, more especially the tentacles and oral hood, and sound-vibrations likewise produce an effect on the organism. Tactile organs exist in the skin, but there are no derived structures corresponding to ears and the lateral line of fishes. To locomotion-inducing stimulants the lancelet responds by forward movements when these are applied to the tail, and by backward movements when they touch the middle or fore-part of the body. The creature generally buries itself tail-first in the sand, and probably swims in a similar manner, although in both cases the movement may be reversed.

To the May number of the *American Journal of Science* Mr. R. S. Lull contributes an interesting paper on the head-muscles of dinosaurs, with special relation to the origin of the neck-shield in the horned group (Ceratopsia). Such evidence as can be obtained with regard to the cranial musculature can, of course, be gleaned only from the form and proportions of the skull, coupled with, in some cases, the marks of the attachments of the muscles themselves. From the analogy of chamæleons, which, although insectivorous, masticate their food, it is inferred that horned dinosaurs had powerful temporal and feeble pterygoid muscles, thereby differing markedly from crocodiles, in which, owing to the absence of mastication, the conditions in these respects are reversed. It is also pointed out that the neck-shield or frill of the Ceratopsia presents a remarkable analogy or parallelism to the so-called casque of the chamæleon's skull, both structures being essentially a backward extension of the parietal segment designed to afford extra space for the origin of the great temporal muscles. It is added that Owen's chamæleon from the Cameroons presents a curious "mimicry" of the Triceratops type in carrying three horns situated very much as in the dinosaur, although these horns are entirely dermal structures, devoid of bony cores. "In the chamæleon they seem to be the result of sexual selection, and are certainly not for aggressive warfare in a creature which moves with the utmost caution; while in Triceratops the presence of efficient weapons in both sexes was an imperative factor in the struggle for existence."

IN the *Travaux de la Société Impériale des Naturalistes de St. Pétersbourg* (vol. xxxviii., part i.) there appear two contributions to the "Flora Caucasica Critica." Mr. N. Kusnezow contributes addenda and a summary of various cohorts allied to the Ericales, and Mr. A. Fomin is responsible for a fascicle on the Campanulatæ.

THE first number of the Proceedings of the Field Club and Natural History Society of University College, Exeter, has been received, in which the inception of the Field Club and records for previous years are chronicled. A list of plant formations on Dawlish Warren is contributed by Mr. J. L. Sager. Mr. J. Stevens supplies a catalogue of Rotifera collected in the Exeter district, among them a new species, *Brachionus sericus*, taken on Hell Tor.

A PAMPHLET dealing with the red-rot of the sugar-cane stem is issued as Bulletin No. 8 from the experiment station of the Hawaiian Sugar Planters' Association. Up to the present this disease, that is ascribed with a tolerable degree of certainty, although not quite definitely, to *Colletotrichum falcatum*, has not been credited with causing much damage in the Hawaiian Islands, so that the account is in the nature of a premonitory warning. Being a wound parasite, the fungus enters readily where the canes have been penetrated by borers, and is liable to be perpetuated by planting of diseased canes. A resistant variety appears to have been found in the yellow Caledonia.

THE short list of new diagnoses, "Decades Kewenses, xxiii.," published in the current number of the *Kew Bulletin* (No. 4), contains Chinese species of Sterculia, Euonymus, and Rheum, also a new Rheum from Tibet. Mr. J. Burtt-Davy communicates some notes on Transvaal trees and shrubs. The group of Acacias is very numerous, and includes the species *caffra*, *Catechu*, *Giraffae*, *horrida*, and *spirocarpoides*, the last-named being a common species of the "umbrella" type in the Waterberg district. Evidence is adduced in favour of referring the Pretoria

"Wonderboom" to *Ficus caffra*. The determination of species in the orders Rubiaceæ, Ebenaceæ, and Celastraceæ is provisional. On the subject of the South African locust fungus, *Entomophthora Grylli*, Mr. G. Massee concurs in the opinion that it does not provide a remedy for exterminating locusts. Mr. T. A. Sprague collates the information regarding the occurrence of rubber in species of Gymnosporia.

MR. R. G. THOMPSON, in the May number of *Man*, describes the ancient gold mines at Gebét, in the eastern Sudan, some eight days' march from Suákim. The works on this site, which is still occupied by miners, consist of an extensive series of underground tunnels excavated with metal tools, such as an iron scraper found in one of the workings. The scanty remains of pottery found indicate that these mines were worked about the beginning of the Christian era. The most noticeable relics are a number of querns of a rude form in which the quartz was ground, the gold being subsequently extracted by the action of water.

IN the April number of the Journal of the Gypsy Lore Society Dr. G. A. Grierson contributes an interesting note on the philology of Romani. The Indian Gypsies, most of whom are of south Indian origin, have little to do with it, although some of them have borrowed words which are closely connected with it. He accepts Prof. Peschel's suggestion that the linguistic home of the Romani is to be found mostly beyond the northern frontier of India, in Kashmir, Gilgit, and Chitral, among the Doms of that region. Their language is one of the Pisáca group, a name which represents an Aryan tribe which reached India from the Pamirs over the Hindu Kush. As they entered the Punjab their speech became partially mixed with those of the other Aryan tribes who entered India from the west, but it can still be traced down the Indus valley into Sind, across Gujarat into the country of the Bhils, and as far as the central Vindhyan range, where it has affected the local dialects of Mahratti.

THE *Australasian Traveller*, the journal of the Commercial Travellers' Association of Australasia, issued as its last Christmas number a richly illustrated folio volume of nearly 200 pages entitled "Australia To-day." It contains accounts of the resources, industries, and attractions of each of the Australian States and of British New Guinea. It directs attention to the enormous value of Australian production, with its output of 474,000,000*l*. of gold and its pastoral and agricultural produce, which together give it a greater output per head of population than any other continent. In addition to a collection of recent statistics, it describes pictorially the working life of the Australians and their industries, and the series of large photographs gives an excellent idea of the varied and beautiful character of Australian scenery.

IT is stated in the *Engineer* of May 29 that in sinking for the sump at the new collieries at Bentley, near Doncaster, where the Barnsley seam was reached six weeks ago at a depth of 624 yards, a further fine seam of coal has been discovered twenty-four yards below the Barnsley seam. It is 5 feet thick, and is known in Derbyshire as the Dunsil seam. Hitherto it has not been found in workable thickness in Yorkshire.

THE new museum of safety devices installed in December, 1905, at the Conservatoire des Arts et Métiers, in Paris, is described by Mr. J. Boyer in the *Engineering Magazine* for May. Its purpose is to indicate the precautions to be taken and the devices to employ to protect workmen against risks of all kinds—unhealthy atmosphere, dangers from machinery, harmful dust, high electric voltages, and poisoning.

THE summary of the weather for the closing week of May, issued by the Meteorological Office, shows that the conditions had generally become more settled and summer-like over the entire country. In the north of Scotland the shade temperature rose to 80°, and almost equally high temperatures occurred generally over the United Kingdom. The spring, covered by the period of thirteen weeks ending May 30, was wet over the entire country, the aggregate rainfall being everywhere in excess of the average. In the north-west of England and in the Midland counties the excess of rain was more than 2 inches, and the number of rainy days was everywhere more than the normal. The temperature for the season was below the average, and there were fewer hours of bright sunshine than the normal. June opened with high summer temperatures, and sharp thunderstorms were experienced on the night of June 1 in most parts of England.

DR. F. EREDIA, of the Meteorological Office at Rome, continues in the Bulletin of the Italian Aëronautical Society his useful discussion of the winds of Italy, for places where trustworthy observations are available for the years 1891–1900. We have received memoirs relating to five provinces, in which he deals with the frequency of wind-direction referred to eight points, for months and seasons, illustrated by diagrams and wind-roses. In all cases the principal results are summarised in an interesting textual discussion.

WE have recently received from Prof. Hergesell a copy of the observations relating to the meteorological service of Alsace-Lorraine for 1903, one of the series of year-books published on a uniform plan by the various States of the German Empire. The tables include monthly and yearly results for a large number of stations, hourly means for Strassburg, and five-day means at fourteen selected places. There is also a valuable appendix by Dr. Kleinschmidt containing monthly and yearly rainfall values for lustra, extending in some cases from 1876 to 1905. Some of these data have been compiled from Dr. Hellmann's great rainfall work and other trustworthy publications.

THE May number of the *Jahrbuch der Drahtlosen Telegraphie und Telephonie* contains two contributions by Prof. J. A. Fleming and Dr. L. Mandelstam, respectively, to the discussion as to the correct deduction and interpretation of Prof. Fleming's formula for the radiation in different directions of the bent antennæ used in wireless telegraphy.

THE *Physikalische Zeitschrift* for May 15 contains an article on the daily variation of the potential gradient in the atmosphere, by Dr. D. Smirnow, of the Central Observatory of St. Petersburg. He shows that the daily variation on clear days may be explained, qualitatively at least, and possibly quantitatively, by the production at sunset of a colder and relatively moist stratum of air in contact with the ground, which, owing to the reduced mobility of the ions and consequent decrease of electrical conductivity, causes positive electricity to collect on the ground, and thus reduces the electric field above the cool layer. At sunrise the layer disappears and the field increases to its former value. During the day the ascending air carries with it positive electricity, leaving negatively charged dust particles behind, and so the field is reduced. The direct action of sunlight in producing negative charges in the upper atmosphere seems to have little effect on the potential gradient near the surface.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JUNE:—

June 6. 5h. 37m. to 9h. 20m. Transit of Jupiter's Sat. III. (Ganymede).
7. 4h. 24m. Conjunction of Mercury and Mars. Mercury 0° 19′ N.
,, 13h. 0m. Mercury at greatest elongation, 23° 58′ E.
13. 9h. 57m. to 13h. 39m. Transit of Jupiter's Sat. III. (Ganymede).
14. 10h. 13m. to 11h. 24m. Moon occults 4 Sagittarii (mag. 4·6).
19. 11h. 10m. Minimum of Algol (β Persei).
21. 8h. 19m. Sun enters Cancer and Summer commences.
22. 8h. 32m. Venus in conjunction with Mars, Venus 2° 4′ S.
28. Eclipse of the Sun partially visible at Greenwich. Begins 5h. 14m.; Middle 5h. 38m.; Ends 6h. 2m. Magnitude (Sun's diameter =1) 0·065. At the time of greatest obscuration nearly one-fifteenth of the Sun's southern limb will be occulted.

THE RETURN OF ENCKE'S COMET.—A telegram from the Kiel Centralstelle announces that Encke's comet was found by Mr. Woodgate, of the Cape Observatory, on May 27. Its position at 17h. 49m. (Cape M.T.) on that date was R.A. = 2h. 59·3m., dec. = 7° 29′ S. This is situated about half a degree north of ρ Eridani, and is, at present, unobservable in these latitudes.

THE RADIAL VELOCITY OF ALGOL.—No. 22, vol. ii., of the *Mitteilungen der Nikolai-Haupsternwarte zu Pulkowo* contains a very full discussion by Prof. Belopolsky of the radial-velocity observations of Algol made at the Pulkowa Observatory during the years 1905–7. The results obtained from each line on each spectrogram are discussed in detail, and the following elements are finally derived:— ω 42°·5 ± 1°·35, $e = 0{\cdot}0476 \pm 0{\cdot}0037$, T = 2·509 ± 0·00019 days, $a = 1{,}693{,}523 \pm 100$ km., and $i = 90°$.

THE RADIAL VELOCITY OF ε URSÆ MAJORIS.—From two spectrograms obtained at Potsdam in 1889, Profs. Vogel and Scheiner found the radial velocity of ε Ursæ Majoris to be −30·4 km., the measurements being made on the Hγ line. But from nine very consistent plates, secured with the Bruce spectrograph in 1902–3, Prof. Adams derived the value −9·4 km., and in 1903 this was confirmed by measurements of seven plates obtained at Potsdam, the mean value being −9 km. Vogel and Eberhard then re-measured the original plates, and confirmed the first value. The comparison of these results suggested that, possibly, the radial velocity of ε Ursæ Majoris is variable. That the star is of peculiar interest is shown by the fact that its spectrum is given as type I. *a* 2 in Vogel's classification, as VIII. P. in the Harvard classification, and that Sir Norman Lockyer, whilst classing it as "Sirian," has pointed out that it has several well-marked peculiarities.

For these reasons Messrs. Baker and Schlesinger, of Allegheny Observatory, obtained—during March and April, 1907—and the former measured, seven spectrograms taken with the Mellon spectrograph, which gives a measurable spectrum of 21 mm. in length between λ 3925 and λ 4750. The resulting mean value was −7·1 km. ±0·46 km., and as this agrees so closely with that obtained by Prof. Adams and with the later value of Prof. Vogel, the matter must still be considered as requiring further investigation (Publications of the Allegheny Observatory, vol. i., No. 4, p. 23).

OBSERVATIONS OF JUPITER'S SATELLITES.—Some interesting observations of eclipses and occultations of Jupiter's satellites are recorded by M. S. Kostinsky in No. 4249 of the *Astronomische Nachrichten* (p. 14, May 20). On April 3 photographic and visual observations of a partial eclipse of J. ii. by the shadow of J. i. were secured; the brightness of J. ii. was diminished about 0·3–0·4 magnitude according to the eye observations, and the minimum brightness occurred at 11h. 52·3m. (Pulkowa M.T.). On February 24 an occultation of the second satellite by the first was observed at 10h. 45·5m., and on March 27 and 30 two series of photographs of the second and third satellites were secured during their eclipse by the planet's shadow.

A partial eclipse of the second by the third satellite was observed by Herr Fauth at the Landstuhl Observatory at 8h. 17m. 55s. (M.E.T.) on February 20.

THE ORBIT OF α ANDROMEDÆ.—The following elements for the orbit of α Andromedæ are published by Mr. Baker in vol. i., No. 3, of the Publications of the Allegheny Observatory (pp. 17–22):—P = 96·67 days, $e = 0{\cdot}525$, T = 1907 November 2·40, ω = 76°·21, K = 30·75 km., γ = −11·55 km., A = 34·60 km., B = 26·90 km., and $a \sin i = 34{,}790{,}000$ km. The discussion of the orbit was based on the measures of eleven lines between λ 3933·789 and λ 4481·437 on ninety-four plates obtained with the Mellon (single-prism) spectrograph, and the results are compared with those previously obtained at the Lowell, Lick, and Potsdam observatories.

THE UNITED STATES NAVAL OBSERVATORY.—The annual report of the United States Naval Observatory for the fiscal year ending June 30, 1907, gives the usual data regarding the time-service, publications, &c., and a brief summary of the observations made with each set of instruments. The observation of each star in Sir David Gill's Zodiacal Catalogue of 2798 stars was nearly complete, but a few more observations remained to be made in the autumn of 1907. More than 3000 observations were made by different observers with the new self-registering transit micrometer installed in October, 1906, and the results again prove the efficiency of this instrument. Bad weather limited the number of photoheliograms obtained, records being secured on only 150 days; spots were shown on the negatives on 148 days. There are now 1455 solar negatives in hand, and in order to minimise the labour of reducing these it is proposed that a heliomicrometer, as devised by Prof. Hale, be installed.

ON THE SHAPES OF EGGS, AND THE CAUSES WHICH DETERMINE THEM.[1]

THE eggs of birds and all other hard-shelled eggs, such as those of the tortoise and the crocodile, are normally simple solids of revolution, but they differ greatly in form according to the configuration of the plane curve by the revolution of which the egg is, in a mathematical sense, generated. Some few eggs, such as those of the owl or of the tortoise, are spherical or very nearly so; a few, such as the grebe's or the cormorant's, are approximately elliptical, with symmetrical or nearly symmetrical ends; the great majority, like the hen's egg, are ovoid, a little blunter at one end than the other; and some, by an exaggeration of this lack of antero-posterior symmetry, are blunt at one end but characteristically pointed at the other, as is the case in the egg of the guillemot and puffin, the sandpiper, plover, and curlew.

Various theories, based upon the principles of natural selection, are current and are very generally accepted to account for these diversities of form. The pointed, conical egg of the guillemot is generally supposed to be an adaptation advantageous to the species in the circumstances under which the egg is laid; the pointed egg is less apt than a spherical one to roll off the narrow ledge of rock on which this bird lays its solitary egg, and the more pointed the egg so much the fitter and likelier is it to survive. The fact that the plover or the sandpiper, breeding in very different situations, lays eggs that are also conical elicits another explanation, to the effect that the conical form permits the many large eggs to be packed closely under the mother-bird. The round egg of the tortoise and the elongated egg of the crocodile have been supposed to be developed in conformity with the shape of the creature that has afterwards to be hatched therein. Whatever truth there be in these apparent adaptations to existing circumstances, it is only by a very hasty logic that we can accept them as a *vera causa* or adequate explanation of the facts; and it is obvious to my mind that, in attempting to deal with the forms assumed by matter, whether in the organic or the inorganic world, we ought first to attempt to deal on simple physical lines with the forces to which it has been subjected, that is to say, the intrinsic forces of growth

[1] A paper read before the Zoological Society of London on April 28 by Prof. D'Arcy Wentworth Thompson, C.B.

acting from within and the forces of tension and pressure that may have acted from without.

Certain elementary points in regard to the formation of the egg must be borne in mind :—

(1) The "egg," as it enters the oviduct, consists of the yolk only, enclosed in its vitelline membrane. As it passes down the first portion of the oviduct, the white is gradually superadded, and becomes in turn surrounded by the "shell-membrane." About this latter the shell is secreted, rapidly and at a late period.

(2) Both the yolk and the entire egg tend to fill completely their respective membranes, and, whether this be due to growth or imbibition on the part of the contents or to contraction on the part of the surrounding membranes, the resulting tendency is for both yolk and egg to be, in the first instance, spherical, unless otherwise distorted by external pressure.

(3) The egg is subject to pressure within the oviduct, which is an elastic, muscular tube, along the walls of which pass peristaltic waves of contraction. These muscular contractions may be described as the contraction of successive annuli of muscle, giving annular (or radial) pressure to successive portions of the egg; they drive the egg forward against the frictional resistance of the tube, while tending at the same time to distort its form. While nothing is known, so far as I am aware, of the muscular physiology of the oviduct, it is well known in the case of the intestine that the presence of an obstruction leads to the development of violent contractions in its rear, which waves of contraction die away, and are scarcely if at all propagated in advance of the obstruction.

(4) It is known by observation that a hen's egg is always laid blunt end foremost.

(5) It can be shown, at least as a very common rule, that those eggs which are most unsymmetrical, or most tapered off posteriorly, are also eggs of a large size relatively to the parent bird. We may accordingly presume that the more pointed eggs are those that are large relatively to the tube or oviduct through which they have to pass, or, in other words, are those which are subject to the greatest pressure while being formed or shaped. So general is this relation that we may go still further, and presume with great plausibility in the few exceptional cases (of which the apteryx is the most conspicuous) where the egg is relatively large though not markedly unsymmetrical, that in these cases the oviduct itself is in all probability large (or perhaps weak) in proportion to the size of the bird. In the case of the common fowl we can trace a direct relation between the size and shape of the egg, for the first eggs laid by a young pullet are smaller, and at the same time are much more nearly spherical than the later ones; and, moreover, some breeds of fowls lay proportionately smaller eggs than others, and on the whole the former eggs tend to be rounder than the latter.

We may now proceed to inquire more particularly how the form of the egg is controlled by the pressures to which it is subjected.

The egg, just prior to the formation of the shell, is, as we have seen, a fluid body, tending to a spherical shape and *enclosed with a membrane*.

Our problem, then, is : Given a practically incompressible fluid, contained in a deformable capsule, which is either (*a*) entirely inextensible, or (*b*) slightly extensible, and placed in a long elastic tube the walls of which are radially contractile, to determine the shape under pressure.

(1) If the capsule be spherical, inextensible, and completely filled with the fluid, absolutely no deformation can take place. The few eggs that are actually or approximately spherical, such as those of the tortoise or the owl, may thus be alternatively explained as cases where little or no deforming pressure has been applied prior to the solidification of the shell, or else as cases where the capsule was so little capable of extension and so completely filled as to preclude the possibility of deformation.

(2) If the capsule be not spherical, but be inextensible, then deformation can take place under the external radial compression, only provided that the pressure tends to make the shape more nearly spherical, and then only on the further supposition that the capsule is also not entirely filled as the deformation proceeds.

In other words, an incompressible fluid contained in an inextensible envelope cannot be deformed without puckering of the envelope taking place.

Let us next assume, as the conditions by which this result may be avoided, (*a*) that the envelope is to some extent extensible, or (*b*) that the whole structure grows under relatively fixed conditions. The two suppositions are practically identical with one another in effect.

(3) It is obvious that, on the presumption that the envelope is only moderately extensible, the whole structure can only be distorted to a moderate degree away from the spherical or spheroidal form.

(4) At all points the shape is determined by the law of the distribution of *radial pressure within the given region of the tube*, surface friction helping to maintain the egg in position.

(5) If the egg be under pressure from the oviduct, but without any marked component either in a forward or backward direction, the egg will be compressed in the middle, and will tend more or less to the form of a cylinder with spherical ends. The eggs of the grebe, cormorant, or crocodile may be supposed to receive their shape in such circumstances.

(6) When the egg is subject to the peristaltic contraction of the oviduct during its formation, then from the nature and direction of motion of the peristaltic wave the pressure will be greatest somewhere behind the middle of the egg; in other words, the tube is converted for the time being into a more conical form, and the simple result follows that the anterior end of the egg becomes the broader and the posterior end the narrower.

(7) With a given shape and size of body, equilibrium in the tube may be maintained under greater radial pressure towards one end than towards the other. For example, a cylinder having conical ends, of semi-angles θ and θ' respectively, remains in equilibrium, apart from friction, if $p\cos^2\theta = p'\cos^2\theta'$, so that at the more tapered end where θ is small p is large. Therefore the whole structure might assume such a configuration, or grow under such conditions, finally becoming rigid by solidification of the envelope. According to the preceding paragraph, we must assume some initial distribution of pressure, some squeeze applied to the posterior part of the egg, in order to give it its tapering form. But, that form once acquired, the egg may remain in equilibrium both as regards form and position within the tube, even after that excess of pressure on the posterior part is relieved. Moreover, the above equation shows that a normal pressure no greater and (within certain limits) actually less acting upon the posterior part than on the anterior part of the egg after the shell is formed will be sufficient to communicate to it a forward motion. This is an important consideration, for it shows that the ordinary form of an egg, and even the conical form of an extreme case such as the guillemot's, is directly favourable to the movement of the egg within the oviduct, blunt end foremost.

(8)[1] The mathematical statement of the whole case is as follows :—In our egg, consisting of an extensible membrane filled with an incompressible fluid and under external pressure, the equation of the envelope is $p_n + T\left(\frac{1}{r}+\frac{1}{r'}\right) = P$, where p_n is the normal component of external pressure at a point where r and r' are the radii of curvature, T is the tension of the envelope, and P the internal fluid pressure. This is simply the equation of an elastic surface where T represents the coefficient of elasticity; in other words, a flexible elastic shell has the same mathematical properties as our fluid, membrane-covered egg.

The above equation is the *equation of equilibrium*, so that it must be assumed either that the whole body is at rest or that its motion while under pressure is not such as to affect the result. Tangential forces, which have been neglected, could modify the form by alteration of T. In our case we must, and may very reasonably, assume that any movement of the egg down the oviduct during the period when its form is being impressed upon it is very slow, being possibly balanced by the advance of the peristaltic wave which causes the movement, as well as by friction.

The quantity T is the tension of the enclosing capsule—

[1] The mathematical statement is not my own; I am indebted for it and for other help in the editing of this paper to my colleague, Prof. W. Peddie.

the surrounding membrane. If T be constant or symmetrical about the axis of the body, the body is symmetrical. But the abnormal eggs that a hen sometimes lays, cylindrical, annulated, or quite irregular, are due to local weakening of the membrane, in other words, to asymmetry of T. Not only asymmetry of T, but also asymmetry of p_m, will render the body subject to deformation, and this factor, the unknown but regularly varying, largely radial, pressure applied by successive annuli of the oviduct, is the essential cause of the form, and variations of form, of the egg. In fact, in so far as the postulates correspond near enough to actualities, the above equation is the equation of *all eggs* in the universe. At least this is so if we generalise it in the form $p_n+\frac{T}{r}+\frac{T'}{P'}=P$ in recognition of a possible difference between the principal tensions.

(9) In the case of the spherical egg it is obvious that p_n is everywhere equal. The simplest case is where $p_n=0$, in other words, where the egg is so small as practically to escape deforming pressure from the tube. But we may also conceive the tube to be so thin-walled and extensible as to press with practically equal force upon all parts of the contained sphere.

(10) If while our egg be in process of conformation the envelope be free at any part from external pressure (that is to say, if $p_n=0$), then it is obvious that that part (if of circular section) will be a portion of a sphere. This is not unlikely to be the case actually or approximately at one or both poles of the egg, and is evidently the case over a considerable portion of the anterior end of the plover's egg.

(11) In the case of the conical egg with spherical ends, as is more or less the case in the plover's and the guillemot's, then at either end of the egg r and r' are identical, and they are greater at the blunt anterior end than at the other. If we may assume that p_n vanishes at the poles of the egg, then it is plain that T varies in the neighbourhood of these poles, and, further, that the tension T is greatest at and near the small end of the egg. It is here, in short, that the egg is most likely to be irregularly distorted or even to burst, and it is here that we most commonly find irregularities of shape in abnormal eggs.

(12) If one portion of the envelope were to become practically stiff before p ceases to vary, that would be tantamount to a sudden variation of T, and would introduce asymmetry by the imposition of a boundary condition in addition to the above equation.

(13) Within the egg lies the yolk, and the egg is invariably spherical or very nearly so, whatever be the form of the entire egg. The reason is simple, and lies in the fact that the yolk is itself enclosed in another membrane, between which and the outer membrane lies a fluid the presence of which makes p_n for the inner membrane practically constant. The smallness of friction is indicated by the well-known fact that the "germinal spot" on the surface of the yolk is always found uppermost, however we may place and wherever we may open the egg; that is to say, the yolk easily rotates within the egg, bringing its lighter pole uppermost. So, owing to this lack of friction in the outer fluid, or white, whatever shear is produced within the egg will not be easily transmitted to the yolk, and, moreover, owing to the same fluidity, the egg will easily recover its normal sphericity after the egg-shell is formed and the unequal pressure relieved.

GEODETIC INVESTIGATIONS IN THE UNITED STATES.[1]

THE report of the U.S. Coast and Geodetic Survey for 1907 has just been received. For the details of the extensive cartographic work of the bureau in the United States proper, Alaska, Porto Rico, and the Philippines, as well as for the account of the progress of the primary triangulation and levelling of precision, the report itself must be consulted. Certain important work of the survey receives bare mention, as, for instance, the results of the investigation of the earth's figure, based on geodetic operations in the United States. This is owing to the fact that these results were communicated to the International Geodetic Association in a preliminary report which has been published.

Soon after the California earthquake of April 18, 1906, it became evident that the permanent horizontal displacements of large areas covered by triangulation in California had so changed the lengths and directions of the lines joining the triangulation stations as greatly to diminish the value of the triangulation for its primary purpose as a framework for future surveys. During the year, therefore, new triangulation extending from Point Arena to stations south of Monterey Bay was done, which serves to restore the value of the old triangulation by determining the new positions of sixty-one of the old triangulation stations. The triangulation included the Farallon Lighthouse, twenty-two miles to the westward of the great fault accompanying the earthquake, and the stations Mocho and Mount Diablo, thirty-three miles to the eastward of the fault. The new triangulation serves to trace the permanent distortions and displacements of the earth's crust for many miles back from the fault in each direction, and to show that they follow certain regular laws. This is the most extensive and accurate determination by triangulation of the effects of an earthquake which has yet been made anywhere in the world. Appendix 3 of the report gives a full report of this investigation.

A report on the measurement of six primary bases with steel and invar tapes in 1906 is printed as Appendix 4. The invar (nickel steel) tapes have a coefficient of expansion about 1/28th that of steel tapes, hence it is much less difficult to keep the temperature errors within the required limit with invar tapes than with steel tapes. Invar tapes had not been used in the United States until 1906 in primary base measurements. The thorough tests of these tapes, made by using them on six bases in conjunction with the steel tapes formerly used, showed that measurements may be made more conveniently, accurately, and at smaller cost per mile than with the steel tapes, and that the invar tapes are sufficiently durable and stable for safe field use. This demonstration is believed to be a distinct step in advance in base measurement.

The steady progress in the magnetic survey of the United States, and accumulation of magnetic observational data, as mentioned in Appendix 5 of the report, should be of special interest to the surveyor and the navigator, as well as to those pursuing the study of the science of terrestrial magnetism. Throughout the year the measurements of the earth's magnetism were made at places distributed over a majority of the States and territories of the United States, and at numerous places at sea along the Atlantic and Pacific coasts of North and South America, and in Porto Rico and the Philippines. Important information was secured in the equatorial regions. Numerous "repeat" observations were made throughout the country in order to follow as closely as possible the secular change in the magnetic elements. Five magnetic observatories were maintained in continuous operation, and important seismological data were also obtained. The facilities of the observatories were afforded to all investigators who desired to make standardisation comparisons of their instruments, and in response to numerous requests information or observational data was furnished for practical application or for use in special investigations of terrestrial magnetism and allied phenomena.

Appendix No. 6, constituting the concluding portion of a manual of tides, treats of the flow of water, of river tides, tidal currents, permanent currents, annual inequality, lake tides, seiches, and miscellaneous tidal matters. Charts of co-current lines are given for the principal marginal waters along the Atlantic coast of the United States. The numbers upon these lines show the times of the maximum flood current. The dependence of the permanent ocean currents and the annual height inequality upon the prevailing winds is briefly pointed out. Seiches are shown to exist in harbours and other tongues of water, as well as in lakes, but their character is fundamentally different in some respects. The analyses of observations upon the tides of Lake Superior show that they follow closely the equilibrium theory, although the

[1] "Report of the Superintendent of the Coast and Geodetic Survey showing the Progress of the Work from July 1, 1906, to June 30, 1907." (Washington: Government Printing Office, 1907.)

range is only 1½ inches at Duluth and one-third inch at Marquette.

In Appendix No. 7 is given a detailed description, with appropriate illustrations, of the long wire drag, a device for detecting erratic obstructions of small extent in navigable waters. The method of operating can be understood from the simple statement that the drag is a wire varying in length from 480 feet to 1400 feet, supported at suitable intervals, and maintained at any desired depth below the surface of the water. This drag is towed over any given area by launches, and in the area so searched no elevation of the bottom above the depth at which the wire is suspended can escape detection. Buoys floating at regular intervals along the drag indicate to observers in the launches when and where an obstruction is touched, and the spot so indicated is then accurately determined.

This method of sweeping has proved a sure means of detecting pinnacle rocks and similar erratic obstructions which heretofore have eluded the hydrographic surveyor, since it is almost impossible to discover them by lines of soundings with the lead. Only the navigator in whose hands rest many lives and much property can realise the relief from mental strain that comes from knowing that the water in which he is sailing is absolutely free from hidden dangers, or that every menace is charted. The device has proved very satisfactory under widely varying conditions, and marks a decided advance in marine surveying.

The report, or any one of the appendices, may be obtained by interested persons, free of charge, upon application to the superintendent of the Coast and Geodetic Survey, Washington, D.C., U.S.A.

THE MECHANICS OF THE INNER EAR.

THE University of Missouri has recently issued a memoir by Prof. Max Meyer, in which an interesting, instructive, and suggestive attempt is made to explain the mechanism of the cochlea without having recourse to the application of the principle of sympathetic vibration, or rather without the assumption that there exists in the cochlea, in the form of the organ of Corti, a vast number of delicate structures tuned, as it were, to tones of different frequencies. Prof. Max Meyer does not base his views on experimental data; his paper is a purely theoretical discussion as to how the cochlea may act, if we make six fundamental assumptions, none of which can, at present at all events, be tested by direct examination or by direct experiment. His inquiry begins with the movements, in and out, of the stapes at the oval window. The tube filled with fluid is divided into three compartments, the upper, the scala vestibuli, communicating at the apex of the cochlea with the scala tympani, at the foot of which we find the round window, while between the two scalæ we have the cochlear duct, or scala intermedia, composed, in its turn, on one side by the basilar membrane, on which rests the organ of Corti, and on the other by Reissner's membrane. When the base of the stapes is pushed inwards at the base of the scala vestibuli, pressure is communicated to the fluid in the scalæ (the scalæ communicating at the apex of the cochlea by a little opening, the helicotrema), and the membrane of the round window passes outwards, towards the tympanic cavity. It is generally held that with such pressure the fluid in the scalæ moves as a whole, and that pressure is communicated to the whole length of the scala intermedia, and especially to the basilar membrane, and that in this way the nerve-endings in Corti's organ are also submitted to pressure. The question then arises, is there any differentiating mechanism in the basilar membrane or in Corti's organ for tones of different frequencies, or, in other words, have we here an organ capable of analysis? Some deny any such property, while others, since the views of Helmholtz were first promulgated, are of opinion that there does exist an analysing mechanism.

The theory of Prof. Meyer essentially is that when the base of the stapes is pressed inwards a section of the membrana basilaris is also pressed in one direction until it reaches its limit of movement. On the basilar membrane rests the organ of Corti, the delicate hair cells being supported on the backs of the rods or arches of Corti. The membrane of Reissner may be regarded as merely protective, and a similar function Prof. Meyer awards to the arches of Corti, which are a kind of skeleton to prevent the delicate hair cells and nerve endings from being crushed by downward pressure on the membrana basilaris. No one can say what is the function of the membrana tectoria, the cushion-like structure that lies over the apices of the hair cells, and the nerve endings that, according to some histologists, lie between the hair cells. It may be a damper or it may be the arrangement by which pressures are made on the apices of the hair cells or nerve endings. There is thus, according to Prof. Meyer, a movement in one direction of a segment of the membrana basilaris, the direction being towards the scala tympani. When the base of the stapes has passed inwards to its fullest extent, the segment also moves to its limit, and then when the base of the stapes passes outwards the segment passes in the reverse direction, that is, towards the scala vestibuli. The rest of the basilar membrane beyond the segment is undisturbed. It is not known whether the basilar membrane is elastic or not; most probably it is non-elastic, but its backward swing has also its limits, and the velocity of the backward spring is probably slower than its forward swing, seeing that it is weighted on one side by the Corti cells, &c. The intensity of the tone will be determined by the amplitude of movement of the base of the stapes—the extent of the segment being greater as the amplitude is greater, and the reverse. Assuming that the number of nerve fibres in each segment is the same (which is unlikely), the greater the extent of the segment the greater will be the number of nerve fibres irritated, and the greater will be the intensity. The pitch will, of course, depend on the frequency of the movement of the segment, and there is no necessity for the assumption that either segments of the membrana basilaris, or structures upon these, are tuned to certain frequencies. When a compound tone or sound, say a fifth (the frequencies of the components of which are in the ratio of 3 : 2), is sounded, the base of the stapes makes a more complicated movement than that of a simple pendular vibration, and then this compound movement is resolved by two segments of the basilar membrane moving synchronously, in the ratio of 3 : 2, and the nerve endings in one segment would be irritated thrice during the time that the nerve endings in the other segment would be irritated twice. Still more, a segment at or near the base of the stapes would move once in the same time, and give rise to the differential tone, and so on.

Prof. Meyer thus recognises the cochlea as an analytic apparatus, without the necessity of any tuned mechanisms, and he works out his theory with great clearness, much ingenuity, and perfect fairness. His explanations of differential tones are in perfect consistence with his theory, and they are graphically delineated. He does not pretend that his theory is an ultimate solution of the problem attacked. Data are still wanting to found a final theory, and when we consider the minute size of the parts involved, it will probably be many a day before these data have been collected. But as experimental, and even observational, research must start from theory, however imperfect, Prof. Meyer has done good service in advancing his views.

The writer would only remark that he finds it easier to conceive the existence in the cochlea of arrangements adapted to frequencies, and consequently of an analysis by resonance, than to think of the membrana basilaris, short as it is, moving in segments when a complex mass of tones is objectively produced. Such a cochlea as Prof. Meyer has conceived might work in the way he thinks, and the writer would suggest that he should make a huge model, with a big piston, and ascertain whether a stout leather non-elastic membrana behaves as he expects it to do. The writer thinks that Helmholtz's resonance theory, with slight modifications, still holds the field, nor does it seem to him to be negatived (and the same remark applies to the theory of Prof. Meyer) even by the difficulties created by a consideration of differences of phase. The physiological effect produced by the relative *intensity* of a com-

[1] "An Introduction to the Mechanics of the Inner Ear." By Prof. Max Meyer. Science Series of the University of Missouri Studies. Pp. 140. (1907.) Price 1 dollar.

ponent of wave forms produced by components combined in different phases may enable us to distinguish one wave form from another, although, as has been proved experimentally, the forms must be different.

JOHN G. MCKENDRICK.

COLOUR PHOTOGRAPHY.

THE second annual exhibition of the Society of Colour Photographers will be open at 24 Wellington Street, Strand, until June 27. It includes about 230 examples prepared by the various methods that are now available. The section of transparencies on Lumière's autochrome plates is the largest; there are a few reproductions of autochromes, some pinatype transparencies, transparencies by the Sanger-Shepherd process, a good show of three-colour prints prepared with the Rotary Company's tissues and with the Autotype Company's tissues, some pinatype three-colour prints, and a few miscellaneous examples. It is clear that all these methods can be made to give good results, but in every section there is evidence that success cannot be expected without skill and practice.

There are no transparencies that surpass, if any equal, the examples of the Sanger-Shepherd process exhibited by Messrs. Sanger-Shepherd and Co., but we are glad to see some excellent autochromes, such as Nos. 108, 113, and 114 by Mr. J. C. Warburg, and No. 89 by Mr. Maurice Meys, as autochrome plates present the simplest method yet known for getting colour results. Many of the autochromes have an unpleasant coloured granulation obvious to anyone of keen vision when the plate is held at the normal distance from the eye. This is doubtless due to the grouping together into patches of the similarly coloured starch grains, and its absence in some examples may justify the hope that the makers can more thoroughly mix the differently coloured grains now than heretofore.

The application of autochrome plates to photomicrography is well exemplified by Drs. O. Rosenheim and H. R. Hurry. These gentlemen also show photomicrographs of the starch grain itself, and the area of the black filling between the coloured grains is larger than one would have expected, probably larger in the particular plate photographed than in many other plates. Mr. Welborne Piper's copies of autochromes on autochrome plates are very interesting as showing the result of attempts to multiply these colour photographs by exposure in the camera and also by superposition. It is clearly possible to use an autochrome that has not been reversed in the making as a negative from which to prepare other autochromes. Of the prints on paper, those by Mr. H. J. Comley, the secretary of the society, and by the Rotary Photographic Company are specially good, the latter showing excellent portraits of the German Emperor ar Empress and of Prof. Ostwald.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Lord Rayleigh will visit Cambridge on Tuesday, Wednesday, and Thursday, June 16, 17, and 18, in order to be installed as Chancellor. At 4 o'clock on Tuesday, June 16, he will open the new extension of the Cavendish Laboratory. On Wednesday, June 17, the Chancellor will hold a levée of members of the Senate in the Fitzwilliam Museum at 11.30. On the same day there will be a Congregation at 3.15 p.m., at which honorary degrees will be conferred. The Chancellor will visit the colleges on the morning of Thursday, June 18, and will be received at the gate of each college at times which will be notified.

Mr. A. C. Pigou, King's College, has been elected professor of political economy in succession to Mr. Alfred Marshall, who has resigned the chair.

Dr. Hobson has been re-appointed as Stokes lecturer in mathematics, and Dr. Baker as Cayley lecturer in mathematics, each for five years from Michaelmas, 1908.

THE Bradford City Council has resolved to extend the technical college at a cost of 19,000*l.*, including equipment and machinery.

A COURSE of three lectures on "Plankton" will be given by Dr. G. Herbert Fowler at University College on June 10, 15, and 23 at 5 p.m. The lectures are to be addressed to advanced students of the University of London and to others interested in zoology; they will be open to the public without fee or ticket.

MR. R. N. RUDMOSE BROWN has been appointed to the newly instituted lectureship in geography in the University of Sheffield. Mr. Brown accompanied the Scottish Antarctic Expedition in 1902 as naturalist to the expedition. He acted in 1906 as Special Commissioner, under the Indian Government, for the investigation of the pearl oyster fisheries of the Mergui Archipelago.

THE International Congress of Historical Science is to be held in Berlin on August 6–12. The work of the congress will be carried on in general and sectional meetings. Among the eight sections are sections on Oriental history; history of Greece and Rome; history of civilisation and the history of thought, mediæval and modern; sciences subsidiary to history (archives, libraries, chronology, diplomatic, epigraphy, genealogy, historical geography, heraldry, numismatics, palæography, study of seals). Copies of the programme can be obtained from the secretary of the congress, Dr. Caspar, Kaiser-Allee 17, Berlin W. 15.

A COMBINED examination for twenty-three medical entrance scholarships and exhibitions of an aggregate total value of about 1500*l.*, tenable in the faculties of medical sciences of University College, King's College, and in the medical schools of King's College Hospital, St. George's Hospital, Westminster Hospital, and the London School of Medicine for Women, will be held in London by the London Inter-collegiate Scholarships' Board on September 22 and following days. Full particulars and entry forms may be obtained on application to the secretary of the board, Mr. Alfred E. G. Attoe, University College, Gower Street, London, W.C., or to the deans or secretaries of the medical schools concerned.

THE establishment of the proposed university for Bristol and the west of England, to which frequent reference has been made in these columns, will make desirable a scheme of cooperation between the Bristol University College and the Merchant Venturers' Technical College. The Society of Merchant Venturers has had the matter under consideration from time to time, and the proposals of the society, signed by its treasurer, have been printed and circulated. The technical college is carried on in three departments, viz. a secondary school, adult day classes for the study of the higher branches of applied science and technology, and evening classes in technological and commercial subjects for artisans. Only a part of the work is of university standard, and such part the society proposes to submit to the control of the new university, but to continue as before the remaining larger part of the teaching not of university standard. The society has expressed its willingness to undertake the faculty of applied science and engineering in the proposed university, and to hand over this work to academic control, a scheme the society maintains would prevent friction and overlapping. These proposals differ in essential respects from those of the university committee, which appears to have thrown out the suggestion that the society's secondary school should be discontinued in connection with the technical college; that the college buildings in Unity Street should be transferred to the University and used only for applied science and engineering, and that another school of technology under a composite committee should be established. To provide a new site and new secondary school—as was done in the similar case of University College, London—would cost, it is said, some 28,000*l.*, and the money does not seem to be forthcoming. The other suggestions of the university committee fail at present to meet with the approval of the society, but we are hopeful that when the money necessary for the establishment of a new university is available it will prove possible by mutual concessions to develop a plan which, while utilising all work of university standing at present being done, will in no way interfere with other good educational work being accomplished in the city.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 16.—"On the Perception of the Direction of Sound." By Prof. C. S. **Myers** and Prof. H. A. **Wilson**, F.R.S.

Lord Rayleigh (*Phil. Mag.*, 1907, xiii., 214) has shown that the determination of the apparent direction of a sound is influenced by phase-differences between the vibrations at the two ears. In the present paper this influence is experimentally further investigated, and a theory is advanced which offers a possible explanation of the effects ultimately in terms other than phase-difference.

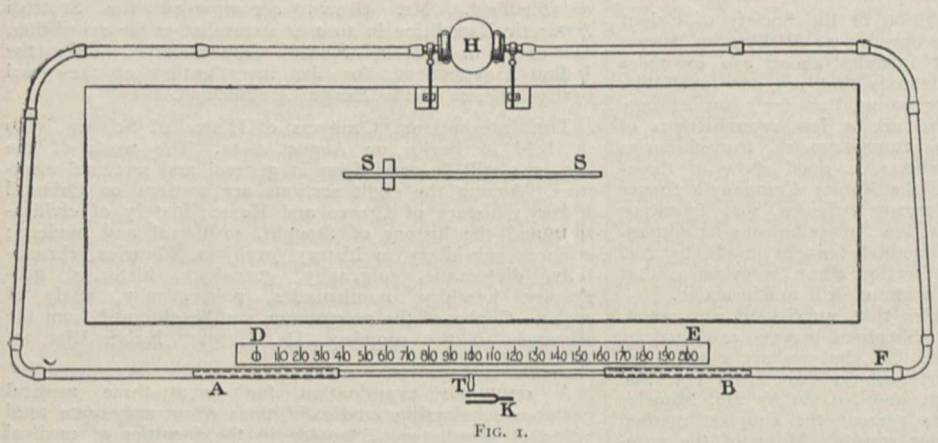

FIG. 1.

The apparatus (Fig. 1) used in these experiments consisted of a brass tube AB about 2·5 m. long and 2·5 cm. in diameter, at the centre of which a short T-piece T was soldered. This tube was freely movable within the two slightly larger tubes CD and EF, from the ends of which tubes were led to two softly padded caps, supported on retort stands, and applied to the ears of the observer H. Beside the tube AB was placed a graduated scale DE, which recorded the position of the T-piece. The sound entered the T-piece from a vibrating tuning-fork K held near it. By sliding the tube AB, so that the T-piece at different times pointed to different divisions of the scale, every kind of phase-difference between the vibrations reaching the two ears could be produced. A screen SS concealed the position of the T-piece from the observer. One of the authors varied the position of the T-piece, sounding the tuning-fork before it at each position, while the other, acting as the observer, stated on which side the fork appeared to be sounding. The answers of the observer could be graded—"full right," "half right," "middle or half right," "middle," "middle or half left," "half left," "full left." At "half right" the lateral direction of the sound was only moderately clear; at "middle" or "half right" it was doubtful, while at "middle" there was no lateral effect at all.

If we call the lateral effect ϕ, considering right effects positive and left effects negative, then, according to Lord Rayleigh's results, $\phi = A \sin(4\pi nx/v)$, where A is constant, x is the distance in cm. of the T-piece from the middle point of the scale, n is the number of vibrations per second, and v the velocity of sound.

The results of the observations can be conveniently expressed in the form of curves, the abscissæ expressing the scale-readings and the ordinates the lateral effects. For this purpose a "full right" is reckoned as 1, a "half right" as a $\frac{1}{2}$, a "middle or half right" as a $\frac{1}{4}$, a "middle" as 0, the corresponding left effects having equal, but negative, values. Figs. 2, 3, 4 show the curves obtained with forks of frequencies 512, 384, 128. The dotted line in each figure is the curve $\phi = \sin(4\pi nx/v)$.

It is at once apparent that the theoretically and the experimentally obtained curves agree with one another remarkably well. The discrepancies which were sometimes met with were, with the aid of manometric flames, traced to the occurrence of resonance in one or other side of the tube. Interesting results were obtained from experiments conducted when the tubes were partially blocked or gradually pinched on one side. Other observations, of psychological rather than physical or physiological interest, are reserved for a future communication.

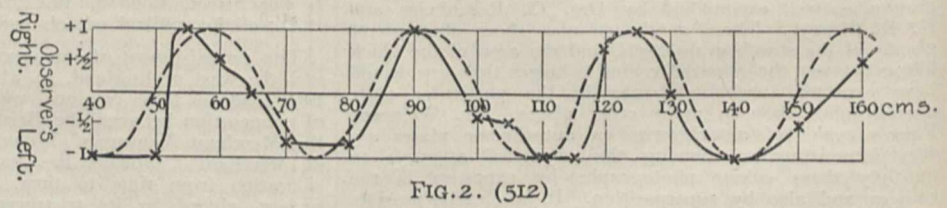

FIG. 2. (512)
(Observer facing towards fork)

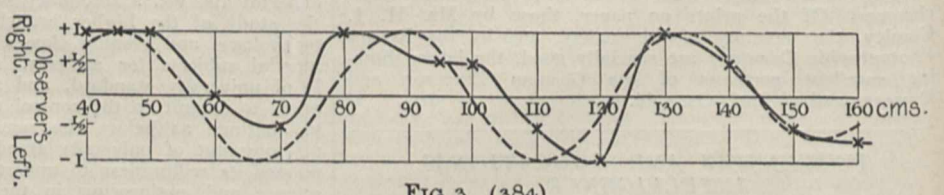

FIG. 3. (384)
(Facing towards)

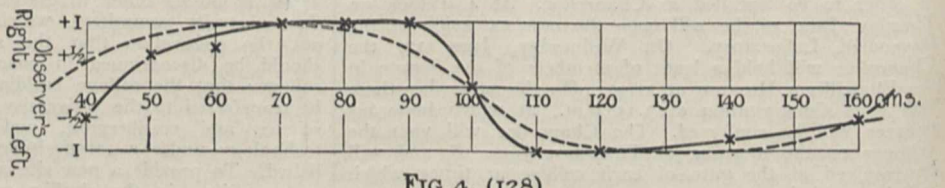

FIG. 4. (128)
(Facing towards)

It is here suggested that the lateral effects thus produced by differences of phase at the two ears are really and ultimately due to the binaural differences of sound-

intensity which must result, if the sound, entering one ear, is transmitted (as from psychophysiological data we know that it must be) across the head by bone conduction to the opposite ear. This suggestion receives support from a detailed mathematical consideration of the conditions. It may be added that the writers hope in a future paper to discuss the applicability of this explanation to the interesting experiments which Lord Rayleigh has brought forward.

March 5.—"The Relation between Wind Velocity at 1000 Metres Altitude and the Surface Pressure Distribution." By E. **Gold.** Communicated by Dr. W. N. Shaw, F.R.S.

It is a matter of common observation that the wind does not blow along the pressure gradient, but in well-exposed situations more nearly at right angles to it or along the isobars. It is equally well known that near the centres of anticyclonic or high-pressure areas the winds are very light, and it has been customary to attribute this fact to the coincident occurrence of small gradients of pressure. It appears, however, that these latter results, instead of being mutually explanatory, are both due to the effective centrifugal force arising from the earth's rotation, the admitted cause of the tendency to motion along the isobars.

If we express the fact that for steady horizontal motion in a path of curvature $1/r$, the part of the centrifugal force arising from the motion of the wind is balanced by the effective gradient of pressure, we obtain the equation

$$\frac{(wr\sin\lambda \pm v)^2}{r} = \frac{1}{\rho}\frac{\partial p}{\partial r} + \frac{(wr\sin\lambda)^2}{r},$$

where p is atmospheric pressure, ρ density, v velocity of moving air, λ latitude, and w the angular velocity of the earth about its axis. If there is no friction, the variation of p along the path must be zero or the path must be an isobar. If $\partial p/\partial r$ be negative, corresponding to a path concave towards the higher pressure, v and $wr\sin\lambda$ must have opposite signs, or the air must rotate in a clockwise direction. Further, in this case $\frac{1}{\rho}\frac{\partial p}{\partial r}$ cannot exceed $\frac{(wr\sin\lambda)^2}{r}$ numerically, and v cannot exceed $wr\sin\lambda$, so that for steady motion in anticyclonic regions there are definite limits to the gradient and velocity.

A general idea of the importance of this result is to be gained from the fact that at no point within 100 miles of the centre of an anticyclonic system of circular isobars in latitude 50° can the theoretical steady wind velocity exceed twenty miles per hour.

It is shown by analogy with the motion of a particle on the earth's surface that the time necessary for bringing about the state of steady motion is small enough for us to expect it to be the general state except where obstacles set up eddies. It is proved that the velocity calculated from the above equation is, for a given surface-pressure distribution, independent of the altitude provided there is no horizontal temperature gradient and the necessary corrections are given for the case of varying temperature when the direction of the horizontal isotherms does not change with altitude. The values of the theoretical steady velocity can by this means be calculated for any altitude from the surface observations. This was done for Berlin for 8 a.m. on each day of the year 1905, the temperature correction being disregarded. The results were compared with the actual velocities observed at 1000 metres' altitude in kite and balloon ascents. The theoretical and observed values showed a striking agreement both in direction and in magnitude, proving that the effect of surface irregularities on the horizontal air motion is practically obliterated at 1000 metres, and that we can obtain definite values for the wind velocity at moderate altitudes from the surface observations of pressure and temperature with a good degree of accuracy.

April 2.—"The Alcoholic Ferment of Yeast-juice. Part iii. The Function of Phosphates in the Fermentation of Glucose by Yeast-juice." By A. **Harden** and W. J. **Young.** Communicated by C. J. Martin, F.R.S.

(1) The addition of a phosphate to a fermenting mixture of glucose and yeast-juice not only produces a temporary acceleration in the rate of fermentation, but, in addition to this, an increased total fermentation.

(2) This last effect is due to the fact that the hexose-phosphate formed during the period of temporary acceleration is continually hydrolysed by an enzyme, with production of free phosphate, which again enters into reaction, and thus brings about an increased fermentation.

(3) It appears probable that the presence of phosphate is essential for the alcoholic fermentation of glucose by yeast-juice, the reaction which occurs being the following:—

$$(1)\quad 2C_6H_{12}O_6 + 2R_2HPO_4 = 2CO_2 + 2C_2H_6O + C_6H_{10}O_4(PO_4R_2)_2 + 2H_2O.$$

This reaction is only realised in the presence of the ferment and coferment discussed in previous communications, phosphate alone being unable, in the absence of coferment, to bring about fermentation in a mixture of ferment and glucose.

The hexosephosphate thus formed is then hydrolysed:—

$$(2)\quad C_6H_{10}O_4(PO_4R_2)_2 + 2H_2O = C_6H_{12}O_6 + 2R_2HPO_4.$$

The rate at which this second reaction occurs determines the rate of fermentation observed when glucose is fermented by yeast-juice.

(4) An optimum concentration of phosphate exists which produces a maximum initial rate of fermentation. Increase of concentration beyond this optimum diminishes the rate of fermentation.

Entomological Society, May 6.—Mr. C. O. Waterhouse, president, in the chair.—*Exhibits.*—A. H. **Jones**: An example of the melanic ab. *nigra* of *Tephrosia consonaria* bred from the ovum from a wild ♀ taken near Maidstone, and a living larva of *Sesia andreniformis* feeding in the stem of *Viburnum lantana*.—R. **Shelford**: Specimens of insects in amber showing several forms closely allied to those of existing insects, one orthopteron being very near to *Ectobia lapponica*.—**President**: A living example of Blatta found in bananas from Mexico. Mr. Shelford said he thought the species to be *Pandora niveus*, Lin.—H. M. **Edelsten**: A living larva of *Nudaria senex*, and living larva and pupa of *Calligenia miniata*.—O. E. **Janson**: A white aberration of *Epinephele jurtina*, taken in Holme Park, Sussex, in June, 1904.—Lieut.-Colonel N. **Manders**: A collection of butterflies from Bourbon demonstrating examples of mimicry and the effects of the interaction of species.—W. J. **Lucas**: (1) A glow-worm found at Oxshott on May 4, inside the shell of the snail *Helix cantiana*. There was no doubt that the larva was feeding on the snail, for on breaking away parts of the shell the moist remains of it were found near the apex. (2) The ♂, ♀, and nymph of the dragon-fly *Oxygastra curtisii*, first described by the late J. C. Dale, and at that time supposed to be confined to the British Islands.—H. St. J. **Donisthorpe**: An example of the beetle *Xantholinus distans*, Kr., taken at Helton, near Dumfries, on May 1, a species new to the British list.—*Papers.*—The British dragon-flies of the "Dale collection": W. J. **Lucas.**—The distinctness of several species of Everes, determined by their genitalia: Dr. T. A. **Chapman.** The author announced as the result of his investigations that *Everes argiades*, Pall., and the so-called var. *coretas*, were separate, though very nearly allied species.

Geological Society, May 6.—Prof. W. J. Sollas, F.R.S., president, in the chair.—Solution valleys in the Glyme area of Oxfordshire: Rev. E. C. **Spicer.** This area is part of the gently tilted great oolite limestone plateau, indented by sunken valleys, principally with a strike-and-dip trend, that appear to be subsidence valleys. They begin suddenly, and descend with sinuous curves to a main valley. The main valley likewise enters a stream valley. The stream valley develops into a broad, sinuous river valley, over which a small river stream meanders. The plateau area is free from drift and from marks of surface denudation; there are no marks of marine currents or of ice, no wind-gaps suggest beheaded streams, nor is there

evidence of vanished heights. At the mouths of the dry valleys issue streams impregnated with carbonate of lime. It is suggested that percolating water, forming an underground course along joint-lines, removes enough material in solution to weaken a long, winding area over which the surface subsides. Solution widens the stream banks into bowls of soakage, and leaves insoluble material to build up a level valley floor, which rises above and obscures the valley outlet streams, these then forming marshes.—The stratigraphy and structure of the Tarnthal mass (Tyrol): Dr. A. P. **Young**; with a note on two cephalopods collected on the Tarnthal Köpfe (Tyrol): G. C. **Crick.** The occasion for this paper is the discovery of fossils which appear to throw new light on the relations of the rocks of this mountain. The rock series is divided into three parts, and the succession summarised. An explanation of the structure is then suggested. A petrographical note is furnished on the amphibolite of Gufidann.

Physical Society, May 8.—Dr. C. Chree, F.R.S., president, in the chair.—A modified theory of gravitation: Dr. C. V. **Burton.** If we are to regard gravitational attraction as exerted through the medium of the æther, it appears to the author difficult to avoid the conclusion that the very great (or possibly infinite) velocity with which such attractions are propagated is due to the very great (or complete) incompressibility of the æther. This conception is embodied in the pulsatory theories of Hicks and of subsequent writers; the chief outstanding difficulty has lain in providing for that agreement of phase which must be assumed to subsist amongst the centres of pulsatory disturbance associated with the mutually attracting masses. This difficulty is avoided if we suppose that primary waves of compressional-rarefactional type are being propagated through the æther with a velocity enormously transcending that of light. These primary waves may be travelling in directions indifferently distributed, or predominantly or exclusively in one direction; but an essential point is that all effective wave-lengths should be very great, measured even by astronomical standards. Thus the pressure changes will be sensibly in the same phase over considerable regions, and if the ætherial compressibility is locally increased (or diminished) by the presence of electrically neutral matter, every particle of such matter will act as a centre of pulsatory motion. For the electron, so far as concerns this modification of ætherial compressibility, a specification is assumed which involves no restraint on the free mobility of the electron through the æther. Incidentally, the dynamics of the problem assumes a relatively simple form, and a value which could be quite insignificant attaches to a "gravitational (or non-electromagnetic) term" appearing in the expression for the total inertia of an electron.—An examination of the formulæ for the grading of cables: C. S. **Whitehead.**—Illustrations of geometrical optics: R. M. **Archer.** Light from a narrow rectilinear source is allowed to pass through a slit and fall upon a flat white surface at almost grazing incidence. It is easy to obtain upon the surface a long narrow streak of light with sharp edges, and if a mirror be placed with its plane approximately normal to the surface another streak corresponding to the reflected ray can be seen. Similarly, the path of the beam after its emergence from a glass block or prism may be traced. Interesting effects can be obtained by using many slits and casting the beam from a distant optical lantern upon them. This mode of illumination is useful in demonstrating the formation of caustics. Quantitative results can be obtained comparable in accuracy with those given by an ordinary optical bench.

Zoological Society, May 19.—Dr. F. DuCane Godman, F.R.S., vice-president, in the chair.—*Exhibits.*—Preparations of a new gland found in certain teleostean fishes: W. **Woodland.** This new gland is quite distinct from the gas-gland, and consists of rows of huge columnar cells, which are situated in close connection with the blood-vessels, which possess large nuclei and nucleoli, and are packed with numerous large spherical granules derived from the red-corpuscle disintegration concerned in the generation of the oxygen contained in the swim-bladder. These granules, thus abstracted by the gland-cells from the blood, are carried away by special ducts appertaining to the gland. The discovery of this gland confirms Jæger's view as to the mode of generation of the bladder oxygen. This gland exists in Gobius, Syngnathus, Peristedion, Box, and some other genera.—Specimen of a petrel, *Œstrelata neglecta*, Schleg., picked up dead, yet in a quite fresh condition, at Tarporley, in Cheshire, on April 1, 1908: T. A. **Coward.** This bird is a native of the southern Pacific, and has almost certainly never been recorded from the northern hemisphere, and certainly never from Europe before.—The tanned skin of a wild cat, obtained by the Hon. Mason Mitchell, of the American Consular Service, in Sze-chuen: R. **Lydekker.** Mr. Lydekker had compared the skin with a light-coloured skin of *Felis temmincki* from Sikkim, and described it as a new local race of that species.—Specimen of chert from the Middle Culm-measures (Carboniferous) of Christon Down, near Doddiscombe Leigh, Devonshire, showing numerous large and well-preserved Radiolaria: C. Davies **Sherborn.**—*Papers.*—The Cyril Crossland collection of Calcarea from Zanzibar and Wasin (British East Africa): C. F. **Jenkin.** Notes on the Australian fossorial wasps of the family Sphegidæ, with descriptions of new species: R. E. **Turner.** Eighty species were described as new, and the absence of the genera Oxybelus and Philanthus, otherwise of world-wide range, from Australia was commented on.—The heredity of secondary sexual characters in relation to hormones; a contribution to the theory of heredity: J. T. **Cunningham.** The paper contained an examination and criticism of the most important recent investigations and theories on the subject by evolutionists of various schools, namely, the theory which attributes such characters to constitutional causes, such as male katabolism, Prof. Karl Pearson's biometrical investigation of sexual selection in man, Castle's Mendelian theory of the heredity of sex, and Geoffrey Smith's views on dimorphism of males and parasitic castration in Crustacea. The author maintained that all these contributions were more or less inconsistent with the known facts concerning the connection between the development of secondary sexual characters and the functional activity of the primary gonads. He directed attention to the recent discovery and experimental proof on the part of physiologists that the development of the characters was due to the stimulus of a chemical substance or hormone produced by the testis or ovary, and passed into the blood, and suggested that conversely hormones from parts of the soma might affect the gametes in the gonads. In this way the hypertrophy of a part of the body due to external stimulation might modify the corresponding determinants in the gametes so as to produce some hereditary effect in succeeding generations. Mr. Cunningham added that his theory was an interpretation in terms of modern physiology of Darwin's theory of pangenesis.

Chemical Society, May 21.—Sir William Ramsay, K.C.B., F.R.S., president, in the chair.—Hydro-aromatic ketones, preliminary note: A. W. **Crossley** and C. **Gilling.** A description of the condensation products obtained from 5-chloro-1 : 1-dimethyl-Δ^4-*cyclo*hexenone-3, with ketonic esters.—The sulphides and oxysulphides of silicon: I. G. **Rankin** and S. M. **Revington.** Berzelius's sulphide is shown to be SiS_2, and the compositions of the monosulphide and the oxysulphides, SiSO and $SiSO_2$, have been definitely established.—Apparatus for experiments at high temperatures and pressures, and its application to the study of carbon: R. **Threlfall.** A simple and comparatively inexpensive steel apparatus for the investigation of reactions at high temperatures and pressures was described, and the results obtained by melting carbon under a pressure of about 100 tons per square inch were detailed. In every case soft, crystalline graphite was obtained, and the view is taken that for the formation of diamond under these conditions other substances must be present, and the nature of these will probably be determined by the constituents of diamond ash.—Acids as accelerators in the acetylation of amino-groups: Miss A. J. **Smith** and K. J. P. **Orton.** It was shown that minute quantities of sulphuric and other mineral acids greatly accelerate the acetylation of such substances as anilines with two negative groups in the ortho-positions with respect to the amino-group.—The chemical action of radium emanation, part iii., on water and certain gases: A. T. **Cameron** and Sir W. **Ramsay.** The decom-

position of water and the re-combination of hydrogen and oxygen under the influence of radium emanation have been confirmed. Carbon dioxide decomposes into carbon, oxygen, and the monoxide, and the last is changed into carbon, oxygen, and the dioxide. Ammonia breaks up into its components, as does also hydrogen chloride. The rate of change in these reactions is in all cases proportional to the rate of change of the emanation.—The chemical action of radium emanation, part iv., on water: A. T. **Cameron** and Sir W. **Ramsay.** The formation of neon from radium emanation in presence of water is confirmed.—Titani-dihydroxymaleic acid, and the detection of titanium: H. J. H. **Fenton.** Dihydroxymaleic acid in aqueous solution gives an intense red-brown colour with quadrivalent titanium compounds. The reaction is sensitive enough to be used as a test for titanium, and serves to distinguish it from vanadium.—The preparation of diselenides. Dibenzyl diselenide, preliminary note: T. S. **Price** and L. M. **Jones.** The diselenides are prepared by the addition of a solution of sodium selenosulphate to a solution of the alkyl chloride.—The optical and sensitising properties of *iso*cyanine dyes: S. E. **Sheppard.** The results of an examination of the absorption spectra, &c., for gelatinobromide plates are given.—The polarimetric study of intramolecular re-arrangement in inactive substances: T. S. **Patterson** and A. **McMillan.** The authors have applied their method (Trans. Chem. Soc., 1907, xci., 504) to measure the rate of inversion of piperonal*syn*oxime and similar substances.—Mercuric zinc cyanide: W. R. **Dunstan.** The formula $Zn_3Hg(CN)_8$ is now given to this substance instead of $Zn_4Hg(CN)_{10}$, as formerly proposed (Trans. Chem. Soc., 1892, lxi., 666).—Ethyl 6-methyl-2-pyrone-3 : 5-dicarboxylate and its derivatives: J. L. **Simonsen.**—Contributions to the chemistry of the amidines, part ii., 2-anilinobenzoxazole and the supposed anilodihydrobenzoxazole: G. **Young** and A. E. **Dunstan.**—The slow decomposition of ammonium chromate, dichromate, and trichromate by heat: W. C. **Ball.** The dichromate evolves nitrogen, water, and ammonia, and leaves eventually a black compound, $3CrO_3,H_2O$. At an intermediate stage a black product having the formula $2CrO_3,Cr_2O_3,2NH_3,H_2O$ is formed.

Royal Microscopical Society, May 20.—Mr. A. N. Disney in the chair.—A series of lantern-slides of old microscopes that the society will exhibit at the Franco-British Exhibition was shown on the screen. Mr. **Rousselet,** the curator, in giving a description of the instruments, said the collection was illustrative of the history of the microscope, and would consist of twenty-eight microscopes mostly taken from the society's collection, several others being lent for the purpose by Sir Frank Crisp and Mr. E. M. Nelson. The collection included, with others, a model of Leeuwenhoek's microscope, date about 1673; microscopes by Musschenbroek, 1702; Wilson, 1702; Culpeper, before 1738; Lieberkuhn, 1738; John Marshall, 1744; John Cuff, 1744; Benjamin Martin, 1760, and one made for George III., 1771; Dellebarre, 1777; Jones's "Most Improved," 1798; Lister-Tulley, 1826; Cuthbert's reflecting microscope, 1827; Chévalier, 1834 and 1840; Hugh Powell, 1839 and 1841; Jas. Smith, 1841; Andrew Ross, 1842; Dr. Edwin Quekett, 1844; and Powell and Lealand, 1848.—An old photomicrographic apparatus designed by Dr. Maddox for Dr. Lionel S. Beale: J. E. **Barnard.** There were two points of interest about it, the first being the application of an arrangement between the objective and the stage for excluding extraneous light, the other was that the illuminating apparatus was carried on a triangular bar, which had the apex inverted, thus losing the advantage to be derived from the application of the principle of the triangular bar.

CAMBRIDGE.

Philosophical Society, May 4.—Dr. Hobson, president, in the chair.—The geographical distribution of the acarine family Oribatidæ: C. **Warburton.** It seemed likely that if ever the Oribatidæ of the world should be widely investigated they would prove to be a very characteristic fauna of the various zoological regions, for they seem to possess none of the facilities for extensive distribution exhibited by most of the other Arachnids or by insects. They are highly specialised mites, not parasitic on animals like the ticks and Sarcoptidæ, nor attaching themselves to other creatures for purposes of distribution like the Tyroglyphidæ. They are, of course, wingless, nor have they the power of spinning silken parachutes like spiders so as to utilise the wind. They are slow moving, vegetable-feeding mites, and in England their distribution is very local. Samples of moss containing the living mites have been received from certain widely separated localities, and the results are not at all what were expected. On the whole there is a great resemblance between all the collections, and some species seem to be practically cosmopolitan. Moreover, these species are not primitive in appearance, nor are they among the most active of the group. The almost world-wide distribution of certain forms seems difficult to account for unless the creatures have remained unaltered for a very long period of time.—Some new and obscure species of the genus Hæmaphysalis of the Ixodidæ: C. **Warburton.** This paper was an attempt to remove the confusion which had arisen with regard to the species *Haemaphysalis flava*, *H. bispinosa*, and *H. papuana*. Four species had been confused under the name of *H. flava*, and two of these were now described as new—*H. japonica* and *H. campanulata*. Neumann's *H. bispinosa* was restored and separated from *H. hystricis*, of which he considered it a synonym. A species confused by Neumann with *H. papuana* was described as new under the name of *H. crassa*.—The fauna of the Bradford coke bed effluent: Dr. A. **Meixner.**

MANCHESTER.

Literary and Philosophical Society, April 7.—Mr. Francis Jones, vice-president, in the chair.—The occurrence of quartz crystals in limestone, columnar coal, marble, &c.: R. **Pettigrew.** Photographs, microscopic and lantern-slides, were exhibited showing microscopic crystals of quartz obtained from mountain limestone, columnar coal from Airdrie, in Lanarkshire, and ordinary statuary marble.—Note on the action of oxalic acid on cellulose: Prof. E. **Knecht.** It appears that the action of oxalic acid on cellulose simply constitutes one example of a general mode of formation of acidyl celluloses.

April 28.—Prof. H. B. Dixon, F.R.S., president, in the chair.—Some observations on the chemical effect of tropical sunlight: Dr. G. J. **Fowler.** The results show that the greatest photochemical effect is obtained on the sea, the highest record being on the Arabian Sea (lat. 16° 31′, long. 54° 8′) in the vicinity of the Arabian coast. Here the chemical intensity of the sunlight was forty-two times what has been recorded on a bright sunny day in winter in Manchester, and three times the highest summer record in Manchester. The average record for Calcutta was about double the highest for Manchester in 1892. There does not appear to be any relation between the photochemical effect of sunlight and the liability to cause sunstroke, the records in the Mediterranean being as high as in Calcutta, and one record furnished by Dr. Bailey from Pontresina being higher than the average for Calcutta. Evidence is also mentioned which suggests that sunstroke is not purely a heat effect. In the same way sunburn does not seem to depend entirely either on the photochemical or heat intensity of sunlight. The full explanation of these phenomena has not, it is believed, been yet given. The results of the observations recorded show generally that the photochemical effects of tropical sunlight do not differ in kind from those observed under European conditions; indeed, in certain favoured European localities equally striking effects may be obtained.

PARIS.

Academy of Sciences, May 25.—M. H. Becquerel in the chair.—The recent eruption of Etna (Taormina, May 15, 1908): A. **Lacroix.** This eruption broke out in a region quite distinct from that of the eruptions of 1883, 1886, and 1892. Details are given of the formation and appearance of the new crater, of the lava, and the erosion phenomena caused by the lava.—The stimulating properties of the serum of healthy and tuberculous animals, and of animals treated with tuberculin, on cobra poison: A. **Calmette,** L. **Massol,** and C. **Guerin.** A description of experiments on the production of lecithin in blood serum by experimental tuberculosis.—A method of M. Goursat

in Monge's problem: P. **Zervos.**—The general problem of probabilities in repeated trials: L. **Bachelier.**—The secondary rays from the α rays: William **Douane.** The production of the secondary rays ceases almost entirely when the radium salt is removed more than 2 cm. from the slit; this distance is precisely that which was found in earlier experiments for the charge of the α rays.—The potential difference and stability of the alternating arc between metals: C. E. **Guye** and A. **Bron.** The contradictory results of earlier workers are largely due to the difficulty of maintaining the stability of the arc. The authors have obtained arcs of high stability by bringing the electrodes to a temperature near their melting points, and having a large reserve of potential (20,000 volts) in open circuit. For metals which are slightly volatile the potential difference, under equal conditions, tends to a lower limit, approximately the same (about 470 volts) for all metals.—The existence and origin of harmonics in the self-induction spark: G. A. **Hemsalech.**—The impossibility of diagnosing death by the radiography of the abdominal organs: Maxime **Ménard.**—Contribution to the study of the oxidation phenomena produced by iodic and bromic acids: H. **Baubigny.** Bromide of silver in ammoniacal solution is stated to be converted at 100° by iodic acid into silver iodide and ammonium bromide; this statement is now shown to be erroneous, the reaction in reality being quite different. A small proportion of the ammonia is oxidised by the iodate at 200°, nitrogen, water, and ammonium iodide being produced.—A new volumetric method allowing the simultaneous estimation of carbonic acid and other acids in atmospheric air: H. **Henriet** and M. **Bouyssy.**—The estimation of tungstic acid and its separation from other substances by the use of a mixture of chlorine and chloride of sulphur: F. **Bourion.** The method proposed is described in detail, and its accuracy proved by the results of analyses of sodium tungstate, silicotungstic acid, ytterbium, silicotungstate, and a mixture of silica and tungstic acid.—The triboluminescence of mineral substances: Adrien **Karl.**—The syncytial nature of the intestine of Rhabdocœles: Paul **Hallez.**—The comparative action of simple salt solutions and artificial serums with complex mineral contents on the blood and circulation: C. **Fleig.**—The action of acids on the coagulation of milk by vegetable ferments: C. **Gerber.**—The experimental study of the cutting of twigs for slips: A. **Imbert.**—The study of the bactericidal action of anti-virulent serum on the adventitious germs of vaccine: L. **Camus.**—The transmission of syphilis to the cat: C. **Levaditi** and T. **Yamanouchi.**—The different levels of alluvium at the confluence of the Yonne and the Cure: Paul **Lemoine.**—Two causes of error in experiments on fluorescein: F. **Dienert.** A fluorescent substance occurs naturally in certain waters, and this may cause difficulty when fluorescein has been used to trace the passage of underground water. The added dye may often travel very slowly, and by its appearance cause confusion when a second experiment is being carried out in the same district.—The temperature of the thermal waters of the eastern Pyrenees: O. **Mengel.**

DIARY OF SOCIETIES.

THURSDAY, JUNE 4.

ROYAL SOCIETY, at 4.30.—On the Aberration of Sloped Lenses and on their Adaptation to Telescopes of Unequal Magnifying Power in Perpendicular Directions: Lord Rayleigh, O.M., Pres. R.S.—The Optical Constants of Gypsum at Different Temperatures, and the Mitscherlich Experiment: Dr. A. E. H. Tutton, F.R.S.—On the Viscosity of Ice: R. M. Deeley.—The Effect of Temperature on the Neutralisation-Volume Change for Different Salts at Different Concentrations: Miss Ida Freund.—Note on a New Sounding Machine for Use on Lakes and Rivers without a Boat: Prof. E. J. Garwood.—The Electrical Qualities of Porcelain, with Special Reference to Dielectric Losses: H. F. Haworth.—On the Decay of the Radium Emanation when Dissolved in Water: R. B. Moore.

ROYAL INSTITUTION, at 3.—The Chemistry of Photography: Dr. Alexander Scott, F.R.S.

LINNEAN SOCIETY, at 8.—Note on the Spicules of *Chirodota geminifera*, Dendy and Hindle: Prof. A. Dendy, F.R.S.—Two New Fungus Diseases: E. S. Salmon.—The Caryophyllaceæ of Tibet: F. N. Williams.—Polychæta of the Indian Ocean: F. A. Potts.—The Stylasterina of the Indian Ocean: Dr. S. J. Hickson, F.R.S., and Miss Helen M. England.—A Contribution to the Mycology of South Africa: W. N. Cheesman and T. Gibbs.—*Exhibits*: Drawings prepared to illustrate Descourtilz's "Ornithologie brésilienne": C. E. Salmon.—Lantern-slides of the Life-history of a Wood-boring Wasp: F. Enock.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—Presidential Address by C. E. Rhodes.—The Mineral Resources of Trinidad: J. Cadman.—The Occurrence of Fluorspar in Derbyshire: C. B. Wedd and G. C. Drabble.—Calcining-kilns: G. Jones.—Cobalt and Northern Ontario: J. B. Tyrrell.

CHEMICAL SOCIETY, at 8.30.—Condensation Products from Pinene Aminodicarboxylic Acid: W. Godden.—A Delicate Test for Bromides alone, or in Solution with Chlorides: J. S. Jamieson.—Experiments on the Synthesis of 1-Methylcyclohexylidene-4-acetic Acid: W. H. Perkin and W. J. Pope.—The Triazo-group. Part iv., Allyl Azoimide: M. O. Forster and H. E. Fierz.

FRIDAY, JUNE 5.

ROYAL INSTITUTION, at 9.—The Nadir of Temperature and Allied Problems: Sir James Dewar, F.R.S.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—Winding-engine Tests, with Notes and Suggestions on the Design and Testing of Plant: S. L. Thacker.—The Utilisation of Sewage for the Production of Crude Oil and Ammonia: M. F. Purcell.—The Oil Prospects of Central British South Africa: Dr. C. Sandberg.—Oil-mining: D. M. Chambers.—Mining in the Boundary District of British Columbia: F. Keffer.

TUESDAY, JUNE 9.

FARADAY SOCIETY, at 8.—The Utilisation of Atmospheric Nitrogen in the Production of Calcium Cyanamide and its Use in Agriculture and Chemistry: Dr. R. A. Frank.

THURSDAY, JUNE 11.

MATHEMATICAL SOCIETY, at 5.30.

FRIDAY, JUNE 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.

ARISTOTELIAN SOCIETY (at Cambridge).—Symposium: The Nature of Mental Activity: Profs. S. Alexander, James Ward, Carveth Read, and G. F. Stout.

PHYSICAL SOCIETY, at 8.—Experiments on a Directive System of Wireless Telegraphy: Messrs. Bellini and Tosi.—On the Lateral Vibration and Deflection of Clamped Directed Bars: Dr. Morrow.—On the Resistance of a Conductor of Uniform Thickness whose Breadth Suddenly Changes, and on the Shapes of the Stream-lines: Prof. Lees.—On the Self-inductance of Two Parallel Wires: Dr. Nicholson.—On Homogeneous Secondary Radiation: Dr. Barkla and Mr. Sadler.—Notes on the Motion of a Corpuscle and on Cloud Formation: Prof. Morton.

GEOLOGISTS' ASSOCIATION, at 8.—Origin of Mountain Tarns: Prof. E. J. Garwood.

CONTENTS.