THURSDAY, JUNE 5, 1902.

THE POPULAR HUXLEY.

Thomas Henry Huxley. By Edward Clodd. Pp. xiii + 226. (Edinburgh and London: William Blackwood and Sons, 1902.) Price 2*s.* 6*d.*

DR. RICHARD GARNETT has described Huxley's work as "that of the populariser; the man who makes few original contributions to science or thought, but states the discoveries of others better than they could have stated them themselves." I am disposed to think that the picture my friend Mr. Clodd has drawn with practised dexterity will rather confirm than dissipate this inadequate judgment. On the last page of this volume he writes, with perhaps a touch of remorse:—"To regard Huxley as a compound of Boanerges and Iconoclast is to show entire misapprehension of the aims which inspired his labours." I entirely agree; but the words might have been added to the title-page without doing serious injustice to what follows.

With such a Huxley I must frankly confess I have very little sympathy. I prefer the one which, with much critical insight, Mr. Chalmers Mitchell has presented to us "in his admirable monograph."

Huxley was so big a man in my judgment that his real merits can well afford to bear the brunt of dispassionate criticism. Disagreeing as I do with Dr. Garnett, I go farther, and think that as a "populariser" Huxley was by no means always successful. And Mr. Clodd supplies the reason in "that passion for logical symmetry" which appears to me often Huxley's besetting sin.

I only echo the opinion of competent judges in saying that he will be always clearly recognised as occupying a foremost place amongst English scientific men of the nineteenth century. He rescued animal morphology from the deductive method, and firmly established it on an inductive basis. In doing this there is scarcely any part of the animal kingdom which he did not illuminate by original and brilliant work. And he applied the theory of evolution with masterly insight to the explanation of the facts. All this was, however, only accomplished in the most cautious way, and was the result of patient observation and study. An examination of his published researches will show that he never advanced a step without making the ground firm beneath his feet.

In his more popular writings I am bound to say that I often fail to find the same qualities. Facts and knowledge were taken frequently at second hand, and were not the acquisition of his own personal labour. No one can deny the literary skill with which they were used. But the habit which grew upon him of pushing home remorselessly the conclusions he drew from them often landed him in very dubious positions. This is the more singular as he saw the danger in the case of mathematical reasoning, and rightly insisted that "what you get out depends on what you put in."

Huxley was firmly imbued with what is ordinarily called a "materialistic" conception of the universe. I think myself that this is probably a true view, though I confess I am getting rather at sea about "electrons" and "ions." Nor am I at all disposed to agree with Principal Rücker that atoms are more than a physical hypothesis. I do not admit that Prof. "Britschli" has produced "a substance which simulates protoplasm" or has done more than give us some pretty examples of surface tension. I do not see even the beginning of a materialistic theory of protoplasm. This, however, was what Huxley attempted in the lecture on the "Physical Basis of Life," of which I see a cheap reprint is about to be issued. Mr. Clodd summarises it as if its contents were accepted scientific truths. But this is far from being the case, and I should myself be in great difficulty if they were presented to me in the examination room.

Huxley—to take only one out of many disputable assertions—after speaking of "the dull vital actions of a fungus," states that its "protoplasm is essentially identical with and most readily converted into that of any animal." Further on he puts the idea into a more picturesque form and speaks of "transubstantiating mutton into man." Except the definition of a crab attributed to the French Academy, I call to mind no statement so compact of error. Every physiologist knows that between the protoplasm of a sheep and that of the human being who consumes it there is a whole series of compounds which bear no resemblance to protoplasm at all. The animal has to build itself up from lifeless matter just as the plant has, only it mostly uses more complex molecules. It is no doubt true that a particle of fungoid differs in no appreciable physical respect from one of human protoplasm, yet the former will never emerge from the fate of the humble mushroom, while the other may be instinct with the thoughts of a Prime Minister. It may be that the difference is a function of molecular arrangement. If so it is of an order entirely different from anything chemistry presents us with. The fact is that protoplasm is not in any intelligible sense of the word a substance at all, but rather a structure or mechanism. Huxley puts this clearly enough later on in a letter to Herbert Spencer ("Life," i. 127).

Huxley's theological writings seem to me to exhibit defects of the same kind. He did not invent biblical criticism, though one might almost imagine from Mr. Clodd that he did. The argument seems to be this: read the Bible as if it were the *Times* newspaper; then ask yourself the question—Can I accept the statements of the one as literally as of the other? The answer of most persons will be, No. Very well then, Huxley replies:—You are in this position: Christianity is based on the Bible, and my sense of veracity compels me to say that it "vanishes" ("Life," ii. 212), or at any rate "is doomed to fall" ("Essays," v. 142), and some other "hypostasis of men's hopes" will take its place (*l. c.* 254).

But I fail to see the validity of the conclusion. Huxley's analysis of orthodox Christianity is that it is a "varying compound of some of the best and some of the worst elements of Paganism and Judaism, moulded in practice by the innate character of certain people of the western world" ("Essays," v. 142). Without discussing this, it clearly represents Christianity as a product of evolution. There will be, therefore, no new hypostasis necessarily; the moulding will go on and there will be fresh adjustments, as there have been in the past, to higher ethical demands.

I confess I hoped to find in Mr. Clodd's book what I have entirely failed to construct for myself, a consistent and systematic summary of Huxley's teaching in these matters. That he has not succeeded convinces me that the thing is impossible. Huxley's position was avowedly negative; he had no illusions on the subject ("Life," ii. 301). Mr. Clodd says that he "asked the churches to revive" the creed of Micah. I fail to find the passage, or that he did more than recommend that creed as a "work of art." Two years later he wrote:—"That there is no evidence of the existence of such a being as the God of the theologians is true enough" ("Life," ii. 162).

The fact is—and I think Mr. Clodd has failed to bring it out clearly—Huxley's theological and ethical writings are not a gospel, but the revelation of the working of a nature of singular complexity. A heart of warm emotion was in perpetual conflict with an intellect which strove to be the "clear cold logic engine" which he so much desiderated ("Life," i. 198). The late R. H. Hutton, who often showed real insight, hit the mark when he said that Huxley's "slender definite creed in no respect represented the cravings of his large nature," and there was more than sly humour in Bishop Thirlwall's remark on the presence at the Metaphysical Society of "Archbishop Huxley and Prof. Manning." The man's real catholicity of temperament endeared him to his friends and overbore the effect of his cold logic and often petulant agnosticism.

In dealing with biblical or any other ancient documents it is not sufficient to dismiss them because their literal accuracy cannot be sustained. The scientific problem is to ascertain how they came to be evolved by mankind and what is the true meaning behind them. This Huxley rarely did, and in consequence laid himself open to the reproach attributed to Jowett that "he did not consider the literature." Huxley said "the story of the Deluge is a pure fiction" ("Essays," iv. 234). But it occurs in Babylonian literature, and he subsequently followed Suess in giving what is probably its true explanation (*l. c.* 247). He gave himself an excellent example of the true method in his analysis of "the account of Saul's necromantic expedition," which he thought "quite consistent with probability" ("Essays," iv. 291), and he defines in the same essay with luminous precision what may be described as the method of biblical palæontology (*l. c.* 290).

It seems to me that it would be a mistake to take Huxley's theology too seriously. It was essentially an intellectual product and not a working system. Thus he took "the conception of necessity to have a logical and not a physical foundation" ("Life," i. 412). He was above all things masculine and human. In re-reading his "Life and Letters," I am struck with the sanity of his judgments on administrative and political questions. To whatever extreme he pushed his logical conclusions in reasoning, when it came to "business" he was essentially practical. He raised many important questions. That is easy enough even for men of smaller intellectual calibre. What he did with them is that which really interests us. The ethical problem is the one of greatest actual importance. His fundamental position as regards this was a divorce between theology and ethics. "The end of the evolution of theology will be like its beginning—it will cease to have any relation to ethics" ("Essays," iv. 371, 372). But the practical difficulty at once occurred to him—How is the dense mass of human action to be influenced by an appeal to abstract principles? Here is his answer:—"I must confess I have been . . . seriously perplexed to know by what practical measures the religious feeling, which is the essential basis of conduct, was to be kept up, in the present utterly chaotic state of opinion on these matters, without the use of the Bible. The Pagan moralists lack life and colour, and even the noble Stoic, Marcus Antonius, is too high and refined for an ordinary child" ("Essays," iii. 397). "Life and colour"—there you have the problem in a nutshell. When it came to the question of Board School education, he fought for the Bible. According to Mr. Clodd (p. 37), shortly before his death he regretted this, and "came to see" that it was "deplorable." But in 1894 he did "not repent . . . in the least" ("Life," ii. 383), and as to the "highest biblical ideal," he wrote in 1897, "I do believe that the human race is not yet, possibly never will be, in a position to dispense with it" ("Essays," v. 58).

Meanwhile it is interesting to note that he had tried various other solutions. One was obedience to natural law, an old-fashioned precept which traces back to Kingsley and farther:—"The safety of morality lies in . . . a real and living belief in that fixed order of nature which sends social disorganisation upon the track of immorality, as surely as it sends physical disease after physical trespasses ("Essays," ix. 146).

But the "colour" question was insistent, as it must be, and so the moral sense was identified with "an innate sense of moral beauty" ("Life," ii. 305). This was compared with the æsthetic sense, and as with that ("Essays," ix. 80), "evolution accounts for morality" ("Life," ii. 360). This was an intuitional theory which was finally replaced by one that was practically utilitarian. "Of moral purpose I see no trace in nature. That is an article of exclusive human manufacture" ("Life," ii. 268). Mr. Clodd will save me the trouble of enforcing the position by further citations. "The terms 'good' and 'evil' have no meaning till communal life begins. Where there is no society there is no sin. A solitary man on an uninhabited island can do no wrong" (p. 284). I believe it is a moot point whether political economy can exist on an island with two inhabitants. But it seems a little harsh when there is only one to deprive him of such consolation as he may derive from his "innate sense of moral beauty" and bring him down without appeal to the level of the beasts that perish.

The Romanes lecture, which Mr. Clodd admires so much, to me is pathetic, because it is a sort of cry of despair. The cosmic order which we were formerly exhorted to conform to is identified with evil, and this is to be strenuously combated by the ethical principle. But the conflict will be unavailing, and the cosmic order will resume its sway. So after traversing the whole field of ethical exploration we are finally thrown into the arms of Schopenhauer. All this is intensely interesting to anyone who cares for such problems or for the working of a remarkable mind. But helpful or constructive I distinctly say that it is not. I turn to Mr. Clodd and find that he extracts from it "a religion that, coordinated with the needs and aspirations of human nature, would

find its brightest motive and its permanency in an ethic based on sympathy."

Sympathy may explain the altruistic aspect of morality; but I fail to see how it accounts for the "renunciation" of the lower impulses which is characteristic of the highest ethical development. And how for practical purposes is "sympathy" to be infused? My experience of human nature inclines me to think that it requires a more powerful appeal to the imagination than is afforded by a mere academic counsel of perfection of this sort. As I am writing these lines my eye falls on a speech in the daily paper by Viscount Goschen. I quote the following:—

"As a layman he wished, on behalf of the laymen, to express their admiration of the work which was being carried on, and which the clergy were doing in the East-end of London. Thirty years ago, when he was at the Poor Law Board, he made a special study of the statistics of poverty, ignorance and crime at the East-end, and he learned that the miserable breakages of civilisation resorted in their deepest despair to Bethnal Green, and hid themselves there amongst the very poor."

If we dispense with the clergy, have we at present any effective agency for dealing with this sort of problem? I see none, and I am firmly persuaded that no abstract principles would have prevented Huxley substantially agreeing with Lord Goschen.

Mr. Clodd frames a severe indictment against the theology of the last century. It did not lift its voice against the excessive use of capital punishment. I confess I do not see where theology comes in; it is a question of purely civil policy. Sentimentalism apart, the free use of hanging is scientifically arguable. Huxley thought that for "moral cripples and idiots . . . there is nothing but shutting up and extirpation" ("Life," ii. 306). Mr. Clodd complains that theology "still wages bitter war to enforce the teaching of her discredited dogmas; and, to her even greater shame, fans and fosters the spirit of militarism." This would be all very well in a secularist pamphlet, but I fail to see its place in a life of Huxley, even if I thought it just. Huxley's views about the Afghans ("Life," i. 489) show that, right or wrong, he was not wanting in the virile instinct of the normal Englishman.

From my point of view, which is that of a thoroughgoing evolutionist, I hold it unscientific to array one plane of theology against another which demands a higher ethical standard in practice. It would be as reasonable to complain that *Amphioxus* was unable to take advantage of a Board School education. If we agree with Huxley that theology is "a natural product of the operations of the human mind" ("Essays," iv. 288), Mr. Clodd is simply pointing his sword to his own breast.

Huxley was so transparently honest that no prejudice would blind his eyes to the merit of any agency that made for good, however sceptical he might be as to the basis on which it rested. Orthodoxy could not desire a more touching appreciation than his of "the bright side of Christianity" ("Essays," v. 254). He had even a good word to say of Roman Catholicism in the past ("Life," i. 346). He was deeply impressed with the life of Catherine of Siena. Whatever may have been his own intellectual convictions, life still remained to him "a hopeless riddle" ("Life," ii. 134). That is the utmost positive outcome I can derive from his ethical teaching, and I do not see that Mr. Clodd carries us farther.

W. T. THISELTON-DYER.

A MONOGRAPH OF MOSQUITOES.

A Monograph of the Culicidae of the World. By F. W. Theobald, M.A., F.E.S. 3 vols. Pp. xxvi+815; 42 plates. (London: Trustees of the British Museum.) Price 3*l.* 3*s.*

THIS work has been undertaken chiefly with the object of enabling "medical men engaged in tracing the connection between mosquitoes and human disease to identify and speak with precision of the species implicated." A considerable knowledge of the principles of entomology has now become a necessity in such investigations, and the present work forms an excellent guide and help in the processes of identification.

The work in three volumes, of which the last consists entirely of coloured plates, has an introduction containing notes on the mounting of mosquitoes, in which the author strongly urges the necessity of preserving specimens in 40 per cent. spirit for purposes of more complete identification. The first portion of the work is devoted to a short account of the external structure of the adult, pupal and larval conditions of the insects and of the bionomics of the different stages, and ends with a synoptic table of subfamilies and genera of the family of Culicidæ and a list of species of Culicidæ, and a further list arranged according to the countries in which the species occur.

The rest of the work deals with detailed descriptions of the members of the different genera. It is lavishly illustrated by many figures throughout the text, which serve to lighten very considerably the difficult task of identification. The coloured plates forming the third volume have been exceedingly well prepared, and their execution must have absorbed much time and labour. It is, however, much to be regretted that many of the drawings, in fact almost all those of insects collected in tropical countries, have been made from preserved specimens, and consequently do not reproduce at all exactly the colours of the insects in nature. It is well known how quickly their delicate colours fade after death and under the influence of the usually employed preservatives, so much so, indeed, that to investigators who are very familiar with the insects in their tropical surroundings the coloured representations in this work appear very untrue.

Without in any way wishing to detract from the great value of the portion of the book which details the specific characteristics of the numerous species described, it is to be regretted that the earlier portion, dealing chiefly with the bionomics of the Culicidæ, and for which the author has been largely dependent for his information on the authority of others who have studied the insects in the tropics, should occupy such a prominent position. In the short description of the parts of the proboscis of the mosquito, the author has shown himself unfamiliar with the minuter details of its structure. He advises the

disuse of the term "epipharynx," "as it is really part of the upper lip." This is not shown to be so if carefully prepared serial transverse sections are made of the proboscis. By this means it is seen that the epipharynx is a tunnel-shaped tube through which blood is drawn up and which is strengthened on each side by a chitinous rod, in the centre of which is a core of chitin-forming cells—prolongations forward of the cells lining the external chitin of the whole body. The epipharynx is by its dorsal surface very intimately connected with the "labrum," or upper lip proper, throughout its whole length. That the labrum does not, however, extend as far as the tip of the epipharynx is shown by the presence of the core of chitin cells which here approaches the dorsal surface. The two pieces, the labrum and the epipharynx, therefore represent two distinct organs, which are bound closely together for a great part of their length by a delicate connective tissue, so that the combined organ might rather be called the "labrum-epipharynx," a term first suggested by Dimmock. Near the base of the proboscis the labrum is composed of a curved lamella of chitin, concave upwards, convex towards the convex upper surface of the epipharynx—the open sides being closed by folds of delicate chitin, which unite below with the lateral rods of the epipharynx, the space thus enclosed being filled with delicate loose cellular connective tissue.

Mr. Theobald also describes the hypopharynx as "a small needle-like thread connected with a poison gland at its base." The hypopharynx does not lie between the four stylets (the mandibles and the maxillæ) and the epipharynx, but, as is well shown in well-prepared sections, the lower edges of the mandibles fit in between the hypopharynx and the epipharynx at the sides, and only in the middle line do the thin lower edges of the epipharynx and the upper surface of the hypopharynx meet. Moreover, the structure at the base of the hypopharynx is not a poison gland, but, a receptacle for the collection of veneno-saliva secreted by the salivary glands situated in the prothorax. This receptacle is somewhat trumpet-shaped, with sides of strong rigid chitin. The mouth opens on to the upper end of a groove which runs along the whole length of the hypopharynx, the veneno-salivary gutter; whilst the broad end is composed of delicate membranous tissue, and receives about its middle the insertion of the common salivary duct. Into this membrane also are inserted the tendons of delicate muscles. The receptacle is simply a store for saliva which is discharged by the falling back of the membrane, previously retracted by the muscles attached to it.

Mr. Theobald emphasises the importance of the scale structure of the insects, and considers it to be one of the most important characters for both generic and specific distinction; the whole classification in the monograph is mainly based on the scale structure. In the description of the wings, the terminology of Skuse, which is the simplest and best suited for purposes of identification, has been adopted.

The paragraphs on the bionomics of mosquitoes treat chiefly with the habits of Anopheles and Culex. These paragraphs contain many incorrect and misleading statements, and other recent works might be consulted for more trustworthy information on this subject. For example, the author concludes that *Anopheles maculipennis* does not bite here in England, and suggests the question whether this may not have some bearing on the dying out of malarial fever in this country. Now there is no doubt that *A. maculipennis* have been found gorged with blood in some parts of England in bedrooms and other places. Moreover, however closely the distribution map of the English Anopheles corresponds with the old malarial district map which Dr. Nuttall has worked out, it is quite certain that there is hardly any district of England entirely free from Anopheles, which are easy to find if diligent search be made.

He further states, on the authority of Dr. Daniells, that in the greater part of India blackwater fever is unknown; on the contrary, however, this disease is more prevalent in some parts of India than in Africa.

In that greater portion of the work which deals with the classification and descriptions of the mosquitoes, the author has prepared extremely serviceable and minutely detailed entomological accounts of the characteristics of all the then known species. Of the old genera, the following have been retained:—Culex, Anopheles, Ædes, Mochlonyx, Megarhinus, Psorophora, Sabethes, Corethra, Uranotænia, Hæmagogus and Tæniorhynchus (modified). The new genera added by Mr. Theobald are Wyeomyia, Deinocerites, Ædeomyia, Panoplites, Eretmapodites, Janthinosoma, Stegomyia, Mucidus, Toxorhynchites and Trichoprosopon.

Of the 300 species described, 136 are new. The majority of species described are those found in and around towns or are known pests to travellers and traders; a few, of the genera Megarhinus and Sabethes, which probably occur more abundantly in forests, are also described.

The author deserves very great credit for the enormous amount of work which must have been entailed in the preparation of the details of this large number of species, and it is extremely desirable that in its second edition the great value of the work, especially to those who are engaged in the study of disease in tropical and sub-tropical countries, will be still further increased by the correction of the errors and contradictions which have evidently been overlooked in the hurry of publication.

THE DIRECT-CURRENT ARC.

The Electric Arc. By Hertha Ayrton, M.I.E.E. Pp. xxv + 479. (London: The *Electrician* Printing and Publishing Company, Ltd.) Price 12*s.* 6*d.*

THERE are few electrical phenomena which are of more interest than those exhibited by the electric arc, or which are more difficult to investigate. The complexity of the laws by which it is governed and the number of factors which can be varied independently make any research into its properties of a laborious character. Mrs. Ayrton is to be congratulated, not only on the painstaking investigations which she has carried out on the direct-current arc, but also on the remarkable success which has attended her work. Much of the book before us is already familiar as the result of papers

published in the *Electrician* or communicated to scientific societies. But in one sense the book may be said to be entirely new, as it presents for the first time the results of Mrs. Ayrton's work in the form of a connected whole in which the interdependence of the various parts is made manifest.

After a short chapter on the general appearance of the arc, Mrs. Ayrton gives, in a chapter of nearly eighty pages, a history of its discovery and development and of the investigations to which it has been subjected. Though the discovery is usually attributed to Davy, it is clear from the quotations given by Mrs. Ayrton that the arc was evolved from the electric spark without any distinct recognition of the difference between the two; to Davy, however, belongs the credit of the first description of an undoubted arc, from which dates, probably, its recognition as a distinct phenomenon. The remainder of the chapter, in which all the important papers on the arc are considered, is of great value, especially, perhaps, to the student, as it leads by easy gradation from the simpler theories which were advanced at first to the more complex and complete explanations which have to be put forward now that all the problems arising are more fully realised.

Mrs. Ayrton then passes on to the behaviour of the arc immediately after striking, and to the necessity of working with "normal" arcs, that is, arcs in which the P.D. has assumed its steady value for the given current and length of arc. The laws that govern the P.D., current and other electrical quantities are then considered in detail, as a result of which Mrs. Ayrton's now familiar equation connecting the P.D. with the current and length of arc is derived. The equation, which is of the form $V = a + bl + \frac{c + dl}{A}$, where a, b, c and d are constants depending on the carbons and V, l and A the P.D., length of arc and current respectively, is shown to fit in with the results of the experiments of previous investigators, even though the equations which they had themselves advanced were different or less complete. This equation, which applies only to solid carbons, is very accurate over the range studied by Mrs. Ayrton. The effect of cores in cored carbons is considered, and it is shown, by an examination of the P.D. between the carbons and the arc, how the various terms of the equation can be correlated with the physical phenomena in the arc.

Especial interest attaches to the above equation on account of its connection with the theory advanced in the final chapter. But apart from this, the whole of this portion of the work is of the highest intrinsic value. We cannot, with the space at our disposal, consider it in any detail, but we might particularly draw attention to chapter viii., which deals with the stability of the arc, and to chapter x., on hissing arcs. The chapters dealing with the efficiency of the arc, considered first as a consumer of power and secondly as a source of light, should appeal strongly to those who are interested in arcs from the practical standpoint, especially as they show how much the commercial standard falls below that actually obtainable. The arc enjoys at present the distinction of being the cheapest form of artificial light, so that the only competition to be met is that between different forms of lamps; but this is quite sufficient to lead to the advisability of an attempt at improvement by the scientific study of the best conditions of working.

In chapter xii., Mrs. Ayrton puts forward her theory of the arc. It is hardly fair to consider this theory apart from the rest of the book, as it arises naturally out of the views advanced therein. For a long time experimenters have been divided into two camps, those who believed in the existence of a back E.M.F. in the arc and those who did not. According to Mrs. Ayrton's view, it is not necessary to assume the existence of a back E.M.F. to account for the high fall of potential between the positive carbon and the arc, as it can be explained in another way. The conducting part of the arc consists, on this view, of a very thin film of true carbon vapour at the crater and of carbon mist throughout the rest of the arc. The very high specific resistance of the carbon vapour accounts, not only for the fall of P.D., but also for the volatilisation and cratering of the positive carbon. It is shown from actual measurements of the cross-sections of the mist and vapour that their variation with current and length of arc lead to a law of variation of P.D. precisely similar to that given in the above equation. If we may venture criticism, we should like to point out that the explanation suffers from being only qualitative, and though the form of the equation is the same there is nothing to show that the constants are of the same magnitude. It remains to be shown by experiment whether this is the case or not.

The method of measuring the "true" resistance of the arc by a superimposed alternating current fails, as Mrs. Ayrton shows, unless it can be proved that the added current in no way affects either the resistance or the back E.M.F. (if existent). It is well known that this method leads in some cases to negative results, and Mrs. Ayrton points out that it may lead to any value from a large negative one to that of the "true" resistance, according to the frequency of the added current, which must be as high as "many thousands of alternations per second for the resistance of the arc not to be altered by it." In a recent paper by Mr. Duddell, read before the Royal Society, the results of experiments with a frequency as high as 120,000 alternations per second were given, and the author claimed that they showed a true resistance of about four ohms and a back E.M.F. of twelve volts. Unfortunately, this paper was not published at the time of the completion of Mrs. Ayrton's book, but it would be interesting to learn whether she can harmonise it with her theory. Incidentally, it may be noted that Mrs. Ayrton's explanation accounts for the effects produced by cores and for the shapes to which the carbons burn, and there can be little doubt that, whether or not it proves sufficient to rank as a complete theory, it is a great advance towards the clear appreciation and the solution of the problems presented.

In conclusion, we may commend the excellent drawings of arcs and carbons with which, in addition to curves and diagrams, the book is copiously illustrated. Altogether the book deserves to rank as one of the most important contributions to electrical literature that has appeared of late years. M. S.

OUR BOOK SHELF.

Palaeontologie und Descendenzlehre. By E. Koken. Pp. 33; illustrated. (Jena: G. Fischer, 1902.)

IN this essay, read before the Congress of Science and Art held at Hamburg in September last, the author briefly explains in a popular manner some of the more important evidence in favour of evolution afforded by palæontological researches and discoveries. After alluding to the old belief in the separate creation and immutability of species, Dr. Koken mentions Lamarck's theory, and then passes on to the revolution in scientific thought and belief brought about by Darwin's work. With a brief reference to Waagen's investigations and theories in regard to the mutations of ammonites, and the expression of the belief that what holds good in this case will also apply to other groups, he proceeds to cite some of the most striking instances of the descent of one group from another. In regard to mammals, it is considered that the earliest forms were nearly allied to the Insectivora, and that from these were developed the Creodont Carnivora, from which subsequently branched off the placentals on the one hand and the marsupials on the other. Allusion is next made to the importance of Archæopteryx, as in some respects a connecting link between birds and reptiles. Attention is then called to the important evidence which has been obtained during the last few years as to the relationship between the anomodont reptiles and mammals on the one hand, and between the former and the labyrinthodont amphibians on the other. A wide cleft still, however, separates amphibians from fishes—a cleft which, in the author's opinion, is in no wise spanned by the lung-fishes, the amphibian resemblances of which he believes to be largely adaptive.

Having cited the foregoing and other instances of genetic relationship between various classes, Dr. Koken next proceeds to consider numerous cases of intergradation between minor groups. In the Mammalia he first of all refers to the now well-known fact that in the early Eocene it is almost impossible to distinguish between unguiculates and ungulates, and then proceeds to discuss several of the phylogenetic lines into which the latter have developed. Special mention is made of the clawed chalicotheroids of the Miocene and Pliocene, as a remarkable side-branch of ungulate development; and Kowalevsky's doctrine of the "adaptive" and "inadaptive" modifications of the artiodactyle carpus is fully explained. A very remarkable instance of the evolution of one type from another, which has not received so much attention as it deserves, is exemplified among the dinosaurian reptiles by the Liassic *Scelidosaurus* and the Upper Jurassic *Stegosaurus*, skeletons of which are figured in juxtaposition.

This excellent little sketch concludes with some remarks upon former land connections and general observations on the evolution of the surface of the globe and its inhabitants. R. L.

The Laboratory Companion to Fats and Oils Industries By Dr. J. Lewkowitsch, M.A., F.I.C. Pp. xi + 147. (London: Macmillan and Co., Ltd., 1901.) Price 6*s.* net.

THE book is essentially a collection of tables of the numerical values obtained in the analysis of oils and fats, and of tables useful in industries where oils and fats are employed; it forms a companion to the author's earlier publication on the "Chemical Analysis of Oils, Fats and Waxes." The amount of information in the book is very extensive, as may be judged from the fact that the number of oils only, for which constants are given is 111, and the number of fats 65.

The author states in his preface that "numerical values, so-called constants, and variables, have been carefully scrutinised, and only the most reliable ones have been given. In some cases the most probable values had to be decided on." As the consequence of this, we find in the majority of cases single numbers given for the iodine value, saponification value, &c., of oils and fats. This precludes reference to the results of the various observers. The arrangement of materials under the heading of separate manufactures is a very useful feature. Thus, under the heading "soap manufacture," are eight tables, including such information as the percentages of caustic soda and caustic potash in caustic lyes, the influence of temperature on the specific gravities of caustic soda solutions, and the amounts of caustic alkali solutions required to saponify fats of certain mean molecular weights.

LETTERS TO THE EDITOR.

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Colour-variation in the Guinea-fowl.

As this bird is such a recent addition to the poultry-yard (for, although known to the Romans, it went out of domestication in the Middle Ages) and has not been selectively bred by fanciers, its spontaneous variations are particularly interesting. Here, in India, where guinea-fowls are much bred, several well-defined types of coloration constantly present themselves in these birds, kept solely for the table.

There is first the normal dark-grey form, speckled with white and with white bars on the primary quills. This is the commonest; but it varies from the wild type in having more white on the naked head and neck, and generally in having the toes and shanks more or less orange instead of black.

Secondly, there is a form, marked exactly as the above, but on a lavender or French-grey background; it resembles, however, the dark normal bird in the coloration of the head and legs.

A third form is of a purplish-slate without spots, but retaining the white bars on the primary quills; the head and legs also are coloured as in the common normal form.

There are also, of course, albino birds, which have entirely orange-yellow legs and feet, and no dark purplish hue about the bare head, but only white and red.

The pied birds which occur are particularly interesting, the marking being very constant—white underparts and white primary quills. The white may invade more of the wing, and may be reduced in amount on the breast and wings until the coloured form is reached, but I have never seen a splashed or blotched bird, such as one often finds among pigeons or ducks.

All the colours, spotted-grey, spotted-lavender and slate, may be pied like this, but the normal spotted-grey oftenest, as one would naturally expect from its greater frequency. The bare dewlap of these pied birds is white when the white feathering comes as far, not blue or purple as in coloured birds.

The only unspotted-lavender bird I have seen as yet was a white-pied one.

I have not had the same opportunities of studying guinea-fowls in England as I have out here, but certainly, to the best of my recollection, all the colour-types I have described occur there, which, considering the difference of climate, shows that this factor does not determine variation in this bird.

As I have remarked above, the pied birds grade into the coloured ones; but typical specimens are more common than intermediate ones, and there is no gradation whatever between the two spotted forms, the dark-grey and lavender. The unspotted slate form does often display a few white-marked body-feathers, but by no means tends to intergrade with the normal type.

If this bird, with its uniform body-colour and barred primaries, occurred in a wild state, the markings of the quills, concealed as these are in repose, would be set down to sexual selection or claimed as "recognition marks"; and a similar cause would be

invoked to account for the white underparts and white quills of the pied forms, which would be well concealed if the bird lay flat on the ground.

Yet in this case of a bird which has been protected by man for a few centuries only, we see these beautifully arranged markings appearing suddenly and almost in full perfection, by simple variation happening to take, in this species, these definite forms.

Last winter I procured in the Bazaar here a pintail snipe (*Gallinago stenura*), marked much like a pied guinea-fowl, with white outer primaries, some white down the breast, and orange toes. This is the kind of resemblance which is put down to mimicry when occurring between two wild *species* of similar size inhabiting the same country.

And thus the view of Darwin, that mimicry has always commenced between forms with a considerable resemblance to start with, receives confirmation; as also from the fact that, in birds at any rate, so many cases of "false mimicry" between species inhabiting distant countries can be shown to occur.

At any rate, whether we are dealing with recognition-marks, sexual selection or mimicry, it seems to me that the study of variation constantly tends to show that natural selection has always at hand far greater material in the shape of colour-variation than is commonly supposed. F. FINN.

Indian Museum, Calcutta, May 1.

A Cubic and Submerged Cubes.

THE following is a curious puzzle. Given a square box having an area of 27 square inches on its floor and having vertical sides, and filled with water to a depth of 2 inches, it is required to find the size of a heavy cube which, when resting on the bottom of the box, will have its upper surface high and dry above the surface of the water. The curious thing is that there is no such cube. A very small cube will have its top nearly 2 inches below the surface; the largest cube that can go into the box, its edge being 5 inches and a fraction, forces all the water above it except a film and, again, has its top nearly 2 inches below the surface. There is one cube, that with its edge 3 inches, which has its top just on a level with the surface of the water; its top may be dry, but is not both high and dry. All other cubes are more or less submerged. This is a numerical example of a unique case.

For an example of the general case, let the area of the floor of the box be 28 square inches and let it contain 48 cubic inches of water. Now it will be found that there are two cubes which, when placed on the bottom, have their tops on a level with the surface of the water. They are the cubes with edges 2 inches and 4 inches respectively. All cubes between those two have their tops high and dry above the surface, while all other cubes are more or less submerged.

It may be interesting to know that these cubes give a physical interpretation to the roots of the cubic obtained by equating the trinomial x^3-ax+v to zero. The equation has two positive roots, m and n, and a negative root, $(m+n)$. If a be the area of the bottom of the box and v the volume of the water, then x is the edge of the cube which has its top flush with the surface of the water. There are, therefore, in general two such cubes, m^3 and n^3, the negative root being inadmissible. Since $a=m^2+mn+n^2$ and $v=mn(m+n)$, by giving values as $m=4$ and $n=2$ we obtain $a=28$ and $v=48$, as in the second numerical example above. Again, if we suppose the two positive roots equal, as $m=n=3$, we have $a=27$ and $v=54$, as in the first example.

If a value be assigned to x lying between m and n, it is readily shown that the trinomial is no longer zero, but is negative, which is the condition that the top of the cube shall stand above the surface, while for values of x on either side of m and n the trinomial becomes positive, so that these cubes are submerged. THOS. ALEXANDER.

Trinity College, Dublin, May 22.

The Electrical Resistance of the Blood.

IN a letter published in NATURE of July 13, 1899, the author communicated some of the results he had obtained in measuring the electrical resistance of the blood. These results showed that the average resistance of normal blood at 60° F. measured by Kohlrausch's method in the apparatus used amounted to 550 ohms, while the specific resistance was 93·5 ohms. Further, a marked change was observed in pernicious anæmia, the resistance in this disease falling to about one-half (300 ohms) that of normal blood. The author has shown (*Proceedings* of the Royal Society of Edinburgh, December 21, 1891) that the electrical resistance of the urine in this disease is greatly increased (about 100 ohms specific resistance instead of the normal 45 ohms); hence we have the striking fact that, while the urine contains too few salts, the blood contains an abnormal amount. The kidneys, then, must obviously be in fault. In a patient, aged fifty-one, suffering from pernicious anæmia, under the care of Dr. A. James, in the Edinburgh Royal Infirmary, the blood resistance, measured on February 25, 1902, amounted to 300 instead of to the normal 550 ohms. The resistance of the urine, measured at the same time, amounted to 88 ohms instead of to the normal 45 ohms. The blood corpuscles numbered 900,000. The blood resistance in diabetes mellitus is high, like that of the urine. A number of experiments have been made by me to ascertain the time occupied by ingested sodium chloride to reach the blood. The blood resistance in five cases was measured before taking 30 grains of the salt and at five-minute intervals afterwards. The average time taken for the first lowering of the resistance of the blood was 15·4 minutes, and the maximum effect was produced in 21·4 minutes.

Further observations on these lines promise interesting results. DAWSON TURNER.

Chickens Hatched in a Tree.

YOU may, perhaps, think the following account of an incident which happened here last week in our poultry-run worth printing.

About May 1, one of our hens, which was known to be laying, totally disappeared. For some ten days she baffled all our efforts to discover any traces of her. At last she was found sitting on the eggs she had laid in a squirrel's nest, in a Scotch fir-tree, at a height of 16 feet from the ground.

For the remaining eleven days of her incubation the hen was watched descending, and ascending from bough to bough to her high perch, at first every day once, but latterly once every other day, as far as could be observed.

On Thursday, May 22, the hen was found with six live chickens and two dead ones at the foot of the tree. Unluckily no one witnessed the actual descent. She could not, however, be persuaded to enter an ordinary hen-coop.

With some trouble, the hen and her six chickens were got eventually on to some straw in an old railway-carriage, which I had erected some years ago on the edge of the hen-run, which is sheltered from the north wind by a fir-plantation, where many squirrels build their nests.

In order to convey her chickens from the railway-carriage to the ground, the hen was seen to spread out her tail and descend with all six young chickens at once on her back. Doubtless she had conveyed them down the 16 feet from the fir-tree in the same fashion, but probably only one or two at a time.

Six-Mile-Bottom, Cambs., May 25. W. H. HALL.

A Curious Optical Effect.

A FORTNIGHT ago, while standing with my back to the sun, which for a few minutes happened to be shining brightly, and with my face within a few inches of some darkly painted boards, which were covered with minute sparkling particles, presumably from an adjacent coke-grinding machine, I noticed that on approaching my face a little closer, the particles became iridescent and apparently magnified to a size of about one-eighth of an inch. On closing one eye and looking closer, concentric circles appeared, with a cross × over them, and in some cases there was a smaller circle just touching the inner margin of the larger one; in others the small circle seemed to be nearer the centre of the larger one. On a subsequent examination, when the sun was not so bright, the concentric circles seemed to be wavy and indistinct, as was also the case with the cross. The whole thing reminded me of illustrations I have seen of effects produced by tourmalines under certain conditions.

If this is a commonly observed phenomenon, I should feel obliged for any references to literature on the subject.

E. MOOR.

49 Arbitration Street, Doncaster, Yorks., May 26.

THE PROPOSED EXPERIMENTAL TANK FOR TESTING SHIP MODELS FOR RESISTANCE.

THE recent opening of the National Physical Laboratory, as described in NATURE on March 27, marked an epoch in the advance of science into the commercial development of this country. Equipped as the Laboratory will be with the best appliances for testing materials and instruments of precision, for fixing standards of measurement and comparison, it will supply that which, in other countries, has already been recognised as a vital necessity to national commercial prosperity.

There is, however, a branch of scientific investigation not contemplated in the original scheme for the Physical Laboratory and which it is now proposed to include in it, namely, an experimental tank for testing, by means of models, the resistance of vessels either already in existence or only in the stage of design.

The system followed in the practical application of theory to the solution of these problems of naval architecture was devised by the late Mr. Wm. Froude. In his first experimental tank, erected at Torquay more than thirty years ago, Mr. Froude carried out the researches which led to his well-known discovery of the laws which govern the resistance offered by water to the propulsion of ships.

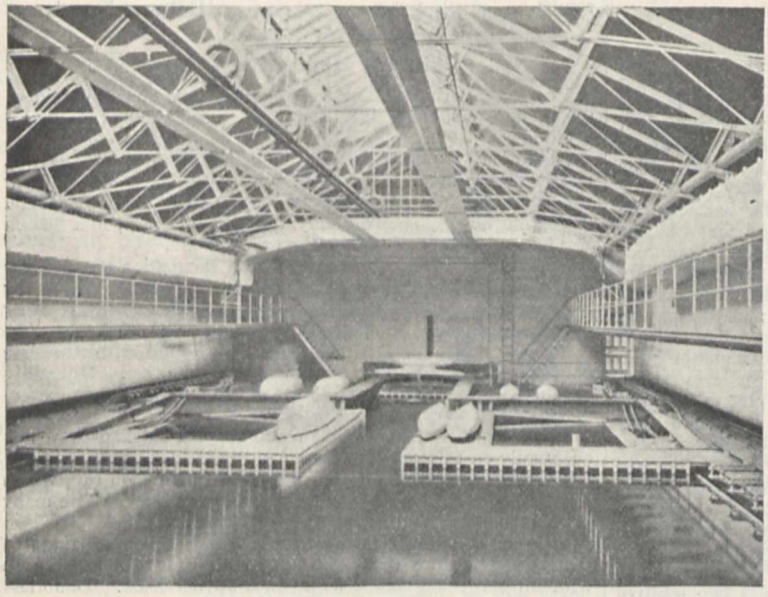

FIG. 1.—View of Washington Tank, north end, showing Wave Breaker.

Although the method pursued has often been described in NATURE and elsewhere, a brief outline of it, by way of reminder to our readers, may not be out of place.

A model of the vessel the resistance of which is to be tested is made either of wood or, preferably, of paraffin. If the latter material is used, the block is cast roughly to the shape of the proposed hull and then placed in a cutting machine, where it is planed down to the exact shape required, by a cutting tool, the movements of which are controlled by the operator. The latter guides the instrument by following with a pointer the lines of the hull on a drawing, the connection between the pointer and the cutting tool being so exact that the contour lines of the design are faithfully reproduced on the hull of the model. The final touches are done by hand, and the trim of the model, when placed in the water, serves as a check on the accuracy of the workmanship.

The model, when ready for testing, is placed in the tank and attached to a travelling framework or "carriage" which spans the width of the tank and is propelled either by a self-contained motor or by a stationary engine and cable. The travelling carriage is fitted with a dynamometer and registering apparatus, which records automatically the pull or resistance of the model and the speed at every point of the course traversed. Thus, at the conclusion of a series of trial runs at different speeds, accurate diagrams are obtained, from which the curves of resistance can be plotted for the various speeds considered, and, by interpolation, for any intermediate speed. In a similar way, the effect of alteration of trim and displacement can be easily determined, and the most interesting and useful experiments on the effect of alterations to existing vessels, on the efficiency of various forms of screw propellers, on the relative oscillations of different types of hull, and many other problems that are met with in naval architecture can be carried out with results that approximate closely enough for all practical requirements to those actually obtained on full-sized ships. The economy in using models instead of full-sized vessels for obtaining such experimental data is sufficiently obvious, and need not be insisted upon.

It is to Mr. Froude also that we are indebted for establishing the exact relations that subsist between the model and the full-sized vessel, upon which depends the success of the experimental method. This relation or law of "corresponding speeds" is to the effect that, comparing ship and model, "the resistance is in proportion to the cube of the linear dimension at speeds proportional to the square root of the linear dimension."

The practical value of Mr. Froude's labours was recognised by the Government at an early period, and his tank at Torquay was established under Admiralty supervision in 1870. Fifteen years later, the Government decided to build and equip a much larger tank at Haslar, near Portsmouth, where models 14 feet long could be run over a course of 400 feet. This tank is under the direction of Mr. R. E. Froude, whose valuable researches by means of model experiments have greatly added to our knowledge of the laws relating to fluid resistance, oscillation of ships, propeller efficiency, and other problems of naval architecture.

The tank at Haslar, erected at Government expense, has been devoted purely to Admiralty work, and it is not found possible to extend its use to the testing of models for private shipbuilders.

The only other tank of this kind in the kingdom is that constructed by Messrs. Denny at Dumbarton, and this is only employed upon the work of that firm.

Recognising the need for a tank where private shipbuilders could at any time send a model to be tested, the Institution of Naval Architects, at their summer meeting in Glasgow last year, passed a resolution to the effect that such a tank ought to be established, and the council of that Institution has since been considering how this proposal could best be carried out.

The two chief difficulties were the selection of a site suitable for the purpose and the raising of the necessary funds to carry the scheme out. As regards the latter requirement, it was felt that those interested in the welfare of the shipowning and shipbuilding interests of

the country would not be slow to guarantee the necessary funds, provided a site could be found easily accessible, and where a tank could be placed under independent, competent and impartial control.

In the grounds of the National Physical Laboratory at Bushy House, a site has been selected which it is proposed to devote to the purpose. This situation, besides being very convenient as regards the nature of the ground (to quote from Lord Glasgow's recent presidential address), offers "many important advantages; a position conveniently near the metropolis, the proximity of an established power installation and a highly trained technical staff, and, above all, a board of management of the highest standing, entirely unconnected with any individual commercial enterprise, whose control would in itself guarantee the treatment in strictest confidence and impartiality of all questions submitted to them."

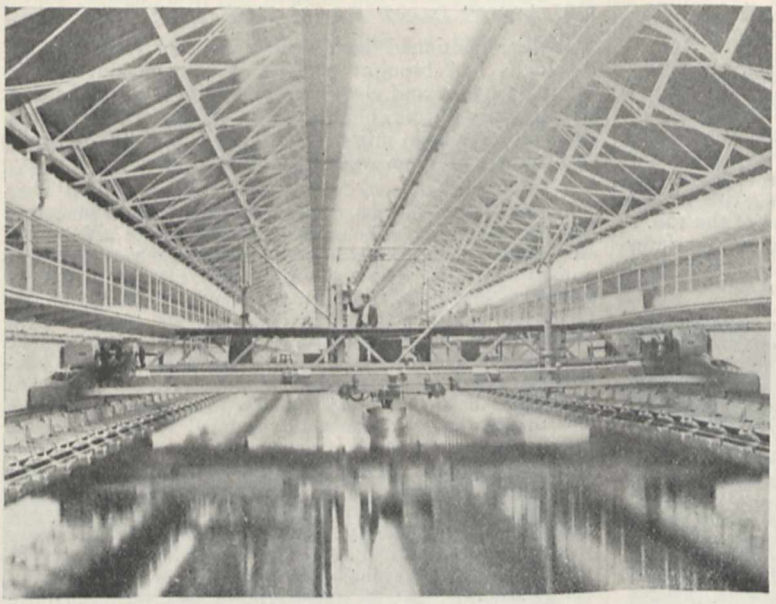

FIG. 2.—View of Carriage and Model at rest.

It is hoped, therefore, that shipbuilders and shipowners and others will come forward liberally to form the necessary guarantee fund for the construction and equipment of the tank, which together are estimated to cost about 15,000*l*. The scheme, which has received the hearty support of His Royal Highness the Prince of Wales, is now ripe for carrying into execution, and it is felt that no more time should be lost in adding this necessary auxiliary to the equipment of British shipyards. The Prince of Wales, in opening the Laboratory on March 19, expressed his confidence—a confidence which we feel sure will be justified by results—that "through the generosity of the public, the necessary means will be forthcoming to meet these difficulties and to secure that which is almost an essential to the shipbuilding industry of a country possessing the largest mercantile marine in the world."

Other countries have not been slow to realise the value of model experiments; Italy has her experimental tank at Spezia; Russia one at St. Petersburg; Germany, besides having a private tank at Bremerhaven belonging to the Norddeutscher Lloyd, is about to erect one in Berlin; and the United States of America, not to be outdone by the old countries, has built the largest tank of all at Washington, where 20-feet models are tested over a 470-feet length of run.

All these tanks, excepting that at Bremerhaven, are worked by Admiralty staffs of their respective Governments, but the private shipbuilder has not been forgotten, and in each case he may, subject to certain regulations and to the payment of fees sufficient to cover the cost of the experiments, make free use of the tank for carrying out researches of his own. But, however convenient it may be to have a tank erected at the expense of a paternal Government, it can hardly be doubted that the arrangement has its drawbacks; private individuals would, at times of pressure, have to give way to Government needs, and at all times the results of the experiments are of necessity obtained as much for the benefit of the Admiralty as for that of the private individual. Both these drawbacks are obviated by placing the management of the tank in private, but disinterested, hands.

Some views of the Washington tank are reproduced here from a paper by Mr. D. W. Taylor (naval constructor, U.S.N.), read before the American Society of Naval Architects and Marine Engineers, and they give a good idea of its chief features of interest. The "carriage,"

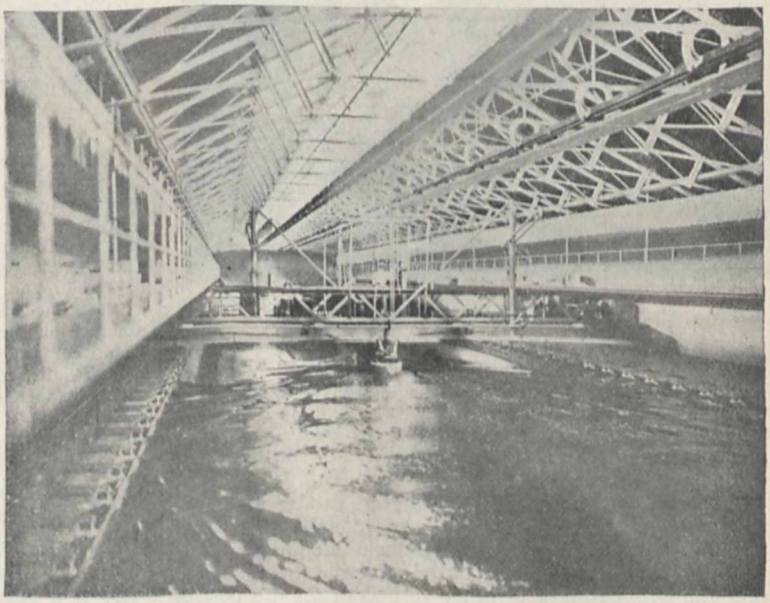

FIG. 3.—Carriage towing a Model (stern view).

which draws the model through the water and contains the recording apparatus, spans the entire width of the tank (46 feet 6 inches) and weighs nearly thirty-two tons. It is propelled by four electric motors, shown in Fig. 2 at

the extreme ends of the framework. As the speed attainable is upwards of 20 knots—developed in a 200-feet run—powerful emergency brakes actuated by hydraulic pressure are provided, in addition to the ordinary friction brakes, and the whole carriage is under perfect control for stopping and starting, and maintaining constant speed during a run.

The extreme length of water surface in the Washington tank is 470 feet, of which about 370 is of the full section across, the remainder being the narrow extremities available for starting and stopping. In order to reduce the time lost between runs through waiting to obtain still water, side troughs 12 inches square in section are laid throughout the length of the tank to absorb the wave disturbance caused by a model run, while at the north end of the tank (Fig. 1) a series of wooden strips placed vertically act as a wave breaker at the close of the run.

Great care is taken to ensure the purity of the water by treating it with alum and filtering through sand

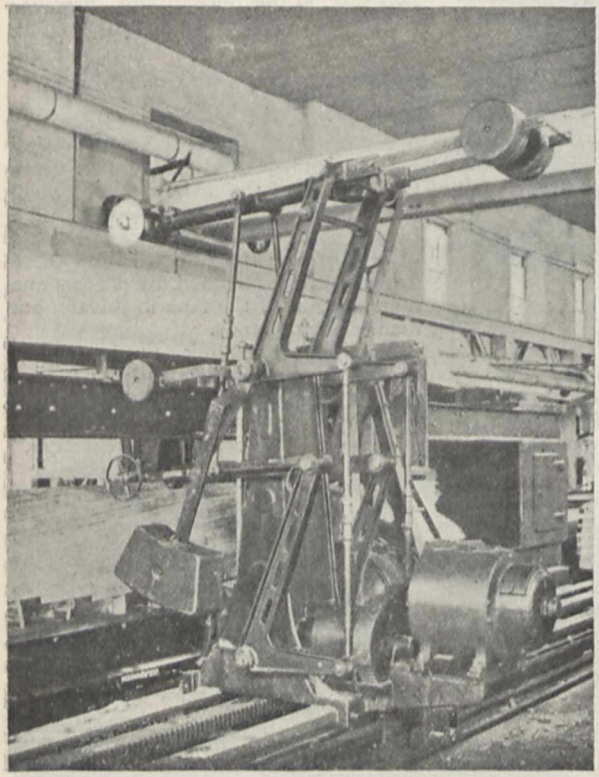

FIG. 4.—Model Shaping Machine.

before admission to the tank. The capacity of the latter is about one million gallons, and the tank can be pumped dry when required in about four hours by a 12-inch centrifugal pump. The temperature in the building is kept as far as possible uniform and slightly above that of an ordinary living room.

A special feature at the Washington establishment is the employment of wood for the models instead of paraffin. This is on account of the heat in summer being too great to allow of the latter material being used, preferable though it is in other respects; for the cost of wood is higher, the difficulties of shaping it to the specified lines are greater, more time is required, and it is, of course, impossible to reduce it to bulk after use, as in the case of paraffin. On the other hand, a wooden model is less liable to accidental damage and retains its shape better if required for future use.

Fig. 3 shows a model being towed through the water, the wave formation being clearly visible; Fig. 4 gives a view of the shaping machine at work on a model.

R. W. D.

VOLCANIC DUST FROM THE WEST INDIES.

IT was mentioned last week that the West Indian mails had brought packets of volcanic dust which fell at Barbados and elsewhere to several institutions and investigators in this country. The characteristics of this material have been minutely examined, and the following descriptions of them will be found of interest.

I.

At the meeting of the Geological Society on Wednesday, May 28, Dr. Flett communicated a preliminary note on the ash which fell at Barbados. The specimens had been forwarded by Dr. Morris, of the Imperial Department of Agriculture, to Prof. Judd, who placed them in the hands of Dr. Flett for examination. The ash consists principally of plagioclase felspar allied to labradorite, hypersthene, monoclinic augite and magnetite. The crystals are often perfectly idiomorphic, and it may be safely inferred that they were formed in the magma before the actual eruption took place, and blown into the air along with the molten material by the force of the escaping gases. A small amount of glass containing steam holes is adherent to some of the crystals, but many are perfectly clean.

The crystals are similar in every respect to the phenocrysts of hypersthene-augite-andesite, a type of rock well known among the recent volcanoes of the Pacific region. In the discussion which followed the reading of Dr. Flett's paper, it was pointed out by Mr. Prior that the same type of rock occurs in other West Indian islands, and also in the Mexican volcanoes, so that the petrographical evidence serves to connect the West Indian volcanic region with the Pacific rather than with the Atlantic. An analysis of the ash by Dr. Pollard was communicated by Dr. Flett. It is quoted below.

SiO_2	52·81	MgO	5·19
TiO_2	·95	K_2O	·60
Al_2O_3	18·79	Na_2O	3·23
Fe_2O_3	3·28	P_2O_5	·15
FeO	4·58	SO_3	·33
MnO	·28	Cl	·14
(CoNi)O	·07	H_2O 105°	·20
CaO	9·58	H_2O above 105°	·17
		Total	100·35

It must be remembered that this analysis does not represent the composition of the material as it existed in the subterranean reservoir immediately before the eruption, but rather the bulk analysis of the crystals which had separated out, together with only a small admixture of the glass.

If this glass could be separated and analysed it would probably be found to differ from the bulk analysis of the crystals in the same way as the glassy base of hypersthene-andesites differs from the bulk analysis of the phenocrysts; that is, it would contain more silica, less lime, iron and magnesia, and more alkalis, especially potash. In Old Red Sandstone times the volcanoes of the Cheviot district erupted hypersthene-andesites, and the glassy base of one of these rocks was analysed by Dr. Petersen with the following result:—

SiO_2	66·25	MgO	·28
Al_2O_3	13·59	K_2O	4·95
Fe_2O_3	3·11	Na_2O	2·25
CaO	2·75	H_2O	5·89
		Total	99·07

The samples of ash from Barbados hitherto examined consist mainly of the crystals. The glassy matter which represents the mother liquor appears to have been vanned away and deposited elsewhere. This, if it should turn out to be the case, is somewhat unfortunate, for the glass, with its higher percentage of potash, would have been more useful as a fertilising agent.

J. J. H. TEALL.

II.

The photographs here reproduced are those of the volcanic dust which fell in Barbados on Wednesday, May 7. The circumstances attending the fall have been so graphically described in a letter, dated May 10, from Mr. G. C. Edghill, the manager of the sugar plantation on which the dust fell, to its owner, Captain Forte, that it seems best to quote parts of the letter *verbatim*. It is to the kindness of Captain Forte (a friend of my father's) that I owe both the letter and the specimen of the dust.

Mr. Edghill writes as follows :—

"Wednesday morning, May 7, opened normally, the day being fine and a steady breeze blowing. Soon after mid-day we began to hear deep subterranean explosions, increasing in intensity, some single, others in volleys of about five or six. Some of these made the earth vibrate like a slight shock of earthquake, and they continued for two or three hours. Then a black cloud began to rise in the direction of St. Vincent, which rose and spread towards and around us, *although the wind was blowing from us towards it.* (The italics are mine.)

"About four o'clock the edge of this cloud began to obscure the edge of the sun, and dust began to fall, at first lightly, but increasing gradually in volume, and making a noise like a fine drizzle. Rapidly then the light grew dim, and the appearances were like those of a total eclipse of the sun, but very grand and startling—making one feel creepy. At five o'clock it was quite dark, and our mill hands had to be lent a lantern to see their way home. At six o'clock it was as dark as midnight, and we went to bed as usual, the only disturbance in the night being incessant thunder and lightning in the direction of the mountain. . . . When the daylight came it was alarming to see everything covered by a layer of dust a quarter of an inch thick. I say a quarter of an inch, because I put out a dinner plate on the lawn above the house when the fall began, and the next morning the dust lay a quarter of an inch thick on it. All the green had given place to a light brown, and the canes had almost quite disappeared. . . . I forgot to mention that the dust was cool and smelling strongly of brimstone. It is estimated that upwards of fifteen tons per acre fell on the island. . . ."

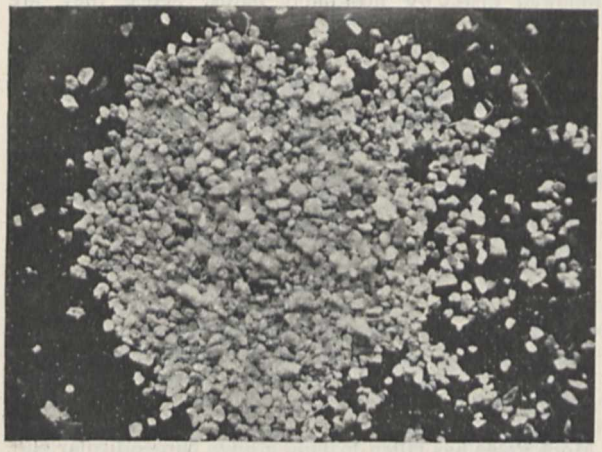

FIG. 1.

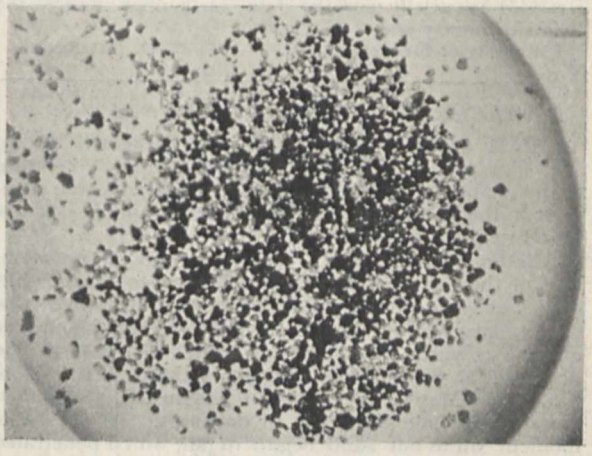

FIG. 2.

To turn to the two photographs, which show the dust magnified exactly seven and a half diameters (or about 56 times in area). Fig. 2 is precisely the same view of the same dust particles as those seen in Fig. 1, except that the light comes through them in Fig. 2 whereas it is shining down upon them in Fig. 1. In other words, Fig. 1 is by reflected light, but Fig. 2 by transmitted light ; Fig. 2 therefore shows clearly which particles of the dust are transparent and which opaque; and it is very instructive carefully to compare Figs. 1 and 2. It will be seen at once what a very large proportion of the particles are transparent—more than two-thirds, in fact. Most of the opaque particles are very strongly magnetic, and are certainly magnetic oxide of iron (they are not titaniferous iron, still less hæmatite). But these are mixed with others, also attracted by the magnet, but far less so, apparently of a dark-coloured mica. The mean size of these dark particles is about 0·008 cubic millimetre. When thrown into water, about half the powder sinks at once, and if the floating particles be examined with a high power, it will be seen that they are all buoyed up by air bubbles ; on violently agitating the dust with the water, the dust sinks, so that it does not seem to contain any of the *lighter* kinds of pumice, which through their extremely porous nature cannot be made to sink so easily.

When the dust is thrown into a solution of density 2·52 (a solution of mercuric iodide in potassium iodide), about one-fifth of its particles float ; these are larger and lighter in colour than the rest, and under the microscope have the appearance of a yellowish-brown semi-transparent glassy material, with bubbles in it, and numerous fine air tubes running through its substance all more or less in one direction ; moreover, it shows evident signs of fusion on its surface, and is no doubt a rather heavy kind of pumice ; along with these particles are some of a clear greenish glass, full of cavities *which do not act on polarised light*—they are transparent obsidian or true volcanic glass. Of the particles which sink in the double iodide solution, those of black, metallic-looking magnetite have already been mentioned, and also the dark-coloured mica ; with these there are remarkably perfect crystals of a felspar, some of which contain cavities of a regular geometrical shape. These crystals have curiously retained in many instances the primitive sharpness of their edges. Probably a sodium felspar is present, as well as the potassium compound, for the ash, after digestion with pure ammonium fluoride, leaves a residue giving a brilliant and long-lasting yellow colour to a Bunsen flame, and with a spectroscope, the lines of potassium and calcium are brilliantly shown as well as the double sodium line. There are also in the ash a considerable number of splintered crystals, of conchoidal fracture, and hard enough to scratch glass, which, like all the crystals present in this ash, act powerfully on polarised light ; they are quartz, and the edges of most of these particles are blunt and the corners visibly rounded. There are also a large number of transparent crystals of a brownish-green colour, very well preserved in form, which a rather hasty examination would indicate as olivine, but of this I do not feel quite sure. The residue after the ammonium fluoride treatment proved to consist chiefly of compounds of iron, calcium and magnesium ; there is a trace of some metal present which forms a sulphide insoluble in hydrochloric acid, but what it is I could not determine, the total quantity of ash at my disposal being only 1·304 grams. Perhaps it is copper—whatever it may be, it is only present in very minute quantity. Magnesium is present in considerable quantity, almost certainly as a silicate. There is more than a trace of manganese, and aluminium is also present, but only in very small amount. Barium and strontium compounds are absent. The dust, when heated carefully in a hard glass tube, gives off a trace of water, which it appears to hold mechanically, and afterwards yields a slight crystalline sublimate, probably of some ammonium compound (? the chloride). No sulphur could be certainly detected, in spite of the strong sulphurous smell which, it seems from the account, the dust had

when it fell, and which points to the ashes having been accompanied by an invisible cloud of sulphur dioxide on their emission from the crater, so that they mechanically occluded some of the gas. The ash gave no effervescence with a powerful acid, the action of the acid being closely watched under the microscope,[1] so that carbonates, such as limestone, and ammonium carbonate seem entirely absent. Finally, the drift of the ash against the wind will have been already noticed. This was due, one would naturally suppose, to the existence of a contrary upper current of air into which the ashes were projected, as they were, indeed, in the great eruption of 1812, when, in spite of the N.E. wind blowing strongly at the time, the ashes fell on the Azores, some hundreds of miles eastward of La Soufrière of St. Vincent.

Eton, Bucks, May 27. T. C. PORTER.

III.

The dust from the Soufrière, which fell in Barbados on May 7 and 8, appears to be composed of fragments of glassy and pumiceous lava, broken crystals of plagioclase felspar, augite and hypersthene, much magnetite, often in perfect octahedra, and a very few crystals of brown hornblende. The felspars range in specific gravity from labradorite to anorthite. Hypersthene is the predominating coloured silicate.

Dust from the eruption of 1812 also collected in Barbados is of much finer grain, but evidently composed of the same minerals with the green augite in smaller proportion.

The magma appears to have been of the nature of hypersthene-andesite, a rock exceedingly common among the recent lavas of American volcanoes. Further, the magma seems to have remained practically unchanged in composition during the Soufrière's ninety years of dormancy.

University of Edinburgh. J. D. FALCONER.

[1] One opaque crystal only seemed to evolve a slow stream of bubbles, as if they came from a cavity in it. Whatever the gas was it dissolved in the liquid very rapidly, the bubbles visibly diminishing almost to nothing in ascending through the very shallow stratum of liquid above the crystal.

RECORDS OF RECENT ERUPTIONS.

FROM accounts which have been published during the past week, some additional details referring to the character and effects of the recent volcanic eruptions in the West Indies have become available and are here brought together.

A letter from Mr. A. D. Whatman, one of the members of the Government relief expedition to Martinique, describes some of the events as related to him by one of the survivors of the steamship *Roraima*, which was about 150 yards from the shore when the catastrophe occurred at St. Pierre. It appears that a little before 8 a.m. on May 8 an explosion was heard, and immediately the whole place was in darkness. At the same moment white-hot sand began to fall, which penetrated everywhere like snow, and immediately killed everyone on deck. After about an hour and a half the fall of white-hot ash stopped.

Referring to the condition of St. Pierre when he visited it, Mr. Whatman says :—

There was no lava thrown out; nothing but this fine sand, which was evidently white hot. Judging from what the few saved said and from what I myself saw and could judge from the position of the bodies, I have little doubt that everyone who was not under cover at the time the sand began to fall was killed in less than two minutes. The rest must have survived for a very short time longer, as they must have been quickly suffocated by the heat from the falling sand, not to mention the fact that the whole town must have caught fire at the same moment. A tremendous blast of air must have crossed from north to south, as all trees have been uprooted, and their remains are all pointing with roots towards the volcano. The lighthouse also fell in the same direction.

A message from the Acting Governor of Martinique states that from the further exploration of St. Pierre it would seem as if the southern portion of the town was destroyed by an as yet unexplained phenomenon, which acted with lightning-like rapidity, and has left traces as of a violent storm sweeping from north to south. The rain of ash which preceded, accompanied and followed this phenomenon covered the surface of the land to a depth of between twenty-five and thirty centimetres. The northern part of St. Pierre is buried beneath a mass of mud.

From the *Observer* we learn that the Deputy-Mayor of St. Martinique, who left St. Pierre just fifty minutes before the catastrophe took place, and was a witness of all the circumstances which led up to it, has given a new account of the condition of the volcano before the eruption. He says that shortly before St. Pierre was overwhelmed, immense fissures, caused by the earthquake, appeared in the side of Mont Pelée, reaching down to the edge of the sea. Into these the sea water rushed, and it was the contact between the water and the burning lava from the volcano which caused Mont Pelée practically to blow up like an overheated boiler.

The *Standard* records some observations made by Prof. R. T. Hill, a member of the United States Geological Survey, who went with Prof. Heilprin to Martinique to observe the volcanic phenomena and effects. Prof. Hill made his observations at a distance of five miles from Mont Pelée. On May 26 he observed what is usually described as lightning playing through the mushroom-shaped cloud overhead, like a sheet covering the country up to ten miles from the crater. These flashes occurred with alarming frequency, and they followed distinctly horizontal paths, hence they are believed to be effects produced by the explosive combustion of gases leaving the Mont Pelée crater.

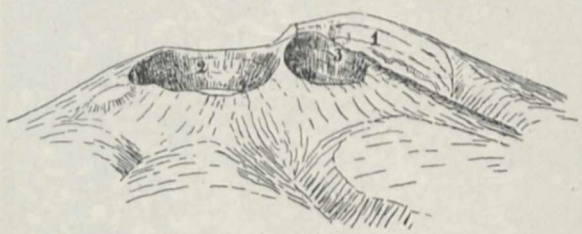

FIG. 1.

Mr. G. Kennan, who reached the new crater near Ajoupabouillon, at the head of the river Falaise, which is boiling hot, reports that a large section of the side of Mont Pelée has fallen, leaving a huge perpendicular cliff, in which there are five immense tunnels or cavities.

Dr. Hans Reusch, director of the Geological Survey of Norway, has sent us the following description of the crater of the Soufrière of St. Vincent as he found it in 1892 :—

During a visit to the West Indies in 1892 I ascended the volcano now so much spoken of on the northern end of St. Vincent. When I was at the top I drew the accompanying bird's eye view from the south (Fig. 1).

It may be of some interest to compare this with the changes which undoubtedly have taken place during the recent eruptions. The crater numbered 1 is the remnant of an old very wide crater—some kind of Monte Somma (of Vesuvius). The height is given on the maps as 4043 feet above the sea. No. 2 is "the big crater," the breadth of which I estimated to be 1 kilometre. The bottom is filled with a lake of bluish-green opaque water, the colour being due to sulphur in fine powder. I calculated the vertical distance from the lake to the lowest point of the brim to be about 150 metres. The dip of the inner sides of the crater was about 60°. The slopes were mostly covered with bushes, but a stratification of the tufa was marked by horizontal lines. The small crater, No. 3, is about half as large as the other one, but comparatively deep. The stratification of its sides is inclined at about 20° in a northerly direction. It is a "steam hole" blown out somewhat to the side of the chief place of eruption. On the bottom lies a little pond of clear water, the rest of the bottom being covered with loose material washed down from the sides of the crater. The only sign of volcanic activity was a little smoke now and then

issuing from a small cleft near the pond; a sulphurous odour was also perceptible. The great eruption in 1812 was exclusively, or at least in greater part, an ash-eruption, as no lava stream was seen on the exterior of the mountain. A few insignificant beds of andesitic lava still occur interstratified in the tufa.

Someone told me that the island was rising slowly out of the sea on its western and sinking on its opposite side; this, however, was denied by others. If any change of importance has taken place on the western side during the last convulsion of Nature, it should not be difficult to ascertain the fact and determine the amount of change of level. I went in a boat along the coast from Château Belair to Kingstown and observed that where the coast consisted of tufa (not where it was formed of solid lava or coarse volcanic agglomerate) it displayed a kind of strandline or beach-shelf. It was a horizontal or slowly dipping platform about a yard broad. Fig. 2 shows the shelf along a promontory seen from some height, Fig. 3 represents a small island surrounded with its beach-shelf, while Fig. 4 gives a diagrammatic section of the shelf.

The sea at high water rises about one foot above the shelf and sinks at low water about 2 feet underneath it. At ebb-tide the outer slope is seen to be covered with seaweed (at X in the diagram), as far up as the sea rises the inner wall (at Y) is covered with a crust of calcareous matter consisting of serpulites and the remains of other sea animals. I cannot suppose that this peculiar beach was due solely to the action of the waves. Organic life has probably had something to do with it, the rate of recession of the cliff being comparatively rapid where the animals lived, while on the other hand the seaweed has been to a certain extent

FIG. 2.

FIG. 3.

FIG. 4.

protective. In any case this beach-shelf should be of good service in determining whether any sudden change of level has taken place during the latest eruptions.

Christiania. HANS REUSCH.

A comparison of Dr. Reusch's observations with those which, it is hoped, will shortly be obtained, should be of value in showing the changes which have occurred.

The Paris Academy of Sciences has decided to send a special scientific expedition to the scenes of the eruptions. The expedition will sail on June 9.

In extension of the diary of recent volcanic events already published in these columns, we give a record of occurrences reported during the past week.

May 10, *Tacoma.*—Mount Redoubt, in Cook Inlet country, Washington State, has been pouring forth dense volumes of smoke for a week past, and a few nights ago became luminous. Volcanic ashes have been falling for several days, and the snow near the mountain is covered with ashes. The last eruption of Mount Redoubt was in 1867.

May 28.—A sharp shock of earthquake was felt in the Cape Peninsula at midnight.

May 28, *Fort de France.*—There was a tremendous explosion, followed by a cloud of black smoke, from Mont Pelée at 8.45 this morning.

May 29, *Fort de France.*—The eruptions of Mont Pelée have become more frequent, although less violent.

May 30, *Kingstown* (*St. Vincent*).—There was a fresh eruption of the volcano La Soufrière this morning. It was accompanied by a thunderous noise and trembling of the earth, while volumes of vapour were emitted from the crater. The eruption lasted an hour.

May 30, *Fort de France.*—Cable communication with St. Thomas was again broken. A violent eruption of Mont Pelée took place at 2 p.m. It is reported that the craters on the north side of the mountain are pouring out torrents of mud.

May 31, *Fort de France.*—Detonations were heard from the volcano this morning, and volumes of smoke were emitted. The Rivière Blanche is again a torrent of steaming hot mud.

May 31, *Kingston.*—During the past week Jamaica has been experiencing magnificent sunsets, the colours being extraordinarily rich and beautiful. The phenomenon is due to the volcanic dust in the atmosphere.

May 31, *Athens.*—For some days past earthquake shocks have been repeatedly felt in various parts of Greece.

DR. HENRI FILHOL.

DOCTOR HENRI FILHOL, professor of comparative anatomy at the Museum of Natural History, Paris, died on April 28 at the relatively early age of fifty-nine. A naturalist and palæontologist of the first rank, he will assuredly be lamented by a large circle of friends, not only in his native land, but also in this and other countries, his many and important contributions to our knowledge of both living and extinct animals being of world-wide interest.

Henri Filhol, son of Edouard Filhol, the famous chemist of Toulouse, was born in that town in the year 1843. Having studied for the medical profession, he early obtained his degree of doctor of medicine. His first contribution to science appears to have been in 1863, when he was about twenty years of age, for at that time was published, in conjunction with M. F. Garrigou, his paper on "L'Age de la Pierre dans les Cavernes de la Vallée de Tarascon (Ariége)" (*Comptes rendus*, lvii.). The French commission sent out for the study of the transit of Venus in 1875 included Dr. H. Filhol among its members; and the fact that in 1876 he received the Lalande-Guérineau prize of the Academy of Sciences is evidence of his confrères' appreciation of these early labours for science.

One of Dr. Filhol's most remarkable pieces of work was his "Recherches sur les Phosphorites du Quercy" (*Ann. Sci. Géol.* 1876, t. vii. pp. 220, pls. 10–36, and 1877, t. viii. pp. 1–273 and 297–340, pls. 1–26). In this are described the remarkable deposits of phosphate of lime, of Upper Eocene age, which occur as great pockets in Jurassic beds in the departments of the Lot, of the Tarn and Garonne, and of the Aveyron; then follows, as the subtitle of the work says, an account of the fossils met with in these deposits and especially the Mammalia. Numerous new forms are brought to light, and others critically revised, in this memoir of more than 500 pages and 52 plates.

Another work of similar character is the "Étude des Mammifères Fossiles de Saint-Gérand le Puy (Allier)" (*Ann. Sci. Géol.* 1879, t. x., and 1880, t. xi.), which occupies some 338 pages and 51 plates, and was the result of studying numerous collections of fossils, made during many years, from these Lower Miocene deposits. Here again numerous forms are described, many being regarded as new to science. A third work is entitled "Étude des Mammifères Fossiles de Ronzon" (*Ann. Sci. Géol.* 1881, t. xii. pp. 270, pls. 6–31). The locality is near the village of Puy, and the calcareous marl which has yielded this great assemblage of fossil vertebrata is believed to be of Miocene age. Many mammalian remains from the locality had already been collected and described by M. Aymard (1856); but not only are these critically revised in the light of new material, but again new forms are made known. A fourth piece of work of the same kind is the "Études sur les Mammifères Fossiles de Sansan" (*Ann. Sci. Géol.* 1891, t. xxi. pp. 314, pls. 46). M. E. Lartet had begun the study of the remains from this Miocene deposit, but died suddenly, leaving the work uncompleted. Dr. Filhol, taking up the study of the extensive material preserved in the Paris Museum, and with the help of additional specimens collected by himself under the auspices of the same museum, produced this important memoir.

These four volumes of painstaking work, including more than 1400 pages and 174 plates, would alone have constituted a most important contribution to natural knowledge, reflecting high honour upon the author; but this is only a part of the work which he accomplished. He had a lively interest in deep-sea exploration, and, as a member of the commission, took a prominent part in the dredgings of the *Talisman* expedition in the year 1883. The results of this and of the *Travailleur* work were made known in his "La Vie au fond des Mers" in 1885. Another work published about this time is the "Faune des Crustacés de la Nouvelle-Zélande," and his "Zoologie Descriptive" was issued in the same year. In 1893 he published, in conjunction with M. Grandidier, "Observations relatives aux ossements d'Hippopotames trouvés dans le Marais d'Ambolisatra à Madagascar" (*Ann. Sci. Nat. Zoologie*, 1893, ser. vii. vol. xvi., pp. 151–190, pls. 7–15). In this memoir are described the remains of the remarkable pigmy hippopotamus found by M. Grandidier, from which place also Dr. Forsyth Major obtained the material recently described by him in the *Geological Magazine*.

Besides the examples of Dr. Filhol's labours above alluded to, he made many other contributions to zoology and palæontology. Under his name will be found, in the Royal Society's catalogue, upwards of fifty papers published before the year 1883, and about as many more have been published since that date. This noble record has been appreciated by his fellow workers throughout the world, and has not been without hearty recognition in his own country; for besides the Lalande-Guérineau prize in 1876, already mentioned, he was awarded the gold medal of the Scientific Congress of the Sorbonne in 1879, the chief prize for physical and natural science of the Academy of Sciences; he was the recipient of the Petit-d'Hormoy prize in 1883, and received the decoration of the Legion of Honour in 1886.

Dr. H. Filhol at one time held the chair of zoology of the Faculty of Sciences of Toulouse, his native town; in 1885 he became subdirector, and subsequently director, of the laboratory of anatomical zoology at the Museum of Natural History, Paris; more recently he was appointed to the professorship of comparative anatomy at the same national institution, and continued to hold that post until the time of his death.

NOTES.

THE German Emperor has, with the consent of the British Government, appointed Sir Joseph Dalton Hooker, G.C.S.I., C.B., late Director of the Royal Botanic Gardens at Kew, a foreign Knight of the Order *Pour le Mérite* for Science and Arts. It has been officially decided that the regulations regarding foreign decorations do not apply to this order.

LORD RAYLEIGH has been elected a corresponding member of the section of natural sciences of the Imperial Academy of Sciences of Vienna.

MR. J. B. SCRIVENOR has been appointed geologist on the Geological Survey, and Mr. D. A. MacAlister has been appointed temporarily to investigate metalliferous mines.

WE learn that Lord Salisbury has asked the President of the Board of Trade to receive a deputation from the Institution of Electrical Engineers on the subject of the present unfavourable condition of the law relating to electric lighting and traction (see NATURE, vol. lxvi. p. 35). The deputation is to wait on Mr. Gerald Balfour to-day (Thursday). In view of the backwardness of this country in electrical engineering and of the large degree in which this backwardness is due to restrictive legislation, it is to be hoped that the Government may be induced to introduce more rational laws without delay.

THE Berlin correspondent of the *Times* writes that experiments were carried out last year at the General Telegraph Office in Berlin with a new system of octoplex typographic telegraphy. It is claimed that this system will enable twenty operators to send 18,000 words an hour through a single wire. The despatching instrument is of the typewriter form, and to telegraph any letter it is only necessary to depress a single key. The receiving instrument prints the message on a sheet of paper (not on a tape), and this can be immediately detached and forwarded to its proper destination. An installation to enable communication between Hamburg and Frankfurt by this system is being put up, and will shortly come into use. Further particulars and developments will be awaited with interest. The invention is due to the late Prof. H. A. Rowland, of Baltimore.

IT is reported that Mr. Thomas A. Edison has been experimenting with a view to the invention of a storage battery to enable automobiles to run 100 miles without recharging. As soon as a 5000 miles endurance test, which is about to be started, is completed, he will begin the manufacture of storage batteries for the use of automobiles, launches and street cars. It is understood that Mr. Edison's invention will also greatly diminish the weight of automobiles.

THE fifty-first annual meeting of the American Association for the Advancement of Science will be held at Pittsburgh from June 28 to July 3. At the first general session the retiring president, Dr. C. S. Minot, will introduce the president-elect, Prof. Asaph Hall. The presidents of sections will deliver their addresses on Monday, June 30, and Dr. Minot will give his address, as retiring president, on the following day, at the Carnegie Museum. The programme of the work of the sections has not yet been published.

THE forty-seventh annual exhibition of the Royal Photographic Society will be held from September 29 to November 4. There will be five sections, namely, (1) selected pictorial photographs; (2) general professional work; (3) photographic apparatus and materials; (4) photo-mechanical processes of reproduction; (5) scientific photography and photography in its technical applications. The judges of sections four and five will be Sir William Abney, K.C.B., F.R.S., Mr. Chapman Jones and Mr. E. Sanger Shepherd.

THE *Bulletin* of the Belgian Academy contains an obituary notice by M. C. Le Paige of M. François Deruyts, who died in February last. M. Deruyts was an ardent student of pure geometry. On leaving the University he published a remarkable dissertation on the theory of involution and unicursal homography, and this formed the nucleus for a series of investigations dealing with the geometry of hyperspaces and the determination of the singular elements in an involution of any order. From general theorems, numerous elegant applications to special curves and surfaces were deduced. M. Deruyts also possessed an intimate knowledge of analysis and mechanics.

AN International Shipbuilding Congress in connection with the Düsseldorf Exhibition was opened on Monday by the Crown Prince of Germany. More than 550 delegates are in attendance. Of foreign countries Great Britain is most numerously represented. The Institution of Naval Architects is represented by the Earl of Glasgow (president), Lord Brassey, Messrs. Elgar, Thornycroft, Yarrow, and others. The Crown Prince, in declaring the Congress open, expressed the regret of his father, the Emperor, that his Majesty was unable to be present, and hoped that the deliberations of the Congress would be fruitful in good results.

THE Board of Agriculture has given notice that the Colorado beetle has again made its appearance at Tilbury. Potato growers are, therefore, requested to examine their plants and

to send to the Board without delay for identification specimens of any insects suspected to be the Colorado beetle. The Board will be pleased to supply copies of a leaflet, with a coloured illustration of the beetle, post free and free of charge upon application. Letters or packets containing specimens, and applications for leaflets, should be addressed to the Secretary, Board of Agriculture, 4 Whitehall Place, London, S.W., and need not be stamped.

AN interesting ceremony was performed at Chamounix on May 19, M. Joseph Valat, the founder of the Roches-Rouges Observatory, being in the chair. The bust of Charles Durier, a former president of the French Alpine Club, was presented to M. Simon, the manager, by M. Schrader, the president of the society. A letter was read from M. Janssen, who was prevented by reasons of health from being present. M. Simon was surrounded by a group formed by the Mont Blanc guides, who ascend Mont Blanc every week in order to bring back to Chamounix the automatic readings registered at the Janssen Observatory. Speeches were delivered by MM. Chautemps, the member for Chamounix to the Chambre des Députés, Morel, Fredel, president of the Mont Blanc section of the Alpine Club, Paul Joanne, an intimate friend of Charles Durier, Prideux of the Academy of Sciences, and other influential members of the Alpine Club.

AT the recent general meeting of the Paris Geographical Society, the following prizes awarded for this year were announced :—The chief gold medal of the Society to Captain Joalland, for the Joalland-Meynier expedition to Central Africa, with a silver-gilt reproduction of the medal to Captain Meynier. The Herbet-Fournet prize, a gold medal and 6000 francs, to Governor Emile Gentil, for work on the Tchad (1895–1901). Silver medals are awarded to the principal officers of M. Gentil's expedition. The Ducros-Aubert prize, three gold medals, to M. V. A. Bernard and Dr. Huot, for the Chari-Sangha exploration, and to M. Ch. Perdrizet, for his work in West Africa. The Conrad Malte-Brun prize, gold medal, to Captain Ch.-Lemaire, for the scientific exploration of Katanga. The Henri Duveyrier prize, gold medal, to Captain E. A. Lenfant, for scientific explorations on the Senegal and Niger. The Louis Bourbonnaud prize, gold medal, to M. P. Bons d'Anty, for explorations in South China. The Jean-Baptiste Morot prize, gold medal, to Captain E. Julien, for explorations in the basin of the Oubanghi. The Léon Dewez prize, gold medal, to M. Hugues Krafft, for his journey into Russian Turkestan. The Pierre-Félix Fournier prize, special medal and 1300 francs, to M. H. Béraldi, for his book "Cent Ans aux Pyrénées." Silver gilt medal of the Society to MM. Marcel Dubois and Auguste Terrier, for their book "Un Siècle d'expansion coloniale." The Alphonse de Montherot prize, silver medal, to M. Georges Brousseau, for his explorations on the Congo. The Charles Grad prize, two silver medals, to M. Maurice Superville and Lieut. Bos, for their exploration of the Kotto. The Alexandre Boutroux prize, silver medal, to M. Albert Lesieur, for his explorations on the French Congo. The J. C. Janssen prize, silver medal, to M. Emile Belloc, for his study of the physical geography of the Pyrenees. The William Huber prize, silver medal, to M. de Martonne, for his geographical studies. The Jomard prize to M. Cl. Madrolle, for his book "Histoire de la Compagnie des Indes en Chine." Competitive prizes of the Society, two silver medals, each accompanied with 400 francs, to MM. P. Pasquier and M. A. Breschin.

ON Thursday evening last the members of the Camera Club and their guests were assembled to listen to a discourse by Dr. E. F. Grün on the new fluid lens with which he has recently been obtaining some very excellent photographs of theatrical and other night scenes. The use of a fluid lens is a very old idea, but it soon fell out of use when homogeneous glass could be made properly and the combination of flint and crown successfully mated. The object of using fluid in lenses at this early time was simply to overcome certain optical deficiencies of the single glass lens. Dr. Grün's idea in adopting this form of lens is to increase very considerably the rapidity of its action, and so successful has he been that he can produce very excellent photographs with short exposures with ordinary night illumination, his lenses working at *f.* 1·4 and even *f.* 0·5. The slides made from the photographs he has taken showed several snapshots taken at different theatres without any previous preparation either as regards the actors and actresses, or the stage illumination, and these were quite sufficient to give one an idea of the important future for such a lens. One of the chief points in the lens is the great depth of focus which is shown in the individual pictures, for not only are the performers in front of the stage in focus, but the scenery at the back is quite sharp as well. The very great rapidity of the lens led Dr. Grün to attempt to take kinematograph pictures of stage performances. The results, although not of a very high order, showed, however, that with a little more experiment just as good pictures of night scenes can be secured as are displayed to-day in kinematograph pictures taken in daylight. There is little doubt that Dr. Grün has indicated the great possibilities of his new lens, and many scenes which could not be depicted on account of their apparent lack of sufficiently brilliant illumination may now be caught in the meshes of this photographic net.

WITH reference to the correspondence which has recently been appearing in these columns on the misuse of coal, we see from last week's *Electrical Review* that a company has just been incorporated in America for the commercial fixation of nitrogen. The company is to erect a factory at Niagara, where it already has one commercial unit in operation. This consists of a chamber about 10 feet high, through which cool dry air is passed. The air is subjected to the influence of electric discharge in the form of small-current high tension arcs, whereby oxides of nitrogen are formed. These oxides are led to an absorption tower, where they are brought into contact with a suitable compound of a substance of which the nitrate is desired; caustic soda or potash, for example, are used for the preparation of sodium and potassium nitrate respectively. If led into water, nitric acid can be obtained. It is said that part of the object of Lord Kelvin's recent visit to the States was to see the working of the process, and that he was greatly interested and much impressed by its success.

IN a short note contributed to the *Atti dei Lincei*, xi. 9, Signor G. Celoria urges the desirability of including the teaching of astronomy in the curriculum of every Italian university and of making the subject a compulsory part of the science courses. At present the regulations require astronomical classes to be held at all universities which possess an observatory, but Signor Celoria considers that much useful teaching may be given without the help of instruments, and further, that the present limitation tends to confine the study of astronomy to its purely practical aspect.

IN the University of Colorado *Studies*, Messrs. William Duane and Charles A. Lory describe a simple electric thermostat for keeping the temperature of a bath constant to within a thousandth of a degree Centigrade for a considerable time. The heat is supplied by an electric current, which in the case of a conducting liquid flows through the liquid itself, and in the case of a non-conducting fluid flows through wires suspended in the bath. A system of tubes containing a liquid with a large temperature coefficient of expansion is placed in the bath, and by means of a suitable mechanism the expansion of this liquid

interrupts or reduces the strength of the heating current when the required temperature has been reached. It might be thought that this arrangement would give rise to considerable fluctuations of temperature with the making and breaking of the current, but it is found that the makes and breaks follow each other so rapidly, often two, three or even more times in a second, that the variations cannot be detected with a differential thermometer which ought to be sensitive to within a two-thousandth part of a degree.

IN the *Revue générale des Sciences* of April 30, M. Nordmann proposes a theory of the propagation of electric force from the sun into space which is based on the assumption that Hertzian waves are emitted from the surface of our luminary, and that the emission of these electric waves must be particularly intense at epochs of maximum solar activity. M. Nordmann admits that hitherto attempts to discover Hertzian waves in the solar radiation have led to a negative result; but, in his opinion, this may be explained by the copious absorption of the electric undulations in the higher layers of our atmosphere. On this hypothetical basis the theory attempts an explanation of cometary phenomena, of terrestrial magnetism, and of the luminosity of matter in the nebulæ and in the vicinity of temporary stars. M. Nordmann's paper thus covers the same ground as the previous researches of Prof. Arrhenius. But the distinguished Swedish physicist advocates the theory of corpuscular electric emission, and M. Nordmann endeavours to show that some grave objection may be urged against this point of view, and that, on the whole, the cosmical phenomena here considered are better explained by the undulatory electric theory of Maxwell and Hertz.

MESSRS. ROSENBERG AND CO. have submitted to us for examination a portable Röntgen ray outfit which they have produced. The outfit consists of a 10-inch spark coil of special construction with tube, holder, fluorescope and accessories, the whole fitted in a strong box measuring 2 feet 1 inch × 11 inches × 14 inches. The coil when tested with a 12-volt accumulator sparked well at 10½ inches—the distance between the discharging pillars. The break has large platinum points, and the sparking can be regulated with great nicety. For those who prefer an electrolytic break there is a means of throwing out the condenser, and other breaks can be used with little alteration. We should advise those who wish to use this apparatus continuously to have a separate tube-holder, as that supplied with the outfit is fixed to the box, and consequently would render the operator liable to "X-ray dermatitis." The screen is thickly and evenly coated, and measures 7 × 10 inches. One advantage of this outfit is that when the box is locked everything is safe, as all attachments are covered up and cannot possibly be damaged. There is ample room inside for plates, volt- and am-meters, and the box contains all that is required except the accumulator. As being trustworthy, cheap and handy, the outfit can be recommended for the purpose for which it is intended, and those who have not made a special study of X-ray work will find little difficulty in obtaining good results with it.

A DISCUSSION of the rainfall of Saxony and the Thuringian provinces, with coloured map, by Dr. G. Hellmann, has been published on the same plan as that adopted for several of the other German States which have preceded it. The work is based upon the results of ten years' observations, and forms a valuable contribution to the rainfall statistics of that part of Europe. The mean annual rainfall for the whole area is rather more than 23 inches, but in the neighbourhood of the Hartz Mountains to the west and the Thuringian forests to the south, the annual fall exceeds double that amount; in the central parts of the province of Saxony the rainfall does not exceed 20 inches. The discussion gives full details of the monthly values and of the greatest fall in various short intervals of time.

THE Royal Meteorological Society has published a fifth edition of "Hints to Meteorological Observers," by Mr. W. Marriott. This useful little work, consisting of only sixty pages, of which twenty pages are tables of reduction, contains all that is necessary for the purpose for which it is intended, and, what we think is of much importance, nothing that is not necessary. Among the chief additions to this new issue are instructions for the construction of thermometer screens for tropical countries, a description of Mr. Dines's pressure tube anemometers, which are likely to come into more general use, and pictures to accompany the cloud nomenclature adopted by the International Meteorological Committee. The Meteorological Congress held at Rome in 1879 expressed the opinion that an international dictionary of meteorology should be published, and as a first step towards the carrying out of this resolution a "Glossary of Meteorological Terms" has been added, which will be of considerable assistance, especially to younger observers.

THE annual report issued by Mr. J. B. Carruthers, Government mycologist at the Royal Botanic Gardens, Ceylon, records important work completed or in progress. Of fungal diseases, those which attack the tea plant naturally receive the most attention. The most important of the leaf diseases, known as grey blight and caused by *Pestalozzia Guepini*, seems to be confined to the tea shrub, as it has not been found on the leaves of plants growing in the jungle or elsewhere in the vicinity of diseased tea plants. Experiments are being carried on to determine how far the disease may be carried by spores, and the liability of weak plants to succumb to the disease. The discovery of the ascus-bearing fruit on the stem reveals a method by which the fungus can perpetuate itself. Under ordinary circumstances it is confined to the leaf, but if it can attain a vigorous state of development it may grow down the leaf-stalk into the stem and there form its fruit. A destructive root disease is due to *Rosellinia radiciperda*, a fungus which can grow both as a saprophyte and as a parasite. It starts on dead timber, such as the root-tissues of a dead Symplocos, and when the soil is thoroughly wet it can travel and spread to the roots of living plants, notably the tea plant. An effectual remedy consists in cutting deep drains at least a foot broad. Other subjects investigated were cacao canker, finger and toe disease, dry rot and pollination of cacao flowers.

THE *Journal* of the Anthropological Institute is highly creditable both to the Institute and to Britain; it is, as a matter of fact, the best extant journal that deals with anthropology in a comprehensive manner, and it is to be regretted that it does not meet with the circulation that is deserved by its interest and value. The range of the second part of vol. xxxi. extends from Wiltshire palæoliths and Irish copper celts to notes on Malay metal work and a classification of Sarawak swords; there are papers on African and Papuan craniology, trephining in Melanesia, colour vision of the natives of Upper Egypt, early Egyptian racial types, an ethnographical account of the natives of Manipur and of the Paraguayan Chaco, the animal cults of Sarawak, and a memorandum on the languages of the Philippines. Several of these articles are fully illustrated with most excellent plates, and it will be noticed that practically the whole range of anthropology is covered by original articles in the current number of the *Journal*.

IT has long been suspected that certain prehistoric peoples trephined the skull of living persons for surgical reasons, and now we have a definite modern instance from Melanesia. The Rev. J. A. Crump, in his paper on "Trephining in the South Seas"

(*Journal* of the Anthropological Institute, vol. xxxi. p. 167), states that in New Britain the local wizard trephines with a piece of shell or with a flake of obsidian in cases of fracture caused by a sling stone. This operation is described; the number of deaths is about 20 per cent., most of these resulting from the first injury and not from any complication after the operation. Complete recovery takes place in two or three weeks' time. In New Ireland the operation is performed, not only in the case of fracture, but where there is epilepsy and certain forms of insanity as the result of pressure on the brain. After trephining has been performed, there is frequent partial temporary paralysis, which almost invariably passes away. Idiotcy is an occasional result also. But the natives affirm that while the cures of insanity and epilepsy are many, the instances where either malady supervenes after the operation are exceedingly few. Dr. Victor Horsley's discussion of this paper lends it additional interest.

ONE of the latest departures of the experimental psychologist consists in prodding people with a pointed instrument when they are asleep to find out how much excitation is required before they begin to move, and how much it takes to wake them up. This method is embodied in a paper on "Experimental Investigations on the Depth of Sleep," by Drs. Sante de Sanctis and U. Neyroz, of Rome, a translation of which is given in the *Psychological Review* for May. The instrument employed is called a Griessbach ethesiometer (made by Brändli, of Basle), and may be used with either a sharp or blunt point. It measures the stimulus necessary to induce subconscious reaction, and that applied at the waking point. Four normal subjects, all relatives of the writer of the paper, were experimented on for about six consecutive months, and afterwards five subjects, mostly epileptic, were operated on, and from the results obtained curves were drawn showing the relative depth of sleep, as measured by the stimuli required, after the subject had been allowed to sleep for various lengths of time. The curves are all of zigzag form, and the experiments may perhaps suggest a practical application in the case of subjects who find it hard to wake in the morning, and who may overcome the difficulty by timing their sleep so that the waking point is at a minimum when they wish to rise.

IN the Report of the Marlborough College Natural History Society for 1901, Mr. S. B. Dixon gives an account of the recent important discovery of Palæolithic flint implements at Knowle, near Savernake Forest. The state of the Society appears to be flourishing, the entomological section showing a specially good record of work. The report is illustrated by some excellent reproductions from photographs of local scenery.

ACCORDING to the Berlin correspondent of the *Times*, an international agreement for the protection of birds useful to agriculture was signed at Paris on March 19, the contracting parties being Belgium, France, Greece, Lichtenstein, Luxemburg, Monaco, Austria-Hungary, Portugal, Sweden, Switzerland and Spain. Certain insectivorous species and others scheduled as being specially useful to agriculture are to receive unconditional protection, the destruction of the birds themselves, or of their nests and eggs, being prohibited at all seasons. It is noticeable that Italy, where numbers of useful birds are annually killed during migration, does not appear among the signatories.

IN the introductory comments to the second (May) number of the *Field Naturalist's Quarterly*, the editor discusses the proper sphere of work for local natural history societies. The importance of taking cognisance of all subjects connected with local biology is strongly urged, as the specialists are sure to look after their own interests, and will, when necessary, institute sections devoted to their own favourite subjects. "The great justification of a field club ought to be that it is doing work that is otherwise neglected. There is not an area of ten miles square in this country but what offers some subject of investigation." Several of the articles in this number deal with the habits and movements of animals in spring, and the illustrations include some interesting photographs of nests and eggs.

WE have received the "Catalogue of the Educational Collection of Minerals belonging to the West Ham Municipal Technical Institute," compiled by Dr. H. A. Auden. From a high scientific standpoint the classification here adopted of minerals, according to electronegative constituents, will no doubt meet with the approval of the learned. Under this arrangement, zincite, corundum and hæmatite (as simple oxides) follow one another; and the same is the case with anhydrous carbonates, such as aragonite, witherite, strontianite and cerussite. For purposes of technical education a practical grouping would appear more desirable. The author's object is, however, to illustrate the systematic grouping of mineral specimens, and in the "addenda" he enumerates the principal metals and ores, jewels and other minerals of industrial importance. An index would have added to the value of this useful work.

A NEW general method for the synthesis of fatty aldehydes is described by MM. L. Bouveault and A. Wahl in the current number of the *Comptes rendus*. It was shown by Henry some time since that aldehydes of the fatty series could be readily condensed with nitromethane to form addition products, which the authors have now found to readily lose water to zinc chloride under suitable conditions, giving nitro-derivatives of substituted ethylenes. These are readily reduced by zinc and acetic acid to oximes, from which the aldehyde can be obtained without difficulty. The method has been applied by MM. Bouveault and Wahl to the synthesis of isobutylacetic aldehyde from the product of condensation of isovaleral with nitromethane, and of caprylic aldehyde from œnanthol.

SINCE the discovery of the remarkable compound of hydrogen and nitrogen known as hydrazoic acid, numerous modes of preparing it have been worked out, mostly through the use of somewhat complicated organic compounds. The only purely inorganic syntheses of this acid are those of Wislicenus from sodium amide and nitrous oxide and of Tanatar from hydrazine and nitrogen chloride. Tanatar now describes in the current number of the *Berichte* another elegant synthesis of this compound. A mixture of hydrazine sulphate and hydroxylamine hydrochloride is treated in acid solution with an oxidising agent and distilled, when hydrazoic acid passes over with the distillate. Hydrogen peroxide and chromic acid appear to give the best yields, which in no case exceed 30 per cent. of the theoretical amounts. Dihydroxylamine is probably the first product of oxidation, which then condenses with the hydrazine and is further oxidised to N_3H.

DR. M. BIAL has recently carried out some interesting experiments on the antiseptic properties of dilute solutions of acids, details of which are given in the last number of the *Zeitschrift für physikalische Chemie*. The observations were carried out with yeast cells, measurements of the retarding action of different acids on the development of the cells being made by observing the amount of carbon dioxide liberated from a solution of grape sugar. It is found that the concentrations of the solutions, which are just sufficient to check completely the development of the cells, are much smaller in the case of the strong acids like hydrochloric and sulphuric acids than in the case of weak acids such as acetic and butyric acids. The results, in fact, lead the author to conclude that the antiseptic power is essentially determined by the hydrogen ion which is contained in the acid solutions, and the electrolytic dissociation theory is able

to account for the observed phenomena in a satisfactory manner. As is required by this theory it is found that the addition of neutral acetates to a solution of acetic acid diminishes the antiseptic power of the acid, the concentration of the active component of the solution, the hydrogen ion, being under these circumstances reduced to a much smaller value.

NUMEROUS theories have been put forward at different times to account for the formation of natural paraffins, the one received with most favour being that due to Berthelot and developed by Mendeléeff in which the action of steam upon metallic carbides was regarded as the main source of the hydrocarbons. The chief stumbling block to this view was the difficulty of explaining the mode of formation of the naphthenes of the Russian oilfields. The researches of MM. Paul Sabatier and J. B. Senderens on the action of reduced nickel, iron and other metals upon hydrocarbons have now placed the "chemical" theory of petroleum formation on a firm experimental basis. By the direct hydrogenation of acetylene in the presence of nickel they have obtained liquid mixtures of hydrocarbons which can be made to correspond either with American or Caucasian petroleum by varying the conditions of the experiment. To account for the formation of petroleum it is thus sufficient to admit that there are in the depths of the earth free alkali metals and metallic carbides, which in contact with water give rise to mixtures of hydrogen and hydrocarbons. These gases encounter nickel, cobalt or iron in a finely divided state, and thus give rise to the mixtures of hydrocarbons forming natural petroleum.

THE additions to the Zoological Society's Gardens during the past week include a Bosman's Potto (*Perodicticus potto*) from West Africa, presented by Mr. Edward Straw; three American Bisons (*Bison americanus*) from North America, presented by H.G. the Duke of Bedford, K.G., P.Z.S.; three Darwin's Rheas (*Rhea darwini*) from Patagonia, a Red Ground Dove (*Geotrygon montana*) from South America, presented by Capt. John L. Marx, R.N.; two Garden's Night Herons (*Nycticorax gardeni*) from the Falkland Islands, presented by Mr. W. Grey Wilson, C.M.G.; an Algerian Tortoise (*Testudo ibera*) from North Africa, presented by Master C. Treverlyn Gill; a Silvery Gibbon (*Hylobates leuciscus*) from Java, deposited; six Ruddy Flamingoes (*Phoenicopterus ruber*) from North America, twenty Alpine Newts (*Molge alpestris*), twenty Newts (*Molge montandonii*) from Roumania, purchased; a Thar (*Hemitragus jemlaica*) born in the Gardens.

THE EQUATORIAL CURRENT ON JUPITER.

THAT differences occurred in the rate of motion of different markings on Jupiter was first discovered by Cassini in the seventeenth century. But other observers in later years appear to have neglected the systematic study of the planet. His disc was occasionally surveyed, it is true, and the positions of the belts described, but the details were not perseveringly followed. Telescopes were formerly of inordinate length and not very effective in performance, but what was accomplished by Cassini might also have been achieved by others. Jupiter's dimensions are such that comparatively small and imperfect instruments are capable of revealing the principal markings. Herschel never made a thorough investigation of the Jovian spots, though he obtained some observations in 1779 and recognised the difference in their motions. Until the last half of the nineteenth century the planet seems to have been generally surveyed in a desultory manner.

The apparition of the great red spot, however, revolutionised the existing state of things, for it was destined, not only to attract an immense amount of attention to itself, but to the whole visible phenomena presented by the surface markings of Jupiter. When this remarkable object first became perceptible it is not our purpose to inquire; it is certain, however, that as an exceptionally conspicuous feature it was widely observed during the last half of 1878.

It was long thought that the equatorial region of the planet supplied us with the most swiftly moving objects. This was, however, found to be a mistaken impression. The white and dark equatorial spots completed a rotation in about 5½ minutes less time than the red spot, and this meant a difference of velocity amounting to about 250 miles per hour. But it was soon seen that though the equatorial current is much more rapid than the rate exhibited in certain other latitudes, it does not equal the velocity of some other occasional markings in the northern hemisphere.

It is only our intention, however, to refer briefly to the equatorial markings observed during the last quarter of a century. But it must be confessed that the observations are not nearly so continuous and complete as the importance of the subject demands. The results have been sufficiently full for all purposes during the last few years, for several observers, including Mr. A. S. Williams, Rev. T. E. R. Phillips, Captain P. B. Molesworth and others, have obtained a mass of useful materials with reference to the equatorial current. And there seems no doubt that the investigation will be adequately maintained. It is chiefly to the continuity of the observations that we must look for the satisfactory elucidation of the phenomena presented. The equatorial spots have not, it is true, been always in strong evidence. In certain years they are liable to be almost, if not entirely, absent. The breaks, therefore, which occur amongst the accumulated observations are not always to be ascribed to negligence on the part of Jovian students.

At present the equatorial spots are both numerous and conspicuous, and it is to be hoped that a large addition to our observations will be effected during this opposition. The results for preceding years are very extensive and exhibit an irregular, though on the whole a decided, increase in the rotation period, but it would be premature to undertake the collection and reduction of all the materials. The observations must be prolonged over a much more lengthy interval before they can be expected to reveal the information we require. As observed at Bristol, the equatorial spots have shown the following variations in their rotation period, but satisfactory mean results from a number of different objects were only obtained during the last four oppositions:—

	h.	m.	s.	
1880 ...	9	50	5·8	... 1 very bright spot
1881 ...	9	50	8·8	... ,, ,,
1882 ...	9	50	11·4	... ,, ,,
1883 ...	9	50	12·1	... ,, ,,
1885 ...	9	50	14·3	... ,, ,,
1886 ...	9	50	22·8	... ,, ,,
1895 ...	9	50	34·3	... 2 black spots
1898 ...	9	50	23·6	... 23 spots
1899 ...	9	50	24·6	... 27 ,,
1900 ...	9	50	24·1	.. 18 ,,
1901 ...	9	50	29·1	... 28 ,,

W. F. DENNING.

GERMAN PROGRESS IN OPTICAL WORK.[1]

I PURPOSE dealing with statistics compiled from information afforded me by two German firms and one Austrian, Messrs. Zeiss, Leitz and Reichert respectively, all of whom are well-known makers of microscopes, and the first named of many other optical instruments, including prismatic field glasses, of which, as is well known to you all, they were the originators. I must say that the figures quoted refer approximately to the end of the year 1899, since which date the average rate of increase has been more than maintained. Taking first the firm of Zeiss, in Jena, twenty years ago they employed fifty men; five years later the number had leaped up to 170, or more than three times as many; in another five years the number had practically been doubled, 327 being the precise number; yet another five years saw the number 580; while to-day (1899) they employ the astonishing number (astonishing, that is, for the class of instruments they manufacture) of 946 men, this grand total being made up as follows: theoretical staff, 22; office and dispatch, 36; mechanics, 322; opticians, 371; wood-workers, leather-

[1] Abridged report of a paper entitled "The Secret of German Progress," read before the Optical Society by Mr. Herbert F. Angus, Hon. Sec. of the Educational Committee of the Society.

workers, foundry-men, &c., 129. Of these men, 832 in number, including only those actually at work in the shops, 58, or 7 per cent., are foremen, and 178, or 27 per cent., are youths under eighteen. Turning now to Leitz, in Wetzlar, who, I may say, manufactures microscopes almost exclusively, we find the same steady progress, if not exhibited in such a striking degree. The numbers employed were: in 1879, 35; in 1884, 100; in 1889, 160; in 1894, 200; and at the present day (1899) 253. This number is divided up as follows: theoretical staff, 4; office and dispatch, 9; mechanics, 164; opticians, 60; case work, &c., 16. The foremen number 10, or 4·2 per cent., and the boys 18, or 7·25 per cent. of the total number actually employed in the shops, viz., 240. The firm of Reichert, in Vienna, although smaller, shows an almost identical rate of progress with that of Leitz, the numbers being: employed in 1879, 20; in 1884, 40; in 1889, 75; in 1894, 100; present day (1899), 150; of these, 3 form the theoretical staff, 8 are employed in the office and dispatch department; while of the remainder 120 are mechanics, 30 opticians and 8 case-makers, &c., the boys being 15 per cent. of the whole. I am afraid the numbers given in detail do not always agree with the totals, but I give them as received. . . . .

In the most successful of these firms, that of Zeiss, it will be noticed what a large percentage (27 per cent.) of boys is employed in comparison with the other two—Reichert 15 per cent., Leitz 7¼ per cent. It will also be noticed that the percentage (7 per cent.) of foremen is proportionately high. Herein, to my mind, lies the superiority of the firm of Zeiss over competitors of their own nationality, and much more so over us. I do not wish you to understand that I consider the number of boys employed by a firm an unfailing criterion of efficiency and progress; stated in this bald way the proposition is absurd, but, when we take this fact in conjunction with the well-known excellence of the productions of Zeiss (instruments than which no more delicate or difficult of manufacture can be found in the whole range of optics), when, I say, we take these two facts in conjunction, what is to be said of the organisation and system which allows of their coexistence? I think, therefore, that I may be allowed to say that the number of boys employed by Zeiss demonstrates their superiority, and not only that, but that it gives them a *potential* or *latent* power of progress, if I may use the expression. . . . .

I will premise one or two remarks which I have to make on the system of training adopted by saying that in Germany, as no doubt you all know, every young man is compelled by law on entering a trade to attend classes for instruction. Such classes the boys employed by Zeiss, of course, attend. A certain number of apprentices are taken who have, in addition, to attend higher classes, and from whom a higher standard of preliminary knowledge is required (that is, they must pass that examination which reduces the term of service in the army to one year). These higher classes are, however, open to the ordinary working boys, if they have sufficient brains to avail themselves of them. The teaching of optical subjects in the technical school of the town is practically under the firm's control, being subsidised by them, and some, if not all, of the teachers being drawn from the works; half the time spent at this school is during working hours, and is counted the same as attendance at the works. . . . .

This training of the boys and apprentices, the scientific management of the business and the experimental work is supervised by a staff of no less than eighteen mathematicians, physicists and chemists, each of whom holds a University degree; the salaries of these gentlemen, together with the cost of the experimental work undertaken, reach a total of from 6000*l.* to 10,000*l.* per annum. Here, then, in my opinion, you have the secret of German progress—a thorough well-grounded *elementary* training of the workmen, controlled and employed by those possessing a *real scientific* training.

A STEREOSCOPIC METHOD OF PHOTOGRAPHIC SURVEYING.[1]

IN the method proposed in this paper, photographs are taken, with a surveying camera, at a pair of points, the plates being exposed in the vertical plane passing through both stations. A réseau, or a graduated back frame, gives the means of measuring the coordinates of any point on the plates with reference to the optical axis of the camera. After development and fixing, the negatives, or positives from them, are viewed in a stereoscopic measuring machine, which, by combining the pictures, renders possible the instant identification of any point common to the pair of plates. Movable micrometer wires traverse each field, and pointings may be made simultaneously with both eyes. The readings of the micrometers, referred to the réseau, give the three coordinates of the point by direct multiplication by, or division from, constants for the plates, which depend only on the focal length of the camera lens and the length of the base. When a sufficient number of points have been plotted from their coordinates, contour lines may be drawn.

Theory of the Method.—Let A and B (Fig. 1) be the ends of

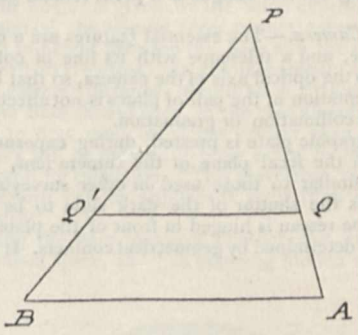

FIG. 1.

the base and Q and Q′ the positions on the photographs of any point P.

Take A as origin and A B as positive direction of x-axis.

Let (X, Y, Z) be the coordinates of P; $(x_a, f, z_a)(x_b, f, z_b)$ the coordinates of Q and Q′.

The equation of A P is:

$$\frac{x}{X}=\frac{y}{Y}=\frac{z}{Z},$$

and if we put $y=f$, we get:

$$x_a=\frac{f}{Y}X$$

$$z_a=\frac{f}{Y}Z.$$

Similarly the equation of B P is:

$$\frac{x-b}{X-b}=\frac{y}{Y}=\frac{z-h}{Z-h},$$

where b and h are the x and z coordinates of B.

Whence,

$$x_b=\frac{f}{Y}(X-b)+b$$

$$z_b=\frac{f}{Y}(Z-h)+h.$$

From these equations we find

$$x_a-x_b+b=\frac{bf}{Y}=e.$$

e is the *stereoscopic difference*, constant for points in any plane perpendicular to A y and vanishing for points at infinity.

The values of the coordinates of P follow:

$$Y=\frac{b}{e}f$$

$$X=\frac{b}{e}x_a$$

$$Z=\frac{b}{e}z_a.$$

A check is afforded by the values of X and Z derived from B P.

$$X=\frac{b}{e}x'_b-b$$

$$Z=\frac{b}{e}z'_b-h,$$

x'_b and z'_b denoting here the coordinates of Q′ referred to B.

[1] A paper read on October 2, 1901, before the South African Philosophical Society, by Mr. H. G. Fourcade, Forest Department, Cape Town.

The measurement of the coordinates of a point being made independently on each plate, although simultaneously, it will be a sufficient condition for the viewing apparatus to make corresponding portions of the two pictures combine with or without change of perspective.

Using a magnifying optical system to view the pair of plates, the condition for distinct vision is that the two images of any point appear in a *corresponding plane of vision*, so that the visual rays meet in space. This condition evidently remains satisfied when the images are magnified, or when they are brought nearer together along a line parallel to that joining the nodal points of the two eyes, and for different distances between the viewing lenses or the eyes, since in all these cases the lines joining the two images of a point remain parallel to the eyes.

Surveying Camera.—The essential features are a camera on a theodolite base, and a telescope with its line of collimation at right angles to the optical axis of the camera, so that by changing pivots the orientation of the pair of plates is not affected by errors of inclination, collimation or graduation.

The photographic plate is pressed, during exposure, against a back frame in the focal plane of the camera lens, by a spring contrivance, similar to those used in other surveying cameras, which permits the shutter of the dark slide to be drawn and replaced. The réseau is hinged in front of the plate, its correct register being determined by geometrical contacts. It is impressed

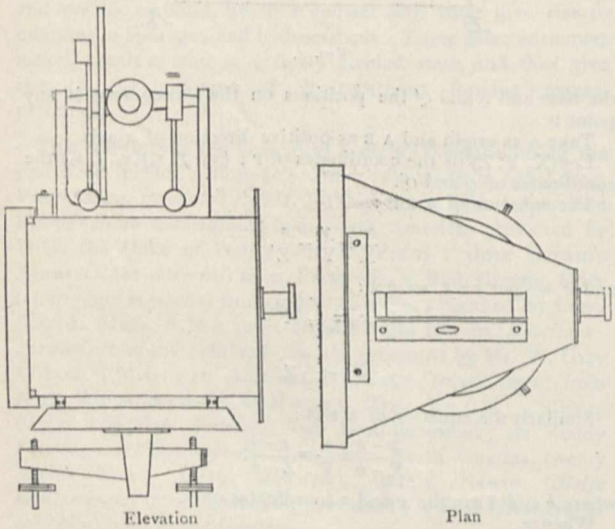

FIG. 2.

upon the plate by exposure to sky light reflected through the camera lens and then moved out of the way for the exposure of the picture itself. A graduated front slide is used to displace the horizon line by moving the lens, but in normal circumstances it is set at the zero of its scale. Fig. 2 shows the general arrangement of the instrument.

Conditions to be satisfied.—One instrumental condition, sufficiently satisfied in construction, is that the front slide be parallel to the vertical réseau lines. Any defect in this respect is eliminated by determining the origin of the réseau coordinates and the focal length for different readings of the front scale.

The camera adjustments are: (1) Plane of réseau to be vertical. (2) Horizon line of réseau to be horizontal. These adjustments are made with the aid of a level, fitted with a Bohnenberger eye-piece.

The auxiliary level having been placed directly in front of the camera and its line of collimation made horizontal, the vertical axis of the camera is set vertical by reference to the level of the vertical circle. Then (1) is effected by turning the camera in altitude with the footscrews, and in azimuth, until the cross wires of the level coincide with their image reflected from the silvered back surface of the réseau when the bubble of the longitudinal level on the camera is adjusted to the centre of its run. Replace the front slide and lens and set again the vertical axis vertical. (2) is now effected by making the ends of the horizon line of the réseau coincide with the cross wires of the level in two positions, using for the purpose the side capstan-headed screws in the base. The transverse level on the camera is then adjusted, and the longitudinal level made perpendicular to the vertical axis by means of the front capstan-headed screws under the camera.

The theodolite adjustments, effected by ordinary methods, are: (3) Horizontal axis made perpendicular to vertical axis. (4) For collimation. (5) Horizontal axis made parallel with optical axis of camera. An approximate adjustment of (5) is sufficient.

Instrumental Constants.—These are (1) the zero of the front scale, (2) the zero of the réseau and coordinates of the R-points, and (3) the focal length. They may be determined in the usual manner, but it is convenient to first make the centre R-point coincide with the zero of the réseau coordinates by collimating directly upon the réseau plate when adjusting the camera with the help of an auxiliary level as already explained. In that case the lens requires to be adjustable horizontally as well as vertically.

The focal length f is found from the measurement of exposed plates containing the images of well-defined points of which the angular distances are known. Call α the angle between two points of which the horizontal coordinates are a and b. Then:

$$f = \frac{a-b}{2\tan\alpha} + \sqrt{\frac{(a-b)^2}{4\tan^2\alpha} - ab}.$$

Measurement of the Plates.—It is unnecessary in a preliminary note such as this is to enter into the construction of the measuring apparatus in much detail, as a description of actual instruments with examples of their use may fitly be given in a subsequent paper. A suitable machine would generally resemble those which have been used for the measurement of celestial photographs, and like such may be of various types.

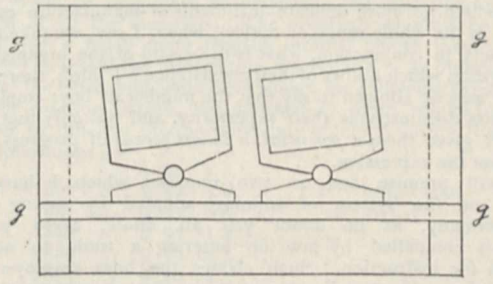

FIG. 3.

In the type now considered, the plates are set side by side at an inclination corresponding to that of the base line and at heights such that corresponding R-points are horizontal. Both plate-carriers can slide about in a horizontal direction on a stage formed of a sheet of plate glass g (Fig. 3), which itself can be moved vertically by a double rack and pinion. Any small error in the setting of the plate and in the fitting of the slides will be automatically corrected by the position of the eyes in front of the eye-pieces of the viewing microscopes and by their power of accommodation, and does not affect the accuracy of the measurements.

The measuring microscopes are of low power and include in their field at least one clear R-square of 1 centimetre side. Their distance apart is adjustable to suit the eyes of the observer. One is fitted with a pair of micrometers at right angles capable of rotation in order to bring the horizontal and vertical wires parallel to the R-lines. The other is similarly fitted, with the exception that one horizontal micrometer is sufficient. The runs are adjusted on a scale.

The centres of the plates are separated to a sufficient distance by introducing in each microscope a pair of prisms of total reflection p (Fig. 4).

The micrometers might also be used in the position of the plates, giving more room for the screws and greater facility in the reading of their heads, and the plates themselves set further back, behind an additional lens, as in the Cambridge measuring machine recently described by Mr. Hincks (*Monthly Notices*, lxi. p. 444).

The zero wires form a frame fitting an R-square, as in Sir David Gill's machine used at the Cape Observatory (*Monthly Notices*, lix. p. 61).

For convenience the whole arrangement is tilted at an angle of 45°, and the light illuminating the plates reflected by mirrors *m* from a window at the back of the observer.

The setting of the plates may be effected by turning a micrometer to the inclination of the base by means of a graduated circle, and making both sets of R-lines agree in inclination and height with the micrometer wires. The second micrometer is then set by making its wires parallel to the vertical R-lines on either plate.

The vertical R-lines are combined by the microscopes, but the horizontal lines only when the distance between the centres of the pictures is equal to that between the microscope object glasses. In making a measurement, the plates are moved by the slow-motion screws on the slides of their carriers and of the stage until the zero square of one microscope fits a zero square of the corresponding plate and the zero wires of the other microscope coincide with a pair of vertical R-lines on the second plate. The points in the field of view may then be bisected without disturbing the zero settings.

The coordinates of a point on the plate are given by the direct readings of the micrometer heads added to the value of the R-line considered. The stereoscopic difference results from the difference of the x's on the two plates.

Range of the Method.—In practice, the range of the method is limited by the blurring of distant detail by light diffused in the atmosphere. This "aërial perspective" is reduced by the use of orthochromatic plates and an orange screen cutting off the rays of shorter wave-length which form the blue haze, but even then

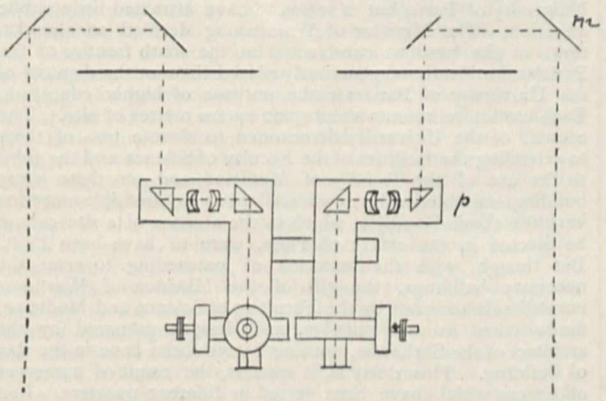

FIG. 4.

the effective range would probably not exceed some 5 miles, or 8 kilometres.

On the other hand, the difference in phase of the objects would prevent their ready combination at distances less than three to four times the length of the base. The view would then correspond with that of a model seen with the eyes at a distance of 10 inches from the nearer edge.

Let $2b$ be the length of the base and α the angle subtended by it at a distance y. Then :

$$y = b \cot \frac{\alpha}{2},$$

$$\frac{dy}{y} = -\frac{b}{y} \cdot \frac{d\alpha}{2 \sin^2 \frac{2\alpha}{2}}$$

$$= -\frac{d\alpha}{\sin \alpha}.$$

Let 1/100th of an inch or 0·25 mm. be the admissible error on the plan, 8 kilometres the limiting value of y and $\Delta\alpha = 20''$. On the scale of the Canadian photographic surveys, 1/40000, the maximum error allowable will be 10 metres at 8 kilometres, or $\Delta y/y = 1/800$. Then $\alpha = 4°\ 27'$ and $2b = 620$ meters.

By increasing the base to 2 kilometres, a maximum possible accuracy at 8 kilometres of 1/2500 of the distance, or 3 metres, would be attained, but the area mapped would be reduced to a narrow strip.

With the base of 620 metres, the area mapped with a plate of diameter equal to the focal length of the lens would be contained between the limiting circles, at 8 and 2·5 kilometres, shown at d and n (Fig. 5), and would amount to 22 square kilometres on either side of the base, or more correctly to that portion not masked by the nearer topographical features.

The error in x will be due to that in y and that of the x-co-ordinate on the plate. We may write :

$$(\Delta x)^2 = \left(\frac{y}{f} \Delta l\right)^2 + \left(\frac{x}{y} \Delta y\right)^2.$$

With a lens of 150 mm. focal length and an error of ·025 mm. in the plate x's, the maximum error is, for the base and the scale of plan considered, 5 metres, or on the plan 0·12 mm.

The error in height is given by the same expression. At the maximum distance, the second term cannot exceed $(1/4\ \Delta y)^2$ if the difference in height between the base and the distant points does not exceed 2000 metres. In absolute amount the total error for points at extreme distances would be $\pm$ 2·75 metres.

The contour lines should then, in the case already considered, be accurate to 0·25 mm. on slopes greater than 15°, but the actual accuracy will be reduced to some extent by the uncertainty of the correction for refraction. This correction, combined with that for curvature, can be applied at sight from a small table with y-argument.

By reducing the base, pairs of photographs may be taken within a confined space, as when mapping hidden valleys. The

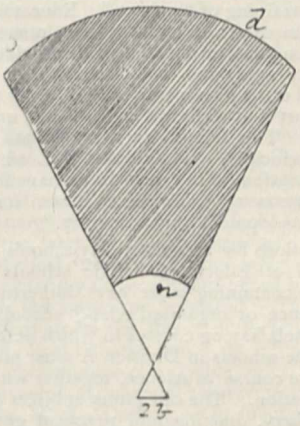

FIG. 5.

method can also be combined to any extent with the ordinary methods of photographic surveying. It would be of particular advantage in the mapping of large areas of mountainous country.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The following examiners have been appointed in the Natural Science Schools:—Mr. William B. Croft, Pembroke College (physics), Dr. Alexander Scott (chemistry), Dr. Leonard E. Hill (animal physiology), Mr. John Watts, Balliol College (chemistry)—*vice* Mr. Elford, resigned.

THE 237th meeting of the Junior Scientific Club was held on May 29, in the museum. Mr. A. F. Walden, New College, demonstrated a new method of distinguishing between calcium and strontium. Mr. E. A. Cockayne, Balliol, exhibited a natterjack, and Mr. Lattey, Trinity, read a paper on the occurrence of natural gas in England.

MR. DAVID ROBERTSON, lecturer in electrical engineering at the Bradford Municipal Technical College and formerly assistant lecturer at the Glasgow and West of Scotland Technical College, has been appointed professor of electrical engineering at the Merchant Venturers' Technical College, Bristol.

THE annual exhibition of work from schools and classes of the School Board for London will be opened by Lord Reay on

June 18. A section will be devoted to scientific apparatus constructed by teachers and pupils. The Board, in including this section has in view the possibility that, by encouraging the construction of apparatus by its teachers and pupils, it may be possible to reduce the present heavy accounts for scientific apparatus and also that, at the same time, it may assist in familiarising the pupils with the practical use of apparatus. The sight of apparatus of a cheap and "home-made" character will be the means of encouraging the study of practical science at home.

ENCOURAGEMENT is being given to the study of natural history or nature-study in many districts. A programme has been sent to us of a series of Saturday afternoon rambles organised for the benefit of teachers by the Technical Instruction Committee of the Essex County Council. Conducted in the sympathetic spirit of the true student of animate nature, the excursions may be made a source of pleasure and profit to all who participate in them, but great care must be taken to prevent them from becoming expeditions of extermination. Prof. Miall points out this danger in a letter to the third number of the *Nature-Study Journal* published by the South-Eastern Agricultural College, Wye. The journal also contains short papers on uses of the balance, the metamorphosis of frogs, bees and flower shapes.

LORD ROSEBERY referred to the Education Bill in his address at Leeds on Friday last. He summed up the Bill by saying that "it discountenances efficiency in primary education, rewards inefficiency, starves secondary education, and ignores altogether the training of teachers." Education, he urged, is a national and Imperial duty, and its development should not be dependent upon local rates. The Bill provides that municipal authorities may apply the balance of the "whisky money," and may spend up to a twopenny rate in order to provide for the higher secondary and technical education so urgently needed in this country. This is not only inadequate in amount, but unsound in principle, and, remarked Lord Rosebery, "the putting of education on the rates is perhaps the surest method that the Government could have chosen for restraining the educational development of this country."

NEW regulations for secondary day schools have been issued by the Board of Education. The schools will be in two divisions—one containing what have hitherto been designated schools of science or organised science schools; and the other, secondary schools having courses in which science is given fair attention. The schools in Division A must provide a thorough and progressive course in science, together with the subjects of a general education. The obligatory subjects are mathematics, physics, chemistry, drawing and practical geometry; and not less than fifteen hours per week must be allotted to instruction in them, of which not more than five hours are to be given to mathematics. Practical work must be done in every science subject. On the completion of the elementary course, students may select physical, mechanical or biological courses, such as have been carried on for some time in schools of science. In Division B of secondary day schools, not less than nine hours a week must be given to science instruction in forms for which grants will be made. The instruction must be both theoretical and practical, and the laboratories must be suitably equipped for the subjects sanctioned.

THE executive committee of the National Association for the Promotion of Technical and Secondary Education adopted the following resolutions referring to the Government Education Bill at a meeting held on May 30:—(1) That this executive committee, while expressing no opinion on the more controversial aspects of the Education Bill relating to elementary education, regards it as essential to the interests of technical and secondary education, (*a*) that the fund available under the Local Taxation (Customs and Excise) Act, 1890, should be permanently appropriated by the Bill and devoted by the local authorities to the purposes of technical and secondary education; (*b*) that the areas of administrative control over technical and secondary education by local education authorities should, as provided by the Bill, continue to be the administrative counties and county boroughs or combinations of such areas. (2) The executive committee also considers it highly desirable, (*a*) that clauses 3 and 15 should be so amended as not to deprive any local authorities of the power they now possess to levy a penny rate for the purposes of technical and secondary education; (*b*) that the local authorities should be represented on the governing bodies of all institutions to which grants are made.

IT has already been announced that Mr. Alfred Mosely has arranged to send out to America two commissions of inquiry—one to study methods of education in their bearing on commercial and industrial efficiency, and the other industrial organisation and the problems of labour and capital. We learn from the *Times* that Mr. Mosely has just returned from the United States, where, in conjunction with President Butler, of Columbia University, he has settled the provisional itinerary of the educational commission. The exact date when this commission will start has not yet been decided. The programme arranged by President Butler seems to be of an exceedingly instructive and comprehensive character. Among the places to be visited are New York, with Columbia University, Auchmuty trade schools, the Educational Alliance, the University Settlement Society and the Normal College; New Haven, Conn., where Yale University will be inspected; Boston, with Harvard University and the Massachusetts Institute of Technology; Philadelphia, for the University, the Drexel Institute, the Manual Training Schools and the Commercial Museum; Baltimore, where the Johns Hopkins University and Hospital will be seen; Washington, for the Smithsonian Institution, National Museum and the Department of Agriculture; Pittsburgh, with the Carnegie Museum; Chicago, with the University, the School of Education, Prof. Dewey's University School and the Armour and Lewis Institutes; and Ithaca, N.Y., where Cornell University will be visited.

FOUR years ago an important gift was bestowed on the University of Paris, but it seems to have attracted little public attention. The Minister of War having decided to abandon three of the bastions constructed at the south frontier of the Parisian fortifications, generously placed them at the disposal of the University of Paris for the purpose of higher education. Each bastion represents about 3000 square metres of site. The council of the University determined to devote two of these to extending the facilities of the Faculty of Science and the third to the use of the Faculty of Medicine, and on these areas buildings suitable for the new installations required in connection with the above Faculties, which in the absence of a site cannot be erected in the centre of Paris, were to have been built. But though, with the intention of proceeding to erect the necessary buildings, the gift of the Minister of War was immediately accepted by the Faculties of Science and Medicine, funds voted for the purpose, and designs prepared by the architect of the Sorbonne, nothing has yet been done in the way of building. This delay is, it appears, the result of numerous objections which have been raised in different quarters. In a recent number of the *Revue générale des Sciences* these objections are answered in detail, and it is shown that it would be a great pity from the point of view of facilities for scientific research if the unhoped for chance of fine large laboratories on the outskirts of Paris was, even provisionally, abandoned.

SOCIETIES AND ACADEMIES.

CAMBRIDGE.

Philosophical Society, May 5.—Dr. J. Larmor, vice-president, in the chair.—Regeneration in *Samia ailanthus*, by Mr. H. H. Brindley. With the object of ascertaining the degree of regeneration and how far it is uniform in the imago after injury to the larva in particular stadia and to particular extents, amputation experiments were made on the legs of this moth in larva. Owing to the large number of cases in which the imago did not emerge the results were somewhat limited, but sufficient instances were observed to suggest (*a*) that compared with Orthoptera and other non-pupating forms the results of injury are very variable, (*b*) that the earlier the instar injured the imaginal limb more closely approaches the normal in form and size, (*c*) there is no uniformity in the presence of the terminal claw apparatus without regard to the number of limb joints such as has been observed in Arachnids, Myriapods and several orders of non-pupating insects, and (*d*) that the length of time spent in pupa and the degree of injury to the larval limb seem not to influence the degree of regeneration. As regards (*b*) the results are in general accord with those of Newport on Vanessa and Chapman on Liparis, though not as regards (*c*) with Newport. The experimental evidence obtained also seems to confirm Gonin's opinion, based on anatomical

grounds, that the imaginal limb is a distinct structure from the larval limb during the instar preceding pupation.—On the unit of classification for systematic biology, a reply to Mr. Bernard, by Mr. J. Stanley Gardiner.—Remarks on Marconi's system of telegraphy, by Mr. H. M. Macdonald.—On trinodal quartics, by Mr. A. B. Basset.—On a definite integral, by Mr. T. J. I'A. Bromwich.—Reflection and transmission of light by a charged metal surface, by Mr. P. V. Bevan.—Note on a general numerical connection between the atomic weights, by Mr. C. A. Vincent. If a list of all the atomic weights in ascending order of magnitude be taken and the order in this list be called n, then the nth atomic weight, from $n=3$ to $n=60$, is given by the equation

$$W=(n+2)^{1\cdot21}.$$

If the atomic weights are from Clarke's 1901 list with hydrogen as unit, then the greatest difference between the computed and determined value will not exceed 4 units, nor will the error ever be greater than 5 per cent.; in thirty-six cases the result will not be a unit wrong and in twenty cases will not be 1 per cent. wrong; the mean error for the whole fifty-eight elements considered is about 1·005, the mean percentage error about 1·6. By replacing $n+2$ of the above formula by N, and taking N as indicating the order in an augmented list of the elements, the formula may be made to embrace the whole of the seventy-seven elements now definitely known. This necessitates predicting an element between hydrogen and helium and one between helium and lithium. No other gaps are left until after samarium, when in order to complete the list it is necessary to assume elements in various places, making fifteen gaps in all. The thirteen gaps introduced after samarium are in general accord with those predicted by the periodic table.—On radioactive rain, by Mr. C. T. R. Wilson. As the experiments of Elster and Geitel and of Rutherford have shown, a negatively charged body exposed in the atmosphere becomes radioactive, apparently showing the presence of some radioactive substance in the atmosphere; it occurred to the author to test whether any of this radioactive substance is carried down in rain. Freshly fallen rain-water (less than 50 c.c. was generally used) was found when evaporated to dryness to leave behind a radioactive residue. The radioactivity was detected by means of the increase in the ionisation of the air within a small vessel, of which the top, or, in other experiments, the bottom, was of thin aluminium or of gold-leaf, the other walls being of brass. The metal surface on which the rain had been evaporated was placed close up to the aluminium or gold-leaf, and the rate of movement of a small gold-leaf which served to measure the ionisation was observed (v. *Roy. Soc. Proc.*, vol. lxviii. p. 151). In many cases the radioactivity obtained from the rain was sufficient to increase the ionisation five- or six-fold. From the evaporation of distilled water, of tap-water or of rain-water which had stood for many hours no radioactivity was obtained. Like the induced radioactivity obtained on a negatively charged body, that derived from rain gradually dies away, falling to about half its initial value in the course of an hour.—On the increase in the electrical conductivity of air produced by its passage through water, by Prof. J. J. Thomson. In continuation of the experiments brought before the Society last term, the author investigated the effect produced on the conductivity of air by bubbling it through water. The air from a large gas-holder of about 350 litres capacity was bubbled vigorously through water by making the air in the vessel circulate through a water-pump; this treatment increased the conductivity of the air, and when the bubbling had been going on for some time the conductivity of the air was ten or twelve times the initial conductivity. When once the air has been put in this highly conducting state it stays in it for a very considerable time; a large part of the conductivity produced by the bubbling remains in the air forty-eight hours after the bubbling has ceased, nor does it disappear when an intense electric force is kept applied to the gas. The effect produced by the passage of the air through water is similar to that which would be produced if the bubbling produced a radioactive "emanation" similar in properties to those emitted by thorium and radium. The conducting gas can be passed from one vessel to another; it retains its conductivity after passing through a porous plug; passage through a long tube heated to redness destroys the conductivity; it takes, however, a very high temperature to do this, temperatures less than 300° or 400° C. seem to produce comparatively little effect; if the gas is passed very slowly through a long tube filled with beads moistened with sulphuric acid, the conductivity is destroyed; unless, however, the stream of gas is very slow, the air retains a good part of its conductivity in spite of the sulphuric acid. Another point of resemblance between the "emanation" from radioactive substances and a gas in this state is that if a strongly negatively electrified conductor be kept in the gas for some time, the conductor becomes radioactive.

DUBLIN.

Royal Irish Academy, May 26.—Dr. R. Atkinson, president, in the chair.—Prof. Grenville A. J. Cole read a paper on Composite Gneisses in Boylagh, West Donegal, in which he urged that the essential features of the foliation in the gneissoid granite from Ardara to Finntown were due to conditions of original flow, and not to subsequent dynamo-metamorphism. He attributed the darkened types of granite, with a specific gravity of about 2·74, to admixture of the pure aplitic intrusive rock (specific gravity about 2·59) and the already foliated schists. The foliation in the granite is commonly accompanied by numerous residual flecks of schist, and larger elongated inclusions occur which have retained the strike of the masses of which they once formed a part. Subsequent shearing has here and there produced mylonitic structures, but the granite was converted into a gneiss by its mode of intrusion, under mountain-building pressures, along the planes of separation of an altered sedimentary series. The gneisses of Boylagh are thus almost all of composite origin, and the foliated masses and limestone bands lying in the central granite of Donegal, and running with so persistent a N.E. and S.W. strike, represent the undissolved residue of an anticlinal mass composed originally of numerous parallel folds. The trend of these folds and of the granite axis points to their establishment in the Caledonian epoch of mountain-building. The later pegmatitic veins which cut them, and which are not affected by the folding, may, then, be of Devonian age.

PARIS.

Academy of Sciences, May 26.—M. Bouquet de la Grye in the chair.—The motor muscle employed in the production of positive work. The comparison with inanimate motors, from the point of view of the dissociation of the several constitutive elements of the energy expenditure, by M. A. Chauveau.—On the ethology of the larva of *Sciara medullaris*, by M. Alfred Giard. The biological history of the larvæ of Sciara is dominated and directed by the conditions of the humidity of the medium in which the organism is placed.—The synthesis of petroleum: contribution to the theory of formation of natural petroleum, by MM. Paul Sabatier and J. B. Senderens (p. 138).—On the rays of convergence of a double series, by M. Eugène Fabry.—On the general exponential representation and some of its applications, by M. L. Desaint.—On functions of complex variables, by M. D. Pompéiu.—The receiver in wireless telegraphy, by M. Édouard Branley. The receiver in common use in wireless telegraphy has a radioconductor containing a fine metallic powder. Owing to the numerous contacts, these tubes are sometimes a little variable in their behaviour, and in attempting to increase the regularity of working the author has recognised that a radioconductor of the type oxidised metal-polished metal is the best, as it not only possesses the required regularity of working, but is more sensitive than the ordinary type. A description and figure of the instrument that has been found to give the best results is given.—On the electric discharge in flames, by M. Jules Semenov. In electric discharge in flames it was found that the negative pole heats much more than the positive pole, the negative pole being the seat of a phenomenon of a reflux of material particles the direction of which appears to be independent of the relative position of the two poles.—On the temperature of the electric arc, by M. Ch. Féry. The optical pyrometer of Chatelier was modified by the introduction of a thin prism of absorbent glass for the production of the photometric equilibrium. The temperatures thus observed with prisms of red and green glass were compared directly with the readings of a platinum-rhodium platinum couple, the results being in very close agreement up to 1500° C., the highest temperature attainable with the couple. Within these limits the law of Wien was found to be verified, and these results were then extended to the case of the temperature of the electric arc. The value found, 3882° C., differs considerably from the value found by Chatelier, 4100° C., from which the conclusion is drawn that carbon does not behave at its boiling point as a perfectly black substance.—Fields of force of bipolar diffusion, by M. S. Leduc.—On the modifications brought about by self-

induction in some dissociation spectra, by M. A. de Gramont. A continuation of previous researches on the same subject. The changes in the spectra brought about by changes in the self-induction of the spark circuit are studied in the cases of arsenic, antimony, graphite, silicon, germanium and thallium.—The employment of urine in the development of the photographic plate, by M. R. A. Reiss. Urine has a slight reducing action upon the photographic plate and may replace water in the developing solutions.—On the temperature of maximum density and the electric conductivity of some solutions of barium bromide and iodide, and calcium chloride, bromide and iodide, by MM. L. V. de Coppet and W. Muller.—On some physical properties of hydrogen telluride, by MM. de Forcrand and Fonzes-Diacon. A mixture of hydrogen and hydrogen telluride was prepared by the action of acids upon aluminium telluride, and this mixture passed through tubes cooled to − 55° C. Pure hydrogen telluride separated out in the solid state, allowing of correct determinations of its melting and boiling points and molecular volume.—The preparation and properties of the chloro-, bromo- and iodo-sulphobismuthites of copper, by M. Fernand Ducatte.—On the alkaline cobaltioxalates, by M. Copaux.—On the constitution of the ammoniacal copper salts, by M. Bouzat. From a study of the amounts of heat developed in the reaction between solutions of ammonia and copper salts the author concludes that the ammoniacal compounds of copper ought to be considered as salts of complex bases.—On *p* : *p*-dinitrohydrazobenzene, by MM. P. Freundler and L. Beranger.—On the thiosulphocarbamic esters derived from primary amines, by M. Marcel Delépine.—The electrical resistance of metallic sulphides, by M. J. Guinchant. The resistance of the sulphides of iron, tin and lead was measured at varying temperatures. The resistance was generally a linear function of the temperature up to 100° C. The resistance of lead sulphide increased with the temperature, that of the sulphides of tin and iron decreased. The sign of the temperature coefficient would appear to depend upon the magnitude of the specific resistance, or of the causes which determine it, and not upon accessory phenomena, such as electrolysis, which accompany the passage of the current. The differentiation of solids into electrolytes and non-electrolytes according to the sign of this coefficient would thus appear to be unjustifiable.—The synthesis of aldehydes of the fatty series with the aid of nitromethane, by MM. L. Bouveault and A. Wahl (see p. 137).—The mechanism of the chemical variations in the plant when under the influence of sodium nitrate, by MM. E. Charabot and A. Hébert. Sodium nitrate behaves like the chloride in favouring esterification and reducing the percentage of water.—The composition and volumetric estimation of sodium methylarsenate, by MM. Adrian and Trillat.—Growth and auto-intoxication, by M. Frederic Houssay.—On the formation of the egg, maturation and fertilisation of the oocyte in *Distomum hepaticum*, by M. L. F. Henneguy.—On a new gigantic Pyrosome, by MM. Jules Bonnier and Charles Perez.—The modes of action and nature of the secretions of a pathogenic microbe, by MM. Charrin and Guillemonat.—Contribution to the study of life in seeds, by M. L. Maquenne.—The volcanic rocks of Martinique, by M. A. Lacroix.—The biochemical action of extract of kidney on certain organic compounds, by M. E. Gérard. The aqueous extract of the kidney of the horse, from which all cellular elements have been removed, is capable of hydrolysing glycogen, guaiacol, oxaluric acid and lactose.—On a comparison of the action of cold and anæsthetics on nutrition and reproduction, by M. Raphael Dubois.—The disease of young dogs. Statistics of the vaccinations practised from May 15, 1901, to May 15, 1902, by M. C. Phisalix.—On the existence of lipase in the blood, by MM. Maurice Doyon and Albert Morel.—Experimental researches on the action of compression on the respiratory exchanges in man, by M. J. Tissot.

DIARY OF SOCIETIES.

THURSDAY, JUNE 5.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—On the Movements of the Flame in the Explosion of Gases: Prof. H. B. Dixon, F.R.S.—Contributions to the Study of Flicker. Paper II.: T. C. Porter.—Effects of Strain on the Crystalline Structure of Lead: J. C. W. Humfrey.—The Spectra of Potassium, Rubidium, and Cæsium, and their Mutual Relations: H. Ramage.—On Some Definite Integrals and a New Method of reducing a Function of Spherical Co-ordinates to a Series of Spherical Harmonics: Prof. A. Schuster.

CHEMICAL SOCIETY, at 8.—The Action of Ungerminated Barley Diastase on Starch. Part I.: J. L. Baker.—The Decomposition of Chlorates. Part V. Potassium Chlorate in presence of Oxides of Manganese: W. H. Sodeau.

RÖNTGEN SOCIETY, at 8.30.—The Sources of Phosphorescence: Herbert Jackson.

LINNEAN SOCIETY, at 8.—On certain Species of Dischidia and their Double Pitchers: H. H. W. Pearson.—(1) On "Silver-leaf" Disease of Plums; (2) Observation on the Occurrence of Crystals of Calcium Oxalate in Seedlings of Alsike (*Trifolium hybridum*, Linn.): Prof. J. Percival.—On the Morphology of the Cerebral Commissures in the Vertebrata: Dr. Elliot Smith.

FRIDAY, JUNE 6.

ROYAL INSTITUTION, at 9.—The Nile Reservoir and Dams: Sir Benjamin Baker, K.C.M.G., F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—On a Peculiarity in the Course of Certain Streams in the London and Hampshire Basins: H. J. Osborne White.—Note on the Occurrence of *Microtus intermedius* in the Pleistocene Deposits of the Thames Valley: M. A. C. Hinton and G. White.

MONDAY, JUNE 9.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—From the Somali Coast through Southern Abyssinia to the Sudan: Oskar Neumann.

TUESDAY, JUNE 10.

MINERALOGICAL SOCIETY, at 8.—On Meigen's Method of Discriminating Calcite and Aragonite: Dr. Hutchinson.—(1) On Krennerite; (2) On the Gnomonic Projection: H. Smith.—On Volcanic Dust which fell at Barbados: G. T. Prior.—*Exhibit*: A new form of Three-Circle Goniometer: H. Smith.

WEDNESDAY, JUNE 11.

GEOLOGICAL SOCIETY, at 8.—A Descriptive Outline of the Plutonic Complex of Central Anglesey: Dr. Charles Callaway.—Alpine Valleys in Relation to Glaciers: Prof. T. G. Bonney, F.R.S.—On the Origin of some Hanging Valleys in the Alps and Himalaya, and their Bearing on the Question of the Relative Erosive Power of Ice and Water.—Prof. E. J. Garwood.

THURSDAY, JUNE 12.

ROYAL SOCIETY, at 4.30.—*Probable papers*:—(1) The Influence of an Atmosphere of Oxygen on the Respiratory Exchange. (2) The Influence of High Pressures of Oxygen on the Circulation of the Blood: L. Hill, F.R.S., and J. J. R. Macleod.—On the Parasitism of *Pseudomonas destructans* (Potter): Prof. M. C. Potter.—On the Toxic Properties of the Saliva of certain "Non-Poisonous" Colubrines: Prof. A. Alcock, F.R.S., and Dr. L. Rogers.—The Dissipation of Energy by Electric Currents induced in an Iron Cylinder when Rotated in a Magnetic Field: Prof. E. Wilson.

MATHEMATICAL SOCIETY, at 5.30.—Sur un théorème fondamental dans la théorie des équations différentielles: M. E. Picard.—Some Arithmetical Theorems: Mr. G. H. Hardy.—The Principle of Huygens in a Uniaxal Crystal: Prof. A. W. Conway.

FRIDAY, JUNE 13.

ROYAL INSTITUTION, at 9.—The Progress of Electric Space Telegraphy: G. Marconi.

PHYSICAL SOCIETY (National Physical Laboratory), 3.30-6.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.

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