THURSDAY, MAY 12, 1910.

THE DEATH OF THE KING.

KING EDWARD THE SEVENTH is no more. An Empire is in mourning. The death of the King has come with a suddenness which has stunned his people, who, however, have already given no uncertain signs of the deep love and respect they entertained for a ruler who always strove to do his duty. Her Majesty the Queen-Mother and the other members of the Royal Family know full well that they are not the only mourners, and that the sympathy of millions in the widest Empire the world has known, and others outside it, is extended to them in their personal loss.

We can answer for it that the grief of the leaders and students of science in the realm is as deep as that of any of their fellow citizens. They do not forget that the late King was the son of the Prince Consort, one of the highest products of the German university system, in which science always finds a place, through whose influence the importance to this nation of the study and fostering of science and art was first recognised, and whose early death, it has been said, was more harmful to Britain than the loss of a great campaign. With such a wise father it is not to be wondered at that the late King began his university studies by attending Playfair's lectures on chemistry (in 1861) when he was twenty years of age. For this reason, again, it is not to be wondered at that among the innumerable public duties the King performed since, as Prince of Wales, he opened the great railway bridge across the St. Lawrence at Montreal, many of those in which he exhibited the keenest interest have had to do with the opening or extension of institutions connected with science.

If there were anything like a complete organisation of science in England, we may be certain the King's interest in it, great as it was, would have been greater still. The organisation of science means a scientific department of the State; this means a Minister of Science in the immediate entourage of the sovereign.

How much we might have gained, great though the late King's work in this direction has been, we can gather from what has been accomplished by the King's actions in scientific matters on which he was kept informed and interested, not by a Minister of State, but by the eminent representatives of medical science attached to his person.

Since the late King's accession to the throne it may be said that the enormous expansion and amelioration of everything that has to do with the healing of sickness and the lessening of all the ills which follow on it are mainly due to his unceasing efforts to secure a better organisation of hospitals and of the nursing staff throughout the land.

In the various addresses which the late King delivered during a period of forty years before his accession to the throne, and since, on the occasions of the calling into being of new English colleges and universities, and on other similar functions, the note of the importance of the advancement of science to the nation was almost invariably struck. On one of the last public appearances of this nature, that of laying the first stone of the new buildings of the Imperial College of Science and Technology, in July of last year, the King said:—"In recent years the supreme importance of higher scientific education has, I am happy to say, been fully recognised in England; and as time goes on I feel more and more convinced that the prosperity, even the very safety and existence, of our country depend on the quality of the scientific and technical training of those who are to guide and control our industries." This and other similar utterances have shown that in the late King science had a firm friend, and that his action for good would have been greater still if representatives of science were to be found among the King's ministers.

Although it is incumbent upon us to refer chiefly to the late King's activities and marks of sympathy in scientific directions, we must at the same time point out his vast services to the nation in other, almost innumerable, ways. An ardent apostle of peace, the whole world was his debtor; and not science alone has gained by his anxiety to foster the arts of peace by honouring those engaged in their pursuit.

In past times only national services in war were distinguished by the sovereign's mark of approval; King Edward did not hesitate to confer marks of honour upon the most eminent representatives of science, art, literature, commerce and industry. We owe to him the foundation of the Order of Merit, the highest

and rarest distinction for State service which now exists, and it is an honour to the few men who hold it that a woman, Miss Nightingale, belongs to the Order.

With regard to his present Majesty, King George the Fifth, to judge of what he has done as Prince of Wales, we may feel sure that there will be no falling off from the strenuous life of public duty exhibited by his father and grandfather.

We are informed by those who have had the privilege of conversing with him that, as one of the effects of his education as a naval officer, for the education of a naval officer must be scientific, he is fully in sympathy with those who insist upon the importance of science as one of the foundations of the greatness of a nation. It was this interest in science which caused him to regret deeply his inability to accept the presidency of the British Association at its meeting in South Africa. State duties had called him to India at that time.

King George is unapproached as a traveller, among crowned heads, whether of his own or of previous time. The new sovereign has probably seen more of the Empire than has been traversed by any single person among all his subjects. After the Australian Commonwealth was inaugurated, the King and Queen journeyed fifty thousand miles by land and water. They returned to Canada for the great tercentenary pageant at Quebec and the consecration of the battlefields, and meanwhile, in 1905, they had put a girdle round the globe again and traversed India from the Khyber to the Ganges, and from the Himalayas to the temples of the South. It has been well said that not one of his subjects realises better than the King how little is known of England by those that only England know, or how inseparably the whole life and fortunes of this island are knitted up with the destinies of the outer Empire. That many of the national shortcomings to which it is our duty to refer from time to time are fully known to his present Majesty is proved by his famous warning, uttered after all his journeyings, "Wake up, England."

In the midst of the nation's grief at a loss so great and so sudden that there has not been time to realise it, comfort may be found in the assurance which we possess that in the future, as in the past, the illustrious Royal Family will guard the best interests of our Empire. They will thus retain the affection and respect of a grateful people, whose hearts now go out to them in profound sympathy with their sorrows. EDITOR.

THE NEW "ORIGIN OF SPECIES."

The Mutation Theory. Experiments and Observations on the Origin of Species in the Vegetable Kingdom. By Hugo de Vries, Professor of Botany at Amsterdam. Translated by Prof. J. B. Farmer and A. D. Darbishire. Vol. i., The Origin of Species by Mutation. Pp. xv+582. (London: Kegan Paul and Co., Ltd., 1910.) Price 18*s.* net.

THE two smaller books by Prof. de Vries written in English have already put us in possession of a clear account of his theory of the origin of species by discontinuous variation. The publication of a translation (of which this is the first volume) of his larger "Die Mutationstheorie" will be valuable to students as containing the detailed arguments upon which it is based.

De Vries has long been known as a distinguished physiologist who has the advantage of a sound training as a physicist. Now a physicist, in attacking a problem, endeavours to get it into the simplest form which admits of experiment and measurement. Having obtained a "law" which fits his results, he proceeds to test its application to more complicated phenomena. But "life" is a complex which at present defies analysis, and the naturalist is therefore obliged to survey organised nature as a whole, and to endeavour to extract from its observation principles of general application. In this way organic evolution has been arrived at, for it is now generally admitted to find its securest basis in the evidence afforded by palæontology of the succession of living forms in the past history of the earth. It might also, though less convincingly, find it in the facts of geographical distribution. Darwin did not invent evolution, but he made it immensely more acceptable, first by breaking down the old belief in the constancy of species, and, secondly, by giving, in "selection," a mechanical explanation of how they came into existence.

To this de Vries raises the same objection as Huxley, though on different grounds, that "we do not observe actual specific changes in nature" ("Plant Breeding," p. 4). His object is to overcome this difficulty. He agrees (p. 207) that

"we have a doctrine of descent resting on a morphological foundation. The time has come to erect one on an experimental basis."

In this he believes he has succeeded. Every-

one must admire the patience and enthusiasm which he has brought to the task, and if the naturalist must be permitted to criticise the result from his point of view, he cannot but approve the scrupulously fair and instructive way in which de Vries has published every detail of his research.

In order to do justice to the theory which de Vries has founded on his observations, it is necessary to attach some precise meaning to the technical terms used. Darwin was nothing if not a naturalist. It is impossible to read de Vries's pages without feeling that he is not quite at his ease with the naturalist's technique. On p. 21 I find, for example, the following statement :—

"It is most remarkable that in the 'Index Kewensis,' which was published at Darwin's expense after his death, no distinction is drawn between varieties and synonyms."

I do not suppose it was intended, but this might be construed to mean that the work as executed failed to carry out Darwin's intention. That this would be the reverse of the fact I can state with confidence, as the plan was discussed and settled between Mr. Darwin and myself in his own house. What he told me he wanted was to be able to trace to its source any specific name that he met with. This the "Index" does, and it is an incalculable boon to those who use it. But its purpose is merely bibliographical, and it was not intended to express any opinion as to the validity of the species which it catalogues; nor was there ever any suggestion that it should catalogue varietal names.

It would be quite possible for a discussion of de Vries's theory to evaporate into a mere logomachy, a mere dispute as to the meaning of words. That I hope to avoid, but if I fail, he himself will have to share the blame. The word "mutability," which is peculiarly de Vries's property, and, indeed, contains the kernel of his theory, is an example. So far as I can find, it does not occur in Darwin's writings. Yet on p. 202 I find the following summary of the Darwinian theory :—

"Mutability may take place in almost all directions; and it is natural selection which operates in one direction during long geological periods";

and that there may be no mistake, he adds that this "obviously represents the view of Darwin." This is emphasised on p. 198, where "species-forming variability" and "mutability" are treated as synonyms. But de Vries's whole contention is that, in the ordinary acceptance of the terms, they are profoundly different. This is apparent from the following passage in the author's "Plant Breeding" (pp. 5-6), a book which, I confess, seems to me to be written with more precision that the larger one.

"The phenomena that follow Quetelet's law are now considered as one group, which is called fluctuating variability or fluctuation, since the individual qualities fluctuate around their average. The processes by which new qualities are produced must be studied separately. Under the assumption that these processes are neither slow nor invisible, but consist in leaps and jumps such as are popularly indicated by the name of sports, they are now called mutations, and the great subdivision of the phenomena of variability is designated, in consequence thereof, as mutability."

Now there is no want of precision about this statement. It of course assumes the very point which has to be proved, that "fluctuating variability" does not produce "new qualities"; but that is another story.

De Vries has elsewhere employed the words continuous and discontinuous, as descriptive of the two processes. Unfortunately, Bateson used these at the same time in a different sense, and this has added another pitfall to the discussion of the subject. At first sight we seem to have a sharp distinction between the theories of Darwin and of de Vries, the one accounting for the origin of species by the accumulation of small variations, the other by "sports." If we take, as an example of the latter, the production of the nectarine from the peach, there can be no doubt that the leap may be considerable. While the occurrence of sports is undeniable, de Vries appears to draw a distinction between the part attributed to them by Darwin and Wallace in the production of species (pp. 12 and 39). Wallace regards them "as absolutely without significance" (p. 40). But Darwin, with more caution, doubts whether they "are ever permanently propagated in a state of nature" ("Origin," fifth edition, p. 49), and this is practically the same thing. De Vries himself is led gradually to minimise their magnitude. He finds (p. 53) "sports" "not a happy" term, and prefers "jerky variability" where "jerks may only induce quite small changes." Later on he finds (p. 55) that "many mutations are smaller than the differences between extreme variants." He quotes Galton's polyhedron which, when disturbed, "oscillates round its position of equilibrium" (fluctuation), and finally "comes to lie on a new side" (mutation). But when the faces are very small, the illustration is obviously not helpful; when the variation is very small, the distinction between the two kinds is inappreciable.

To meet this difficulty, de Vries sets up other criteria. These he has drawn from a mass of experimental work for which it is impossible to conceal one's admiration, and is a positive addition to our knowledge. But it is, of course, permissible to draw from it somewhat different conclusions. "Mutants" arise without transitional forms (p. 248). It appears, however (p. 504), that such do occur, but simultaneously, and not before; the mutants, therefore, are artificially selected from a varying population. But they possess from the first absolute stability; this is an extremely interesting point; it is, of course, implied that they were self-fertilised, and that the conditions were unchanged. It is, however, to be noticed that it was not universally the case, as three of the mutants studied "proved to be inconstant," and some actually reverted to the original parent (p. 508). Such mutants he calls "elementary species," a term for which he invokes (p. 57) the authority of Darwin, who, however, only said that "varieties are incipient species," a very different thing.

It follows that "specific characters are absolutely

independent of selection" (p. 90); "by natural selection species are not *created* [no one ever thought they were], but eliminated" (p. 199). Selection "now has served its time as an argument for the 'Theory of Descent'" (p. 29). It was, indeed, finally disposed of by Lord Salisbury (p. 70), a fact which would have more weight if he had not ludicrously misapprehended the Darwinian theory.

The utility of specific characters (p. 65) and adaptation necessarily go by the board as well. Desert plants are not adapted to desert life. "They endure the desert, but only with difficulty" ("Plant Breeding," p. 350); "the spurs of the orchids . . . have not been originated in the way in which plants are now using them" (*l.c.*, p. 352). It must be admitted that all this is perfectly consistent, and follows logically from the conception of the species as an arbitrary result, "independent of the environment," and for which "we can as yet assign no cause" (p. 130). This makes a pretty complete sweep of the Darwinian theory, and practically takes us back to the position of Linnæus, who was content to suppose that species were created. It must, however, be put to de Vries's credit that he makes an heroic attempt to save Darwin himself from the wreck by claiming him as at heart a mutationist (p. 87) who "only by the pressure of criticism" (p. 39) gave up the true faith. There is a little irony in the fact that, as the critic was apparently Fleeming Jenkin (p. 37), the mischief was the work of a physicist. The attempt, though generous, is scarcely convincing, and so Darwin goes, and with him goes the splendid and fertile field of biological research for which he opened to us the door. Its place is taken by the procession of arbitrary mutants which have nothing to tell us because they have nothing to say. It is a rather dreary outlook, only mitigated by the "hope that we may be able to gain some control over the formation of species" (p. 186). Yet when I turn to Darwin and read "We have no evidence of the appearance, or at least of the continued procreation, under nature, of abrupt modifications of structure" ("Variation," ii., p. 414), I pluck up a little conviction of something that seems more full-bodied than a mere echo of Fleeming Jenkin. It may be remarked, however, that the celebrated argument of the latter has never been refuted.

I do not know whether to take comfort from the fact that if Darwin fares badly, Lamarck fares worse.

> "Specific characters are never 'acquired'; and there is no need for taking 'acquired characters' into consideration in the whole domain of comparative biology and the theory of descent" (pp. 130–1).

That gets a troublesome question out of the way, at any rate. To finish clearing the ground, a last dictum:—"No theory of the origin of species can have any bearing at all on this subject" [sociology] (p. 159). "Man is immutable albeit highly variable" (p. 156), a reservation with little satisfaction, as de Vries will allow no stability to racial variation.

It may be asked, on what are these sweeping conclusions based? Bateson inferred the discontinuity of variation from the observed discontinuity of species. De Vries apparently does not accept this, but for once adopts the obvious Darwinian explanation, "Subspecies become species by the extinction of intermediate forms" (p. 186). His own theory is based on the prolonged study of a single species of unknown and suspect history. It is, perhaps, one of the most remarkable cases in science of generalisation from a single instance, and that highly dubious.

He commences the account of his experimental work by remarking (p. 217):—

> "The chief obstacle in the way of . . . investigating the origin of species is our complete ignorance of the conditions under which the process takes place."

To test it, he "brought over one hundred species into cultivation" from the neighbourhood of Amsterdam. "Only one of these turned out to be what I really wanted." He does not tell us in what respect they failed, but concludes that mutability occurs "relatively rarely." It seems, therefore, to be open to the same kind of objection as has been urged against natural selection, that it "will generally act," as Darwin said, "very slowly, only at long intervals of time" ("Origin," sixth edition, p. 85). I think it is clear that what baffled de Vries was specific stability. It takes a somewhat prolonged subjection to cultural, *i.e.* changed, conditions to break this down. I have given numerous instances in these pages of extremely stable species which ultimately broke down. I have watched the process at Kew in *Primula obconica*, which now produces flowers two inches across. The process was described by Vilmorin half a century ago:—"The fixed character of the species being once broken, the desired variation will sooner or later appear" (Darwin, "Variation," ii., p. 262). I cannot doubt, therefore, that if de Vries had had patience, every one of his hundred species would have become plastic in his hands.

He, then, has been obliged to rest his theory on a single case, that of *Œnothera lamarckiana*. There is no evidence that this is a "natural species." It made its appearance in the Paris Jardin des Plantes, and, as pointed out by Lock and Boulenger, de Vries's results are open to the interpretation of being simply due to "Mendelian disjunction."

But, waiving this point, there is a graver difficulty. De Vries insists (p. 130) that his mutations are "independent of the environment." A moment's reflection will show the disadvantage under which his theory rests in this respect compared with that of Darwin, which provides a means of automatic and continuous equilibrium, and remorselessly eliminates whatever fails to adjust itself to it. De Vries admits (p. 199) that his mutations must submit themselves to selection; but they are so handicapped at the start that they can rarely have much chance, and this is confirmed by the inability of sports to hold their own in nature. Even *Œnothera lamarckiana*, whatever it may do under cultivation, does not appear to be able to produce permanent varieties under natural conditions.

Two other lines of argument require brief examination. De Vries points to the familiar little crucifer, *Draba verna*, which is now in flower everywhere, as a case of natural mutation. Jordan collected from

different countries some two hundred forms, differing often in extremely minute characters, but which he and other observers found to be stable in cultivation. Most systematists regard them as mere varieties. But species are only the stable forms of diverging races, the connecting links between which have disappeared. A naturalist will unite in one species in the Linnean sense, as in the case of *Draba verna*, a range of forms where it is conceivable that the differences could be bridged by continuous variation. Darwin thought that such forms might be stable, as, indeed, they appear to be. They may, in fact, be regarded as adjusted to slight differences in the environment, a view which derives some confirmation from the fact, which I confess surprised me, that de Vries finds only one of the two hundred forms of *Draba verna* in the neighbourhood of Amsterdam. This view would, of course, be rejected by de Vries, who looks upon them by analogy as mutants. The Darwinian explanation equally rests on an analogy, the production of the races of cultivated plants by artificial selection.

De Vries feels the force of this, and it is therefore essential to his case to break down the analogy. He admits (p. x) that "the process of selection has enabled us to produce improved races." But he draws a curious distinction between horticultural and agricultural methods. "In horticulture, varieties arise by mutations. . . . In agriculture, the highly improved races arise gradually through selection" (p. 82). For my part I am quite prepared to admit that mutation has had some share in the production of the latter; and as to the former, de Vries quotes my own observations on *Cyclamen latifolium*, where there can be no doubt that the existing race is the result of continued selection. The distinction, in fact, cannot be sustained.

De Vries objects to any argument drawn from cultivated races. We know little usually of their origin (pp. 13, 14), and this is true; they are often of hybrid origin (p. 75), which is equally true; both objections, it may be noticed, have been urged against his own Œnothera; finally, "improved races" (unless arising by mutation) lack stability (p. 120). This has been fully discussed by Darwin, and both he and Sir Joseph Hooker insist "on what little evidence this belief rests" ("Variation," ii., p. 32). Such races are the result of artificial selection, and are only stable under artificial cultural conditions. If these are withdrawn a new adjustment has to be sought, and, as Wallace has pointed out, in the face of competition for which they are in no way fitted. As Darwin says, "to assert that we could not breed our . . . esculent vegetables, for an unlimited number of generations, would be opposed to all experience" ("Origin," fifth edition, p. 16). The fact is accepted in the law courts, and if a pea such as Veitch's Perfection did not come true from seed, the purchaser would have a cause of action against the vendor.

De Vries states (p. 124) that "fruit-trees grown from seed quickly revert to the original type." This is too extreme a statement. The measure of truth in it is easily accounted for. Stability can be obtained in races where seminal reproduction can be quickly repeated. But a generation of fruit trees approximates to that of mankind, and though, theoretically, stability might be obtained, it would require a Methuselah to do it.

De Vries prefaced the first edition of this book by remarking that "The origin of species has so far been the object of comparative study only." It must always be to his credit that he has been the first to submit it to experiment. If the results seem so far inconclusive, the method, in the long run, must be fruitful. Darwin deliberately relied on continuous variation, de Vries relies on discontinuous. It must be obvious that the former has been a potent solvent of a wide range of biological problems where de Vries leaves us without an answer; and he frankly admits that on the fundamental principle we are as much in the dark as ever. For mutations, "we can as yet assign no cause" (p. 130), though (p. 207) he suggests that "the opportunity for the appearance of mutations is at once given" by change of environment. Beyond this we are no wiser as regards one kind of variation than as regards the other. We are evidently a long way from that "control of the mutative process" which "will, it is hoped, place in our hands the power of originating permanently improved species" (p. x). W. T. THISELTON-DYER.

PHYSICAL SCIENCE IN THE TIME OF NERO.

Physical Science in the Time of Nero; being a Translation of the "Quaestiones Naturales" of Seneca. By J. Clarke, with notes on the treatise by Sir Archibald Geikie, K.C.B., P.R.S. Pp. liv+368. (London: Macmillan and Co., Ltd., 1910.) Price 10*s.* net.

THE genius of the Roman people was mainly for action, conquest, and organisation. In the realms of thought they made but few original advances, here showing a striking contrast to the Greeks, whose progress in civilisation some few centuries previously had been intellectual rather than material, and made in art, philosophy, and speculation as to the deeper problems of life and nature. Of course, western nations owe, and have owed, an immense debt to the intellectual advances made by the Greeks, and there seems little danger that this debt will ever be underestimated. But there is reason to fear that full justice may not be done to the scientific progress made by the Romans; and Mr. Clarke's admirable translation of Seneca's "Quæstiones Naturales" comes very opportunely to illustrate its extent.

As Mr. Clarke points out in his introduction, Lucius Annæus Seneca was an exceptionally able man of many aptitudes—rhetorician, advocate, philosopher, author, politician, and for fifteen years tutor first and latterly also *âme damnée* to that monster of iniquity, the Emperor Nero. During his lifetime Seneca must have been best known for his eminence as a politician; during the many years when he was out of imperial favour, and had no share in politics, he devoted himself to philosophy, science, and authorship. As a philosopher he illustrates the eclecticism

of the Stoics, particularly in ethics. It was in ethics that his deepest interest lay. Even in a physical treatise like the "Quæstiones Naturales," he often breaks off a scientific discussion in order to improve the occasion by an outburst of orthodox morality *à la* Mr. Barlow, in which he chastens the excesses of the fashionable society of his day with a gusto that vividly recalls the sermons of a modern fashionable preacher, and with all the energy of an itinerant tub-thumper. In fact, so pure is his puritanism, so moral the morality of his denunciations, that one is almost tempted to disbelieve the known facts of his biography. But if his Stoicism is thus perhaps suspect, no similar accusation can be brought against his honesty as a man of science. "There is considerable internal evidence in the 'Quæstiones Naturales,'" says his translator, "that his pursuit of such studies was in part an outcome of the true scientific spirit, and that he possessed in no ordinary degree the scientific imagination." He was also an eclectic in his views about the material world, believing it to be built up out of the four elements—fire, air, earth, and water—of Empedocles, Plato, and Aristotle. But he rejected the fifth Aristotelian element, οὐσία, the immaterial *quinta essentia* so misconceived by mediæval philosophers, and he did not hesitate to part company with the Stoics whenever he felt inclined to disagree with their views. Of training as a man of science Seneca had none, for none was available in his day.

No doubt the "Quæstiones Naturales," or "Physical Inquiries," were written about and after the year 60 A.D., not long before Seneca's suicide was ordered by Nero; they are in a semi-epistolary style, and dedicated to his friend Lucilius. Their text has suffered much in the process of transmission through the ages; none of the MSS. is earlier than the twelfth century, and much ingenuity has been exercised by their editors (most recently by Prof. Gercke, of Breslau) in rearranging the various portions of the work into the order and form in which Seneca may be supposed to have left them. Originally the work consisted of eight books, two of which, probably ii. and iii., have now become fused into the present book iv. Most of it is taken up with meteorological questions, and consists of discussions as to the nature of meteors, the rainbow, thunder and lightning, winds and the atmosphere, snow, hail, and rain. One book is devoted to the forms of water, another to earthquakes, a third to comets. Seneca's general method is to state what is known or asserted about the phenomenon he is describing, and to give a critical discussion of the explanations—for it is chiefly in the explanations that he is interested—it has received, and, finally, to state and establish his own view about its causation.

The science of the ancients rarely advanced beyond the rudimentary stages for two main reasons. The first is the difficulty they always had in understanding that accurate observation and reasoned experiment were either necessary or desirable. The second is the facility with which their nimble minds sought refuge from this hard world of facts in speculation. To them a theory was as good as a fact, and a theory weighted with the authority of some great philosopher was better than many facts. The chief merit of Seneca as a man of science lies in his recognition of the importance of observation, and of the use of common sense in the interpretation of the observed facts of nature. It is true that many of his observations were faulty, many of his explanations were based on false analogy, many of his arguments are illogical or even ridiculous when viewed in the light of modern knowledge; but in these matters he merely suffered from the disabilities of his age, and his shortcomings are not to be too hardly judged.

The style of the "Quæstiones Naturales" is that of the polished orator and rhetorician. Seneca addresses Lucilius directly, and in the heat of argument he often sets up and argues with scientific men of straw whose duty is to advance views foredoomed to demolition. The text, as we have seen, is full of uncertainties and corruptions, but it has been very happily treated by its translator. The English version is most readable, and gives a first-rate reproduction of the varied style, the oratorical questions, the irony, the sarcasm, the occasional poetic afflatus, with which Seneca animated what might have been in other hands a heavy didactic exegesis. Mr. Clarke's skill as a translator is particularly evident in the success with which he has broken up into reasonable fragments the often long and involved sentences of the Latin original. Again, Seneca's habit was to employ important words—"aer" and "spiritus," for example—in several different senses, and, conversely, to express a single idea, such as that of the atmosphere, by a variety of different words in different contexts. The translator appears to be singularly successful in conveying what was Seneca's real meaning in these numerous and difficult passages. In conclusion, it may be added that Sir Archibald Geikie's valuable notes, which take the form of a running commentary on the seven books, and are given at the end of the translation, are of great assistance in the appreciation of Seneca's attainments and limitations. They are written from the point of view of modern science, and do much to show how and why he so often fell into scientific error. The book is well got up and indexed, and may be cordially recommended to all who are interested in Seneca, in the art of translation, or in the history of science. A. J. J.-B.

THE STUDY OF IMMUNITY AND ITS PRACTICAL APPLICATIONS.

Immunity and Specific Therapy. By Dr. W. d'Este Emery. Pp. xiv+448. (London: H. K. Lewis, 1909.) Price 12*s.* 6*d.* net.

THE amount of literature bearing on immunity and on the specific therapy of infective diseases which has appeared during the last few years is so great that it is difficult, even for the "specialist," to keep pace with its production. Reviews and summaries on the subject are therefore very needful, and the publication of Dr. Emery's work is opportune.

The book surveys almost the whole field relating to immunity—microbial toxins, antitoxins, bacterio-

lysis, agglutinins, precipitins, phagocytosis, and immunity to bacteria—and though perhaps somewhat more full of detail than the needs of the medical practitioner require, will be of great value to the pathologist and bacteriologist. The subject is dealt with critically and judicially, the various hypotheses are presented to the reader, and divergent views are stated fairly.

The opening chapter of the book gives a good general account of the essentials of immunity. One point we are glad to see the author brings out, viz. the ill effects to the patient of prolonged anæsthesia in surgical operations. It does not seem always to be appreciated that the power of recovery of a patient is, to say the least, jeopardised when anæsthesia is prolonged beyond a certain time.

The account of the interactions between toxin and antitoxin (chapter iv.) contains a clear statement of the hypotheses of Ehrlich, Arrhenius and Madsen, and Bordet, and is concluded with the judicial summary that

"No theory is absolutely sufficient to explain all the phenomena, and soon after each new one is adduced the supporters of the older ones bring forward evidence which renders it untenable. The probability is, at the time of writing, that Ehrlich's views are generally held, and are open to the fewest objections. They are complicated, it is true, and have had to undergo constant modifications as new facts have arisen; but the facts themselves are complicated. Yet it must be confessed that there are some grave objections to its acceptance in its present form, and it may become yet more involved before it can be fully accepted as a complete explanation" (p. 91).

The summary of Ehrlich's "side-chain" hypothesis of the formation of antitoxin (chapter v.) is excellent. Incidentally the definition of a "proteid" is dealt with, and it is suggested as a logical outcome of Ehrlich's hypothesis that proteids might be defined as substances which, when injected into suitable animals, give rise to the production of antibodies; this would then include the toxins, enzymes, &c., substances which do not give the proteid reactions as usually accepted by chemists. At the time of writing, Ford's work on the production of antibody by what is apparently a carbohydrate derived from poisonous fungi had probably not appeared, but, nevertheless, with this possible exception it does appear to be true that all anti-bodies are the result of the action of proteid or proteid-like substances. In the chapter on phagocytosis, opsonins, opsonic determinations, and vaccine treatment are naturally considered at some length. The divergent views on the nature of opsonin are well summarised; the author considers that there appears to be no sufficient evidence for the existence of thermostable opsonin apart from amboceptor, and that if thermolabile opsonin is not complement, complements may play the part of opsonins. The vaccine treatment of infective diseases is dealt with somewhat fully, and the opinion is expressed that "of the practical success of this treatment in certain diseases there can be no doubt," particularly in diseases due to acute infections with staphylococci, pneumococci, *B. coli*, and some other organisms, but as regards tuberculosis only a moderate degree of success has been obtained by the author.

Dr. Emery evidently holds the opinion that determinations of the opsonic index are not essential for the control of dosage in vaccine treatment. He points out that a patient with a low opsonic index may improve under treatment, fresh lesions may appear when the index is high, and the index may rise greatly just before death, and says:—

"The more carefully the opsonic index is considered, the more certain will it appear that a high index is not an indication of immunity; it neither proves that the lesion is undergoing cure, nor that a fresh infection will not occur. . . . Nor is a low index any proof of lack of immunity, since patients may improve remarkably during a prolonged negative phase" (p. 280).

A chapter is devoted to the colloidal theory of antibodies and its bearing on such phenomena as agglutination and the interactions between toxin and antitoxin, and gives a good account of this difficult subject.

A final chapter deals briefly with the practical applications of immunity research in the treatment of infective diseases.

The book contains a glossary of terms, a useful bibliography, and is well and sufficiently illustrated. A number of small verbal errors somewhat mar the text, but a sheet of "errata" correcting most of them has recently been issued. We can recommend the book as an excellent summary of the voluminous literature on a difficult subject. R. T. HEWLETT.

THE CARBONISATION OF COAL.

Modern Coking Practice, including the Analysis of Materials and Products. By T. H. Byrom and J. E. Christopher. Pp. xi+156. (London: Crosby Lockwood and Son, 1910.) Price 8*s.* 6*d.* net.

IN the preface to this handbook the authors point out that

"The subject of coke manufacture is of rapidly increasing interest and significance, embracing as it does the recovery of valuable bye-products in which scientific control is of the first importance."

This declaration, taken in conjunction with the fact that one of the authors is a Fellow of the Institute of Chemistry, awakens the hope in the reader's mind that at length the technical library has been enriched by a work which might rank with Simmersbach's "Grundlagen der Koks-Chemie," and afford substantial aid to those studying the economic principles of coal distillation, which is one of the most important questions of the present century.

This expectation, however, is doomed to disappointment, as the reader soon finds that the title of the book should have been "Modern Coke-oven Construction and Practice," that all discussion as to the effect of temperature and mass on the distillation of coal and the products yielded is avoided, and that whilst the change in structure from the beehive coke-oven to the modern recovery plant is well dealt with, and the manufacture of sulphate of ammonia receives full attention, yet the subject of tar is dismissed in one page.

In speaking of tar fuel, on p. 5, the authors say:—"The modern tendency, however, is to distil the tar first, and recover its many valuable constituents such as benzene, naphtha, carbolic acid, naphthalene, creosote, and also the tar colours discovered by Perkin."

This looseness of expression might lead some to believe that the coal-tar colours were a distillate from tar.

A few pages further on solid fuels are subdivided into organic and inorganic, the latter consisting of sulphur, silicon, phosphorus, and aluminium, the latter being credited with giving a heat quite equal to that produced in electric furnaces, a statement which will be doubted by the users of "Thermit."

In the chapters devoted to the construction of the modern form of bye-product recovery coke-oven, the authors are at their best, and this portion is well illustrated with many reproductions of photographs from existing plants, as well as elaborate sections and plans, yet the same fault is to be found as in other parts of the book, that is, the principles which govern the various stages in the process of carbonisation, and the chemical changes taking place during the operations, are ignored, whilst details of mechanical interest only are elaborated.

In the preface the reader is told that the book embodies a series of lectures delivered at a technical college to a class of men engaged on coke-ovens, and, interesting as they must have been to the audience, it cannot be too strongly impressed upon those delivering lectures of this kind that, unless there is given a foundation of scientific facts and theory upon which the practical man can build and evolve original ideas, the value of such lectures must be enormously lessened.

Not only is the theory of carbonisation neglected, but the coke produced during the process of gas manufacture is hardly mentioned, although the gas coke produced in the United Kingdom more than doubles in quantity that made in bye-product recovery plants, the beehive coke-oven, with its wicked waste of tar and sulphate of ammonia, still being the most favoured means of squandering our already depleted coal-measures.

At the present time there is a great opening for an author who, with scientific knowledge of the subject, can gather together the work of Stein, Flack, Richters, Muck, Parry, Thörner, Lunge, Knublauch, and others on the carbonisation of coal, and weave into tangible shape the lines upon which economy of coal, abolition of smoke, increase of manurial ammonium compounds, and enhanced values for our tar products can be obtained.

THE HUMAN CENTRAL NERVOUS SYSTEM.

Voordrachten over den Bouw van het centrale Zenuwstelsel—een Voorbereiding tot de Kliniek der Zenuwziekten. Door Prof. J. W. Langelaan. Pp. vi+485, and 309 text-figures. (Amsterdam: A. Versluys, 1910.)

THIS consists of the course of instruction on the embryology and anatomy of the human nervous system given in Leyden in the sessions 1907-8 and 1908-9 put into the form of a book, which is illustrated with an excellent series of photographs of sections and drawings by Heer G. Koster. It is quite a revelation to find what soft effects of light and shade the artist has obtained with pen and ink, without sacrificing accuracy and clearness, in the production of these admirable illustrations.

The book is subdivided into four sections, dealing respectively with (A) the development of the human central nervous system (pp. 1–98); (B) the nature and histogenesis of the nervous tissues (pp. 99–137); (C) the form of the various parts of the central nervous system (pp. 138–286); and (D) the structure of the central nervous system (pp. 287–485).

The most distinctive section of the book is part A. Part B contains a good and impartial summary of the present state of our knowledge concerning the mode of development and the nature of nerve-fibres and cells, and supplies the reader with a good bibliography. Although parts C and D, on the whole, are excellent accounts of the subjects of which they treat, they present no special features which the student cannot find elsewhere in text-books written in languages more generally understood than Dutch is. Moreover, the text of these sections is not so "up-to-date," nor is the bibliography so satisfactory as those of the early sections.

Section A is a model of the manner in which embryology should be taught to medical students.

It begins with a clear account of the early stages of development of the primate embryo, leading up to the formation of the nervous system, and then describes the history of the further growth and differentiation of the brain and spinal cord in *human* embryos. Most books on embryology are rendered confusing to the student by the introduction of descriptions of what happens in the chick or the developing rabbit, with tags of miscellaneous information concerning the embryos of other vertebrates, and the plea is urged in support of such a mode of procedure that it is the comparative method. But the use of data culled from comparative anatomy in works on human anatomy can be justified only when they help to elucidate the latter or explain some general principle which cannot be appreciated from the mere study of one vertebrate; unless the information directly serves one of these two purposes it is worse than useless to insert it. One of the great merits of Prof. Langelaan's work is that it gives a straightforward account of the human brain and its development; and no comparative data are inserted in the embryological section except to explain stages in human development which are not known from direct observation of human material; and then he is careful to rely almost exclusively on information obtained from the study of the mammals most nearly related to man that supply the desired facts.

A considerable part of the embryological section of the work is based upon the author's own researches, which are already familiar to readers of *Brain* (1908) and the *Anatomischer Anzeiger* (1908); and this fact gives section A the freshness which springs from first-hand knowledge, in contradistinction to the staleness of conventional errors which

mar all mere compilations, however conscientiously they may have been done.

Although there are a good many errors, both of commission and omission, in this book, and many statements which we cannot endorse, the work is, on the whole, the best elementary text-book on the anatomy of the human nervous system, and it certainly contains the most useful account of the development of the human brain that has appeared in a student's text-book. If it were not for the difficulty of language the book would appeal to a large class of students and medical men. G. E. S.

OUR BOOK SHELF.

The Miners' Guide. By F. P. Mennell. Pp. viii+196. (London: Gerrards, Ltd., 1909.) Price 4*s.* net.

THIS little book aims at being a guide to the prospector, and should largely attain its object. It is neither lengthy nor profound, but sketches, lightly, those principles of geology it is desirable that the prospector should be acquainted with.

In discussing the source of metals in lodes the author appears to lean strongly to the theory of lateral secretion, and is at some pains to show how large a quantity of metal may be contained in the rocks of a mineral district, even when barely perceptible traces of its existence can be detected by analysis. He is a firm believer in the underground circulation of meteoric waters as a means of dissolving and concentrating these metals in lodes and other deposits, and seems to doubt the existence of a bary-sphere.

The description, in chapter iii., of the characters of ore bodies is all too short, and chapter iv., which is devoted to prospecting, might also be expanded with advantage; but this is supplemented later by a review of the occurrence of, and prospecting for, gold, silver, platinum, the base metals, and other useful minerals and precious stones. An important feature of this portion of the book is a general account of the uses of the different minerals, and the conditions necessary to be observed in preparing them for the market. Prices and production also receive some attention, and the more important localities are cited. Chapter xi. deals with sampling, and in the space available gives a good description of the operations that must be undertaken, and the methods of computation that must be adopted, to ascertain the average value of a lode sampled. The following statement, however, "As a guide to the possibilities of undeveloped ground, geological knowledge is often worth any amount of sampling, but the miner can only judge from his own experience what scientific knowledge enables the geologist to gauge by the help of theories founded on other people's experience as well as his own," seems to assume a dangerous position and to tend to a reliance on theory, rather than actual testing, to determine the value of any mineral deposit.

The working notes are necessarily fragmentary, dealing as they do with alluvial working, including dredging; lode mining; methods of crushing, cyaniding, &c., in one short chapter. The book, however, contains many useful hints, and is one that should certainly appeal to the prospector in far lands.

The Coccidae of Ceylon. By E. Ernest Green. Part iv., with 39 plates. Pp. 251+344; plates xciv.–cxxxii. (London: Dulau and Co., 1909.)

THE work before us well illustrates the enormous recent development of our knowledge of entomology, for when Mr. Kirby published his "Catalogue of the Described Hemiptera Heteroptera and Homoptera of Ceylon," in the Journal of the Linnean Society (Zoology, vol. xxiv., 1891), he was only able to enumerate seven species of Coccidæ from the island—*Lecanium mangiferae*, Green (1889); *L. coffeae*, Walk. (1852); *L. viride*, Green (1889); *L. nigrum*, Nietn. (1861); *Pseudococcus adonidum*, Linn. (1758); *Coccus(?) floriger*, Walk. (1858), and *C. laniger*, Kirb. (1891).

Shortly afterwards, however, Mr. Green took up the systematic study of the Coccidæ in earnest, with such good results that he soon accumulated materials for a monograph of the Coccidæ of Ceylon. At first he estimated that it would probably run to four parts, containing thirty plates each; but now he finds that "the present (fourth) part contains many additional plates, which (with the several supplementary plates) bring the total number up to 135, or fifteen more than the number promised to my subscribers. For the completion of the monograph it will be necessary to bring out a fifth part, of double size, containing from fifty to sixty plates." Even so, considering the rapidity with which material accumulates, we should not be surprised if a further extension, or a speedy supplementary part, may not be found necessary.

But, however this may be, part iv. contains the conclusion of the subfamily Lecaniinæ, with nine genera and nineteen species; and the new subfamily Asterolecaniinæ, with six genera, 24 species, and two varieties.

The work is based almost entirely on Mr. Green's personal observations, and a large proportion of the species described and figured are new. We have nothing but praise for the text and letterpress of this monograph of a family of insects which is important both as destructive to vegetation and, in some instances (as in the cochineal insect), as yielding products of considerable commercial value.

Colonsay, one of the Hebrides. Its Plants: their Local Names and Uses. Legends, Ruins, and Place-names. Gaelic Names of Birds, Fishes, &c. Climate, Geological Formation, &c. By Murdoch McNeill. Pp. viii+216. (Edinburgh: David Douglas, 1910.) Price 2*s.* 6*d.* net.

THE main purpose of the author is to publish a list of plants collected during some years' stay on the island, to which he has added general notes on the history, geology, and fauna. The author has been a keen observer of the birds, both migratory and native; among the former are the barnacle goose, pintail duck, and wild swan, while eider-duck and cormorants live on the outlying reefs or unfrequented coast, and guillemots, buzzards, and kestrel nest on the northern shores. In the same localities with the eider-duck are found shoals of seal, both the large grey and common species.

A chapter is devoted to the description of the woods, lochs, and pastures. The lochs are the most interesting botanically. The white water-lily, the common reed, and bottle sedge are the most conspicuous plants in the shallows; species of Potamogeton and *Callitriche autumnalis* are abundant in the deeper waters. The enumeration of flowering plants and ferns amounts to 567 species, but this number includes garden escapes. The author has been fortunate in obtaining the cooperation of special authorities on certain genera. Mr. A. Bennet has identified a dozen species of Potamogeton, and a similar number of Rubi are given on the authority of Rev. W. M. Rogers. Among the more typical and rare plants are *Spergularia rupestris*, *Lobelia Dortmanni*, *Sedum roseum*, *Myosotis repens* and *Ligusticum scoticum*.

The book is pleasantly written, and contains a considerable amount of observational matter scattered through its pages. The Gaelic names and quotations will only be appreciated by a limited number of readers.

LETTERS TO THE EDITOR.

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

The Stability and Efficiency of Kites.

IN NATURE of March 17 Mr. Dines suggests that the instability of kites may be due to changes in the relation of the weight to the velocity of the wind, or to deformation of the kite by excessive pressure, or that there is a critical velocity at which the forms of the stream-lines become so altered that instability results.

My own experience leads to the opinion that deformation by a strong wind is practically the only important cause of instability. At the Blue Hill Observatory, where the conditions for experimenting are unusually severe, the Clayton modification of the Hargrave kite is the only one that can be employed. In this form the longitudinal sticks are continuous from one cell to the other, and the lateral sticks form the front and rear edges of the cells which prevent the fluttering of the cloth unavoidable in kites the rigidity of which depends upon the tension of the covering. The Clayton-Hargrave kite is rigid, but there is no strain or tension anywhere except when flying, and it has proved itself to be sufficiently stable. Relief from sudden and excessive strain is necessary, and to secure this the bridle is made elastic, so that in strong winds the angle of inclination becomes smaller. Thus equipped, the kite is not uniformly efficient in strong winds, for, as the angle of inclination becomes smaller, the pressure of the wind upon the edges of the cells becomes relatively greater, and the altitude is reduced. A normal altitude of 55° to 60° may be lowered to 40° by an increase of wind of 15 to 25 metres per second. If the front cell of the kite is equipped with rigid curved lifting surfaces the efficiency is greatly increased, the mean altitude exceeding 60°, and the loss due to increase of wind is unimportant in velocities up to 25 metres per second.

Some of the lightest of these kites have flown in the strongest winds encountered while experimenting, the velocity in some instances having exceeded 30 metres per second. An interesting example of this kind occurred on April 14 during the international ascension. Two kites, weighing 600 and 850 grams per square metre, and having lifting surfaces of 11 and 7 square metres, respectively, were employed to lift the line. The outer section of the line was 1500 metres of wire having a tensile strength of 140 kilograms, and the next was 2500 metres long, having a tensile strength of 180 kilograms. The large light kite was placed at the outer end of the line, and the other at the junction of the two sections. At a height of 2000 metres, with 3500 metres of line out, two gusts of wind resembling thunder-squalls were encountered, the mean velocity for twenty minutes exceeding 30 metres per second, and the maximum reaching 33. The strain on the line at the ground did not exceed 90 kilograms, and, allowing for the weight of the line, probably did not exceed 110 at the second kite. The pull of the larger kite in a 10-metre wind is usually about 45 kilograms, and that of the smaller about 35, and, allowing for the pressure of the wind on the line, this, apparently, was not greatly exceeded. The large kite will fly in a wind of 5 metres per second, and was perfectly steady in a velocity of 33 metres per second. The pressures corresponding to these velocities are, respectively, 2 and 80 kilograms per square metre of surface exposed normally; hence it seems improbable that a well-made kite could become unstable through disproportionate weight or some unusual property of a high wind. It should be said that the velocities given are "true" velocities, and not to be compared with those from the large Robinson anemometers, in which the factor 3 is employed. The maximum velocity referred to, expressed in English units, becomes 74 miles per hour "true" velocity, 90 when reduced to the U.S. Weather Bureau standard, or about 100 miles per hour when reduced to the same scale as the Kew pattern when the factor 3 is employed.

In 1900, while comparing different wires for use as kite-lines, I found that, theoretically, the larger wires were the more efficient, although slightly weaker, weight for weight, than the smaller. The reason for this is that the pressure of the wind is more effective upon the small wires than on the large. A No. 10 wire weighing 2·16 kilograms per 1000 metres usually breaks at 85 kilograms. Its diameter is 0·61 mm., and the surface presented to the wind is 1 square metre for each 1650 metres of length. If we wish to double the strength of our line we employ a wire 0·93 mm. in diameter, weighing 5 kilograms per 1000 metres of length. The cross-section, however, has increased only one-half, the surface presented to the wind being 1 square metre for each 1100 metres of length.

An opportunity to secure experimental data did not present itself until January, 1908. Since then, in conducting the monthly kite ascensions at Blue Hill, I have employed small kites flown with small wires, and large kites flown with large wires, to determine the relative efficiency of the two systems. The results show very conclusively that the system of large kites and large wires is the more efficient, not only for the sizes experimented with, but very probably for much larger sizes. The lifting surface of the kites employed has varied from 3 to 13 square metres, and the line has been made up of pieces of wire varying from No. 10, of 85 kilograms, to No. 21, of 235 kilograms, tensile strength.

The opinion, held by many, that large kites are inferior to small kites in meteorological work is not sustained by these experiments. The Clayton-Hargrave kite when built with three sections can be made stronger for the same weight than when made with two or four sections. The increase of weight as the size increases is unimportant in meteorological experiments, for kites with lifting surfaces exceeding 15 square metres need not weigh more than 650 grams per square metre. The ability of these larger kites to withstand high winds apparently is greater than that of small kites, for the large and heavy sticks necessary in the framework, like the large wires, present relatively a smaller cross-section to the wind for a proportionate weight and strength.

Increased stability may be secured by placing two diverging vertical planes in the rear cell of a kite. If these planes are adjustable, the kite may be caused to fly on either side of the mean direction of the wind, or any errors of flight may be corrected.

The entire question of stability appears to be one of eliminating unequal strains and unnecessary resistances.

F. P. FERGUSSON.

Hyde Park, Mass., U.S.A., April 20.

I AM much interested in Mr. Fergusson's letter, and his long experience with kites, about double my own, makes me very diffident about expressing an opinion contrary to his.

Doubtless deformation is a very fruitful source of instability, but after carrying out some thousand kite ascents from a steamer and on land, I am of opinion that it is not the only cause. However, my position is that we do not know with certainty the cause of instability, and it is very desirable at the present time that we should know beyond dispute.

I agree with Mr. Fergusson as to the advantages of large kites; they are more stable than small ones, and, as he has shown, since the wind resistance on the wire is the one serious obstacle to reaching great heights, it is obviously desirable to make that resistance small in proportion to the other forces. But there are practical objections. Large kites and thick wire require a stronger and more expensive outfit, and more assistance at starting and landing; also, should an accident occur, the risk of its being serious is far greater.

I do not agree with Mr. Fergusson that the Clayton-Hargrave kite is the only one that can be used when the wind is strong. The conditions in England in the winter are probably more severe than at Blue Hill, and have been particularly severe during the last winter. Nevertheless, the strength of the wind has on no occasion prevented our

flying a kite with non-rigid edges at Pyrton Hill, and we have been fortunate in breaking only one kite in landing it, and in not failing once since last October to bring back the kite to the starting point without accident; also Mr. Cody's kite, which has non-rigid edges, will certainly fly in a strong wind.

Mr. Fergusson states that a kite of 7 square metres surface will exert a pull of 35 kilograms in a wind of 10 metres per second. In English units this is equivalent to 1 lb. per sq. foot of sail area in a wind of 22½ miles per hour. If the whole area were exposed normally to the wind, the pressure or pull would be 53 kilograms, and hence, remembering that the back sails are partially sheltered by the front, and that the angle of incidence is only about 15 degrees, 35 km. seems a very high value. The pull of a diamond-shaped box kite of 7 metres sail area in the same wind is certainly below 15 km. It would be interesting if Mr. Fergusson would tell us how the wind at the kite is measured at Blue Hill. I do not think any anemometer placed in the kite can be trustworthy—one might as well place one close to the roof of a house amongst a set of chimney stacks—and if an anemometer is placed on the wire there is the difficulty of avoiding oscillation and of correct orientation.

I am glad to be able to state that we do not now officially publish in England values of wind velocity based on the factor 3 for the Kew pattern Robinson cups, but on the factor 2·2. This reduces what would have been called 100 to 73; but the values quoted by me in my letter of March 17 are entirely independent of the Robinson anemometer. For reasons fully given in a recent publication of the Meteorological Office (M.O. 202) those values are doubtful, but the evidence is in favour of their being too low rather than too high.

I should like to take this opportunity of replying to Mr. Gold's criticism of the method of measuring wind velocities on a kite in England, namely, by measuring the tension of a piece of cotton carrying a light sphere at the far end, away from, and out of the influence of, the kite (NATURE, April 21). It is true that the surface of the cotton exposed to the wind is comparable with that of the sphere, but the force is for all practical purposes a normal one, since the tangential component is admitted by all to be very small. It follows that the tension of the cotton, neglecting its weight, is the same throughout, just as in the case of the string stretched on a smooth curve given in text-books on mechanics, and hence the tension measured is the tension of the cotton where it is tied to the sphere, and is independent of the length.

W. H. DINES.

A Difference in the Photoelectric Effect caused by Incident and Divergent Light.

RECENT investigations have shown that the ionisation produced by the secondary rays arising from a thin metal plate traversed normally by a primary beam of Röntgen or γ rays is greater on the emergent than on the incident side. The present experiments were made to see if a similar effect could be detected with ultra-violet light.

Thin films of platinum were prepared by sputtering from a platinum kathode on to quartz plates 1 mm. thick. These could be mounted in the centre of two similar brass cylinders so that their planes were perpendicular to the axes of the cylinders. A narrow beam of ultra-violet light from an arc passed down the axis of the two cylinders normally to the plates. The saturation current from the illuminated plates to the cylinders could be measured. The plates could also be turned so that the film side was either away from (position A) or towards the light (position B).

In every experiment two similar plates were used; one was used as a standard to determine the strength of the ultra-violet light, and its position, whether A or B, was unchanged. The other plate was compared with this for each of the two positions alternately. By referring each measurement to the standard plate, the otherwise troublesome variations of the arc were rendered harmless. Unless the films were very thick it was always found that position A gave rise to a relatively greater photoelectric current than position B, although it was penalised by having to pass through the thickness of the quartz plate.

When no allowance is made for the absorption by the quartz, a very thin film gives 12 per cent. more photoelectric current for the emergent than for the incident light. When the absorption of the quartz is allowed for the difference is increased to 16 per cent.

These results have been confirmed by reversing the direction of the light without altering the position of the plates, and other experiments have been made to ensure that they do not arise from scattered light or other defects in the apparatus. The ratio of the emergent to the incident effect has been determined for a series of films of varying thickness.

This investigation was suggested to me by Prof. O. W. Richardson, and the experiments have been carried out under his direction.

OTTO STUHLMANN, JUN.

Palmer Laboratory, Princeton, N.J., April 26.

A Link in the Evolution of the Bees.

THE ligula or "tongue" of the bees presents two main types, one broad, obtuse, and often emarginate, the other pointed, acute, frequently much elongated. The obtuse-tongued bees have been considered to be the more primitive, and there is no doubt that the most advanced types are long-tongued. The difference between the two groups has seemed so important that at one time (Trans. American Entomological Soc., xxix., p. 185) I entertained the idea that they had no common bee-ancestry, but were derived from different groups of wasps.

Frederick Smith, in 1853, described a new genus of bees from Australia under the name Meroglossa. This was based on a male from Port Essington, which had many of the characters of the obtuse-tongued Prosopis, but had a pointed, dagger-like tongue. Ashmead, in 1899, placed it in the same group as Prosopis, in spite of the tongue; in 1905 (Trans. Amer. Ent. Soc., xxxi., p. 318) I gave an account of Smith's type, remarking that it was "not unlike some Prosopis." In 1905 I described a number of Australian species supposed to belong to Prosopis, but remarked of one of them (*P. turneriana*) that the mouth-parts did not seem to agree with the genus. I had at that time no material for dissection, but Dr. R. C. L. Perkins had such material, and discovered that several had acute tongues. In Proc. Hawaiian Entom. Soc., October, 1908, he founded the genus Palæorhiza for my *P. perviridis*, with the following interesting remarks:—

"Palæorhiza is evidently represented by many species in Australia. Several have been described as belonging to the genus Prosopis, in spite of the fact that the most superficial examination shows that these insects have an acute lanceolate tongue. Hitherto no connecting-link between the blunt-tongued and acute-tongued bees has been recorded, but in Palæorhiza we have a form which, except for the structure of the tongue, would be assigned to the section of Obtusilingues. It will therefore be obvious that this section and the Acutilingues can no longer be maintained as of great importance, since Palæorhiza must always be associated with Prosopis, as the male genital characters, and all other ones, save the lingual, clearly show."

Nevertheless, he proposes for Palæorhiza a distinct family, Palæorhizidæ, at the same time suggesting that it should be Meroglossidæ if Meroglossa is allied.

In the course of going over the splendid collection of Australian bees formed by Mr. Rowland E. Turner, now the property of the British Museum, I have been able to examine the structure of a number of species of Palæorhiza. In the first place, I find that Palæorhiza and Meroglossa are substantially the same genus; but the truly astonishing thing is that the females have broad, obtuse tongues like Prosopis, while the males have sharp, dagger-like tongues! I first discovered this in *P. penetrata*, subsp. *percrassa* (properly *Meroglossa penetrata percrassa*), a black insect with the face of the male canaliculate, much in the manner of the original type of Meroglossa. My natural thought was that there must be two species, in spite of every appearance to the contrary. I next took

the undoubted sexes of *Meroglossa parallela* (Ckll.), a metallic insect related to the type of Palæorhiza, and these showed exactly the same thing. I then looked at a new species (*Palaeorhiza* or *Meroglossa melanura*), with a honey-coloured abdomen black at apex, the mesothorax striped with yellow and black, and the base of the metathorax finely longitudinally fluted. In this the sexes were associated without a doubt, and the difference in the tongues was as in the others. Still others were examined, all with the same result. It appears that the female in this genus lacks, or fails to develop, the determiner which represents the pointed apex of the tongue. Another peculiar character, a comb on the first two joints of the maxillary palpi, is common to both sexes of Meroglossa.

Another generic name for Australian bees must fall. The study of additional material shows that my Prosopisteron is not valid; its type-species must be known as *Prosopis serotinella*.

The extraordinary *Pachyprosopis mirabilis* of Perkins, described from N. Queensland, without further data, was taken by Mr. Turner at Mackay in May, 1900.

T. D. A. COCKERELL.

University of Colorado, Boulder, Colorado, U.S.A., April 21.

Fluorescent Absorption.

IN NATURE of January 6 Mr. Burke criticises the conclusions which I drew from my experiments proving that fluorescent absorption does not exist (*Phil. Mag.*, 1909).

The method which I devised was a direct one, and free from all sources of error. I cannot see any point in Mr. Burke's criticism; I used a scheme for making the source of light and the fluorescing absorbing cell intermittent, throwing the flashes either "out-of-step" or "in-step" at will. If the flashes were out-of-step, the light from the source traversed the absorbing cell while it was not fluorescing. This flash entered the eye, and was immediately followed by the flash of fluorescent light from the cell, the source being in darkness during its emission. The total amount of light, or the sum of the two sets of flashes, was the same whether they were "in-step" or "out-of-step," showing that the absorbing power of the cell was not increased by its fluorescence. Mr. Burke now appears to stand alone as a champion of fluorescent absorption, for Nichols and Merritt have recently repeated their work with improved apparatus and methods (one of them being a modification of my stroboscopic method), and have failed to find any trace of the phenomenon.

R. W. WOOD.

Johns Hopkins University, April 28.

Centre of Gravity of Annual Rainfall.

MR. WATT'S *nil admirari* attitude towards the C.G. of annual rainfall is unfortunate, for, notwithstanding his disclaimer in the first sentence, I find that his statement in the last sentence of his letter in NATURE of April 28 is another *a priori* shot! In the Mysore rainfall annual reports of the last fifteen years I have given diagrams of the monthly rainfall of the eight districts as percentages of the yearly totals, but they are not *simple*, or *similar*, or *symmetrical*. Yet year after year there is a close agreement in the C.G., or date round which each year's rainfall balances. *Verb. sat, sap.*

J. COOK.

30 Hermitage Gardens, Edinburgh, May 3.

Impure Manganese Di-oxide.

A FEW weeks ago I had occasion to order a quantity of manganese di-oxide for general lecture and laboratory experiments, and we duly received the same from a well-known firm the name of which it would be invidious to mention. Although in colour the manganese di-oxide was normal, we soon found that its chemical properties were very erratic. When mixed with potassium chlorate and heated gently, the mass inflamed inside the flask, and a reaction proceeded with explosive violence, resulting in the formation of clouds of smoky gas relatively poor in oxygen. When warmed with concentrated hydrochloric acid the action was unusually vigorous, and an inferior grade of chlorine was evolved possessed of a curious odour resembling that of euchlorine. The black colour of the powder rapidly disappeared, yielding a yellow solution, and a white, insoluble residue, which, from its voluminous appearance, suggested silica.

One of my senior students, Mr. William Davison, thereupon analysed the di-oxide, and obtained the following results:—

	Per cent.
Manganese di-oxide	60·06
Antimonious oxide	33·64
Silica	2·20
Ferric oxide	3·00
Arsenious oxide	trace
Sulphur	trace
Moisture	1·05
	99·95

That this was a case of wilful adulteration I do not suppose for a moment; but it seems desirable to direct the attention of teachers and others to the possibility of such a common and cheap article as manganese di-oxide being sold, not only in an impure form, but in one which it is positively dangerous to use with potassium chlorate for such a simple and universal experiment as the preparation of oxygen.

J. NEWTON FRIEND.

The Technical College, Darlington, May 6.

BRITISH NEW GUINEA.

COLONEL MACKAY was chairman of a Royal Commission appointed to proceed from Australia to inquire into the present conditions of the territory now known as British New Guinea. As such, he proceeded along the south coast of the island to its eastern extremity, then visited the D'Entrecasteaux and other groups in the offing, subsequently proceeding along the north coast to Buna Bay. Here he left the sea and struck inland to visit the Yodda Goldfield, returning overland to Port Moresby. This was the most arduous and interesting part of his journey, for the Owen Stanley Mountains, which here reach about 7000 feet, had to be crossed. Apparently the range really consisted of a series of more or less parallel ridges, up and down which the party was scrambling for seventeen days, camping during much of the time in tropical rain forest.

It is the record of the above trip which "Across Papua" presents to us in pleasantly written form. The expedition was not in any way a scientific one, but the author shows that he has considerable powers of observation. He notes "the absence of stone on the higher ridges, and the extreme narrowness of their root-strewn, moss-carpeted crests. How also, as we approached the higher altitudes, lichen and moss gradually enveloped the timber until they covered limbs and leaves alike; but what impressed me most was the serene calm that reigned over all, for I heard no crash of fierce or fearful animal, no sound of human voice, no song of radiant bird in all that kingdom of mist and sunshine, of sparkling dew-gems, and immemorial silence."

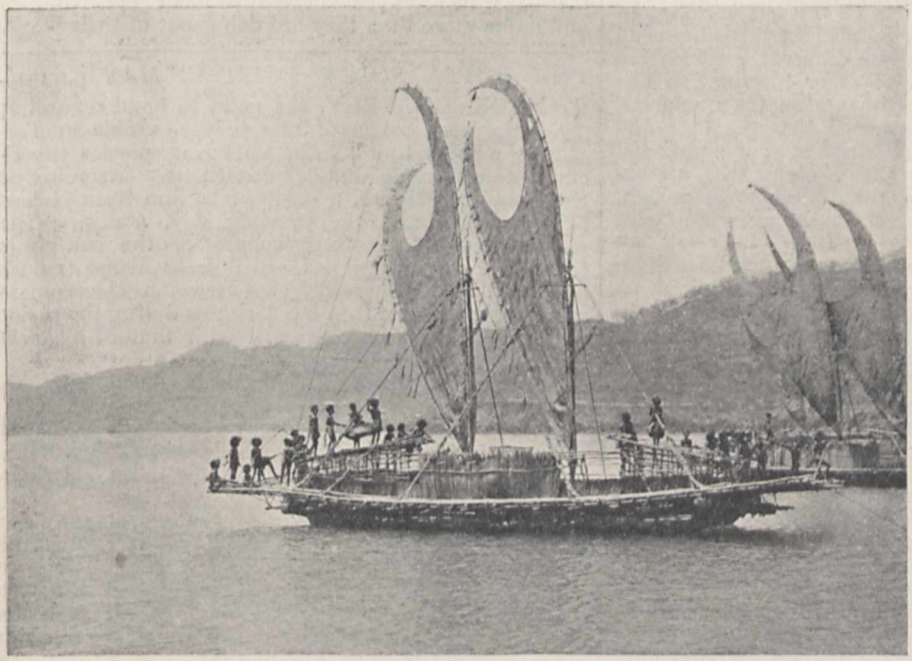
The truth of this traveller's description we know well, but what wealth it suggests to the tropical naturalist—the enormous variety of plants which make up such a forest, each with its peculiar insects, many lizards and frogs showing quite peculiar adaptations to their damp environment, peculiar land shells on every ridge. The natives live on the lower slopes, but seem to be less cannibal and of better stock than

[1] "Across Papua." Being an Account of a Voyage Round, and a March Across, the Territory of Papua with the Royal Commission. By Colonel Kenneth Mackay. C.B. Pp. xvi+192. (London: Witherby and Co.) Price 7*s.* 6*d.* net.

those of the coast. Here would be an unique chance. At present the country is untouched, but in a dozen years it may well be opened up, and if gold be found all would fall before the axe.

Colonel Mackay's observations suggest much work, too, for the ethnologist. The Yodda Goldfields have brought to light red pottery with designs, and stone bowls with patterns on their rims, indicating that the country was once occupied by a race superior to the present Papuans. The latter, too, even on the coast, are interesting enough, but they are fast getting spoilt by the missionaries and traders. Those of the hills near "the gardens of the ghosts" are still untouched, making mummies of their dead, for whom they have a supreme respect. The splay-footed people near Cape Nelson should also be well worth a visit.

It is rightly pointed out that no tropical country can remain long undeveloped, owing to the teeming millions of the overcrowded East, and British New Guinea, to be secure, must be opened up. Coco-nuts, coffee, cocoa, and rubber will probably in a generation cover most of the available land, while gold may



Native Trading Vessels of Port Moresby. From "Across Papua."

cause still more rapid growth. The book before us will doubtless assist this development, as the conditions and climate are shown to be by no means worse than those of Ceylon or the Straits not many years ago. Perhaps this is the aim of the book, but we confess that we desire the more solid observations of a trained naturalist. Unfortunately, such have not always the brightness and sense of humour possessed by Colonel Mackay. J. S. G.

SOME RECENT AGRICULTURAL FIELD TRIALS.[1]

SINCE the application of the "whisky" money to agricultural education in Great Britain a considerable amount of experimental work has been carried on by some of the more energetic of the county committees. A few of the experiments deal with animals but by far the greater number with crops, presumably because the expense is less; they serve a variety of useful purposes, arousing an interest in practical agriculture, showing the farmer (if, indeed, he needs showing) that artificial manures will give increases in crop, and, finally, they may furnish very useful material for the county agricultural lecturers.

Field experiments are perhaps the most difficult of all experiments to interpret. The growth of plants is influenced by so many factors—temperature, water supply, food supply, &c.—that small variations in the conditions may lead to marked differences in result. The soil is a very complex mixture and not uncommonly shows some variation even within the limits of a single field. Even if the soil itself is tolerably uniform a slope may introduce irregularities. The influence of a tree or hedge makes itself felt for some distance, while the effect of the previous treatment of the ground is often very great. Of course, if the intention is mainly to get up an interest in agricultural trials these considerations are of little moment, but they assume great importance where it is desired to give definite information about the effect of manures on the crops. A perusal of the reports before us leaves a rather mixed impression. There has been a vast amount of work done, and much industry and energy have been displayed, but it is not always clear that the experimenters have grasped the first principles of the art of making experiments. In no case is the experimental error indicated, nor can we find it has been ascertained; indeed, so far as we know, it is only at Rothamsted that the determination is made, and there, where all the conditions are favourable and the workers thoroughly competent, it amounts to 10 per cent.

In the Sussex experiments a number of plots were laid out on each of twenty farms and received various combinations of artificial manures. As the experiments have only gone on for one year it is impossible to draw any definite conclusion, so great is the disturbing effect of season. In the discussion all the results have been averaged, in spite of the fact that the soil varied from a chalk loam in some centres to a heavy clay probably destitute of chalk in others. It is, of course, not legitimate to take an average of incomparable quantities, and we suggest that more useful results would be obtained by arranging the soils into strictly comparable groups.

The Northumberland experiments have gone on for a longer time and averages for several years are given, so that the effect of season is more or less eliminated. They are well known as illustrating the value of basic slag in improving poor clay pastures. On the light soils potash has been found very effective. A more detailed study could be made if the

[1] West of Scotland Agricultural College, Reports on Experiments; Durham County Council Education Committee, Report of Dairy Investigations; Northumberland Education Committee, Guide to Experiments for 1909; East Sussex Education Committee, Experiments on Meadow Hay; Agricultural Students' Gazette, Experiments on Pasture; Journal of the Department of Agriculture and Technical Instruction for Ireland.

error of the experiment was known. Thus we are informed that the most effective slags are those in which a high percentage of the phosphates present dissolves in citric acid. On looking at the figures, however, we find that the extreme difference in yield is little more than 10 per cent., which is probably well within the experimental error.

Percentage of phosphoric acid soluble in 2% citric acid	93·1	74·2	66·1
Hay obtained, in cwts.	9½	9½	8

Again, one of the conclusions drawn from the rotation experiments is that sulphate of ammonia has had distinctly exhausting results except on the crop to which it was applied. The fall in yield, however, is only 7 per cent. In neither case is the conclusion justified by the evidence.

Among the West of Scotland reports is one in which the new nitrogen manures, cyanamide and basic calcium nitrate, are shown to have given valuable returns. Most of the reports deal with different varieties of oats and potatoes. General conclusions cannot be drawn since we are told "that the character of the seasons was found to affect the relative as well as the absolute productiveness of the oat varieties in an astonishing degree." A number of measurements of the straw and grain of these different varieties are recorded, and a good deal of other information has been collected. In the experiments on the manuring of potatoes it generally happened that the best and most profitable crops were obtained after applying ten tons of farmyard manure per acre along with a complete dressing of superphosphate, sulphate of potash, and sulphate of ammonia, a result agreeing with others obtained elsewhere.

The Cirencester experiments on pasture have been going on for eighteen years or more, and show some interesting results worth working up in greater detail, since they differ in several ways from those obtained at Rothamsted. Thus superphosphates alone gave better results than no manure and also encouraged clover; the plot receiving sodium nitrate alone was poor, tufted, and worse than the plot receiving ammonium sulphate alone; Ustilago was most prevalent on the plot receiving kainit alone.

The Irish experiments on winter milk production and winter rearing of calves were made to see if either of these schemes would pay. At present Ireland places but little butter on the market during winter, with the result that the summer trade suffers. It is considered that higher prices would be realised in summer if the winter trade could be developed. Satisfactory financial results were obtained. The reports derive considerable interest from the tables of costs, a welcome though rather unusual feature in experiments of this sort.

The Durham dairy investigations were intended to settle certain practical points such as the feeding of concentrated food on pasture and the relative value of moderate and heavy rations for milch cows. It was shown that an increase in food caused an increase, but not a proportionate increase, in milk yield, a result in accordance with Holtsmark's very complete investigations in Norway. Brewers' grains were, as usual, found to increase milk production, but no attempts were made to ascertain whether, as is sometimes asserted, they have any physiological action. This is all the more unfortunate since in a second series of experiments the materials for this study seem to have been at hand, the increase in milk yield amounting in the two experiments only to 0·7 per cent. and 3·3 per cent. There is nothing to indicate the magnitude of the experimental error, but as only five cows were taken in each set it cannot have been less than the quantities recorded. The only legitimate conclusion is that brewers' grains in this particular instance failed to produce their usual effect. Here is just the experiment that the trained investigator would have welcomed in order to follow up the subject. But the author of the bulletin not only misses the opportunity, but draws the wholly unwarrantable conclusion that a moderate allowance of 20 lb. of brewers' grains per day has the effect "of increasing, at all events for a certain period, the daily yield of milk"!

We have directed attention to these defects because they recur not infrequently in the work carried on in the counties. Unfortunately some of our agricultural experimenters have a habit of ignoring or explaining away an unexpected result. If only they would learn that to follow up an unexpected result is the beginning of wisdom in research work, we might make much greater progress in agricultural science than we are doing now. Of course, it may be urged that the object of the experiment is simply to arouse interest or to demonstrate some well-ascertained fact, so that scientific method is not necessary. Even if the experiments have served the purpose for which they were intended it is nevertheless much to be desired that the experimenters should realise their opportunities and make more than they are doing out of their work.

THE TOTAL SOLAR ECLIPSE, MAY 9, 1910.

UNFORTUNATELY, the news to hand regarding the observation of this eclipse, visible in Tasmania, tells us that all the observing parties experienced unfavourable weather conditions. According to the *Times* of May 10, a Reuter telegram from Hobart (Tasmania), dated the previous day, states, "The observation of the total eclipse of the sun from Bruni Island has failed, owing to dense clouds and rain. Mr. Baracchi, the Victorian Government astronomer, reports that the darkness during the period of totality might be compared with that of a starlit night."

A cablegram from Mr. McClean, dated May 10, shows that this party also met with no success, on account of bad weather. The message was as follows:—"Eclipse invisible, steady rain all day. Only two fine days last fortnight. Terrific gales and thunder frequent."

While it is most disappointing that no observations of this eclipse have been secured, yet it was rather anticipated that such would be the case, owing to the unfavourable time of the year for satisfactory weather conditions. Nevertheless, Mr. McClean deserves high praise for getting a party together, with a fine outfit of instruments, and going so far to make the attempt to secure observations. While he returns on the *Orvieto*, which leaves Melbourne on May 18, he has made arrangements to leave all his instruments out there so that he can pick them up for the total eclipse of next year. This eclipse will be best visible from some of the islands in the western Pacific, but it is not yet settled which particular one will form the basis of operations.

The last mail from Australia has brought some details as to the station which Mr. McClean is just leaving and the preparations he made, and it is hoped that these will be published in a subsequent number of NATURE.

W. J. S. LOCKYER.

PROF. E. F. W. PFLÜGER.

THE name of Pflüger has been made known to many generations of students as belonging to some inhuman agency by which, to their confusion and vexation, an edict was enacted known as "Pflüger's law." To how many of those students has the human picture ever been presented of the untiring

young *privat-docent*, working alone in his single room night after night for two years without an interruption until, in 1859, he published his accumulated results in a bulky volume, "Untersuchungen ueber der Physiologie des Elektrotonus," Berlin, 1859?

By the side of this picture of the active young searcher in the 'fifties of last century might be placed a picture of the no less active learner of the 'nineties who, at the age of seventy, with forty years of service behind him as professor of physiology in the University of Bonn, and with no worldly reward in front of him of money or position or of fame, day by day and month by month carried out with his own hand the mechanical *minutiae* of daily quantitative estimation of nitrogen necessary to satisfy his mind as to the balance sheet of nitrogen of a dog under physiological conditions strictly supervised by himself, and, as is shown by the 131 volumes of Pflüger's *Archiv*, of which the first volume appeared in 1868 and the 131st in 1910. His faithful service to physiology continued for ten years longer, to the fifty-first year of his ordinary professorship, to the eighty-first year of his life.

Eduard Friedrich Wilhelm Pflüger, born in 1829, a pupil of Johannes Muller, is the last of the great German school of physiological and biological workers —Hæckel, Lieberkühn, Du Bois Reymond, Henle, Ludwig, Brücke, Helmholtz, Pflüger.

Pflüger lived a retired life, devoted to his work in the laboratory and in the library, which he hardly ever left, and in which he did not welcome the interruption of the visitor; *no one admitted except on business* might well have been the inscription upon his door, and he was never seen at physiological congresses. I count among one of the pleasantest recollections of my life a day spent in Pflüger's laboratory with Pflüger himself and Heinrich Herz, whose simple demonstration of Maxwell's forecast had been made in the previous year, and whom death so soon cut short. We spent the day watching the movements of Lippmann's capillary electrometer, and the time passed unnoticed; there was no inhumanity in connection with the author of Pflüger's law when the accuracy of a physiological assertion of fact was to be scrutinised.

To the scientific world Pflüger's permanent monument consists in the 131 volumes of Pflüger's *Archiv*. Many workmen have contributed to that monument, and, among the mass of contributions, the work of Pflüger himself stands good as well and truly laid. The mechanism of spinal action in the frog, and his law of reflex action as studied upon the decapitated animal, were his earliest subjects of study, and are to-day still classical. We cannot discuss the mechanism of nervous coordination without at once appealing to the experiments of Pflüger and the decapitated frog more than fifty years ago, in preface to our discussion of the experiments of Sherrington on the spinal mammal which belongs to the last decade.

The tenth volume of Pflüger's *Archiv* (1875), containing his paper, "Ueber die Physiologische Verbrennung in den lebendigen Organismen," has played an important part in our knowledge and notions as to the chemical respiration of the tissues.

Pflüger's bloodless and salted frog continuing to discharge CO_2 in an atmosphere of nitrogen or in vacuo is clear evidence that CO_2 is not due to the immediate action of oxygen, but that it is formed from the dissociation of some storage compound, or, as Pflüger expressed it, previously absorbed oxygen has helped to wind up the physiological clock, the CO_2 discharged at the moment is a sign that the clock is running down. In discussing the latest contribution to our knowledge of this subject, those, for instance, brought out by Leonard Hill as regards the beneficial effect of oxygen upon muscular work, we are obliged to refer to Pflüger's teaching.

Nutrition, its debtor and creditor account in the body in terms of nitrogen and of carbon; glycogen, its relation to carbohydrate antecedent and its questionable relation to protein antecedents; fat, its absorption, relation to carbohydrate, the problem of diabetes and the origin of diabetic sugar, formed the principal field of Pflüger's unceasing labours during the last twenty-five years of his life.

Pflüger died on March 17, aged eighty-one, at the end of over sixty years of single-minded and unswerving devotion as a student of physiology, fifty years of which were spent as ordinary professor of physiology in the University of Bonn.

A. D. WALLER.

NOTES.

IN consequence of the lamented death of the King, and out of respect to his memory, many scientific meetings and other functions have been postponed or cancelled. The soirée of the Royal Society, announced for May 25, will not take place. The meetings of the society will not be resumed until May 26. The president of the Royal Institution has decided that the lectures and evening meetings be discontinued until further notice. The anniversary dinner of the Royal Geographical Society, which was arranged for May 23, will not be held; the anniversary meeting will be held as arranged, at 3 p.m. The meeting of the Royal Meteorological Society which had been fixed for Wednesday, May 18, has been postponed to Wednesday, May 25.

WE notice with regret the announcement of the death of Prof. S. Cannizzaro, Foreign Member of the Royal Society and professor of chemistry in the University of Rome, at eighty-three years of age.

AT the meeting of the Royal Society on May 5 the following candidates for fellowship were elected into the society:—Mr. J. Barcroft, Prof. G. C. Bourne, Prof. A. P. Coleman, Dr. F. A. Dixey, Dr. L. N. G. Filon, Mr. A. Fowler, Dr. A. E. Garrod, Mr. G. H. Hardy, Dr. J. A. Harker, Prof. J. T. Hewitt, Prof. B. Hopkinson, Dr. A. Lapworth, Lieut.-Colonel Sir W. B. Leishman, Mr. H. G. Plimmer, and Mr. F. Soddy.

Now that our returning summer migrants are being eagerly looked out for, and the arrival of many of them has been recorded during the last few weeks, the question arises in the minds of many people, "Do the same individual birds which nested last year come back to nest in the same place?" This is a question, of course, which might be equally well asked of our "resident" birds, but in the case of migrants, such as the swallow, which we know for certain does not winter anywhere north of Africa, actual proof that the same individual returns after its long journey to and fro, and its sojourn in its far off winter quarters, to the very same spot in which it nested the year before is sensational. Such proof in the case of one swallow, in any case, is just to hand. Dr. C. B. Ticehurst records the following in the last number of *British Birds*:—"On April 12, 1910, the first swallow (*Hirundo rustica*) was seen at 4 p.m. passing the house at Huntbourne, High Halden, Kent, which lies in the line of a small migration-route; at 6 p.m. a small flight of swallows passed over to the north, and from it four birds separated, and after flying round the house and settling on the chimney-pots, finally went to roost in a shed where two pairs bred last year. Two days afterwards I caught a

swallow at roost in this shed, almost certainly one of those that arrived on April 12, and found it was one which my sister had caught and ringed as an adult bird on May 8, 1909, the bird having come down one of the chimneys into one of the rooms. I may note that there was no mark or injury of any kind on the leg which bore the ring." The system of marking birds by aluminium rings will no doubt teach us much that we cannot learn by any other means. Last year more than 2000 birds were "ringed" by readers of Mr. H. F. Witherby's magazine *British Birds*, and this year at least double that number will be "ringed." Each ring bears a separate number as well as the inscription "Witherby, High Holborn, London," and careful details are kept of the date and place at which each bird was marked. Should any of these ringed birds fall into the hands of any readers of NATURE, Mr. Witherby would be glad to be informed of the date and place of the capture and the number on the ring.

PROF. WALTER NERNST, director of the Physical Chemistry Institute in the University of Berlin, has been elected an honorary member of the Manchester Literary and Philosophical Society.

AN International Conference will meet in Paris on May 18 to consider the questions raised by the development of aërial navigation, with the object of arriving at an international agreement with respect to them. Most of the European Powers will be represented. Delegates to represent the United Kingdom have been nominated by the Admiralty, the Army Council, the Board of Trade, and the Secretary of State for the Home Department.

THE prize of 20*l.* recently offered by the Scottish Meteorological Society for the best essay on a meteorological subject has been awarded by the council of the society to Mr. David MacOwan, of Edinburgh University, for an essay on "Atmospheric Electricity." The competition, it may be recalled, was open to students of the Scottish universities and to graduates of not more than five years' standing.

DR. AND MRS. SELIGMANN have returned from their first exploratory ethnological survey of the Anglo-Egyptian Sudan, to which they were appointed by the Anglo-Egyptian Government. They studied the hitherto uninvestigated Nubas of southern Kordofan, and the Shilluks, Dinkas, and Shir of the White Nile. A short time was spent between the White and Blue Niles, where a Neolithic site was discovered. Observations were made on the sociology and religion of various tribes, and some anthropometrical data were obtained, especially of the Nubas.

AT the meeting of the American Philosophical Society on April 23, the following foreign members were elected:—Prof. A. von Meyer, Madame Curie, Sir David Gill, K.C.B., Prof. E. Meyer, and Prof. C. E. Picard. We learn from *Science* that members of the U.S. National Academy of Sciences have been elected as follows:—Prof. F. R. Moulton, Prof. W. A. Noyes, Mr. T. B. Osborne, Prof. C. Schuchert, Prof. D. H. Campbell, Prof. J. Loeb, and Prof. J. Dewey. Dr. G. E. Hale has been elected foreign secretary of the academy, to succeed the late Prof. Alexander Agassiz. The Draper medal has been conferred on Dr. C. G. Abbot, director of the Astrophysical Observatory of the Smithsonian Institution.

THE Royal College of Physicians announces that the next award of the Weber-Parkes prize of 150 guineas and a silver medal will be made in 1912, and that the adjudicators have selected as the subject of the essay "The Influence of Mixed and Secondary Infections upon Pulmonary Tuberculosis in Man, and the Measures, Preventive and Curative, for dealing with Them." The Croonian lectures of the college will be delivered in June next by Dr. F. W. Andrewes, the Harveian oration in October by Dr. H. B. Donkin, the Bradshaw lecture by Dr. G. N. Pitt, the FitzPatrick lectures by Sir T. Clifford Allbutt, and the Horace Dobell lecture by Dr. W. Bulloch.

THE annual autumn meeting of the Institute of Metals will be held in Glasgow on September 21–22, on which days papers of scientific and practical interest will be read and visits made to works of metallurgical interest. An influential local committee, of which Prof. A. Barr is chairman and Dr. Cecil H. Desch is honorary secretary, has already been formed to carry out the necessary arrangements, of which further notice will be given in due course. There has been established at the offices of the institute a pathological museum for specimens of metals and alloys, the first contributions to the museum having been received from the president, Sir Gerard A. Muntz, Bart. This museum, which is the only one of its kind, ought to be of great service to all interested in the metallurgy of the non-ferrous metals, as it is intended that it shall contain specimens showing the various ways in which such metals as copper, brass, aluminium, &c., can fail either as a result of faulty manufacture or of improper usage.

A REUTER message of May 5 from San Juan del Sur, Nicaragua, stated that Cartago, Costa Rica, was practically destroyed by an earthquake at 6.30 p.m. on May 4. Five Central American Republics reported earthquake shocks. The *Times* Washington correspondent says that though Costa Rica is supposed to be the southern limit of the earthquake zone, the discussion has again commenced as to whether a sea-level canal would not have been more stable than the lock type for the Panama Canal now under construction. According to Reuter, two hours after the shock a brilliant meteor passed over the Costa Rica-Nicaraguan frontier, leaving a luminous track behind it, and augmenting the fears of the populace. As in many other cases, this earthquake occurred as the moon was approaching perigee on May 8 and conjunction on May 9, so that the conditions were favourable to deformation of the earth's crust.

AN International Congress in Naval Architecture and Marine Engineering will be held in London on July 4–8. From a preliminary programme issued by the Institution of Naval Architects we learn that there will be a reception on the evening of July 4, and that the congress will be opened formally on Tuesday, July 5. The mornings of July 6–8 will be devoted to the reading and discussion of papers in the halls of the Institution of Civil Engineers and the Institution of Mechanical Engineers. The programme will include, among others, papers contributed by Admiral Sir Cyprian Bridge, G.C.B., Sir Andrew Noble, Bart., K.C.B., Sir W. H. White, K.C.B., Sir Philip Watts, K.C.B., the Hon. C. A. Parsons, C.B.; *Italy*, Colonel G. Russo; *Japan*, Admiral Kondo, I.J.N., Count Shiba, and Prof. Terano; *Germany*, Dr. O. Schlick and Prof. Flamm; and *France*, Prof. A. Rateau.

THE fifteenth annual congress of the South-eastern Union of Scientific Societies will be held at Guildford on June 8–11 under the presidency of Prof. E. A. Gardner, Yates professor of archæology at University College, London. The presidential address will be delivered on the evening of June 9. There will be a reception by the Mayor on the evening of Wednesday, June 8, followed by the illumination of the Castle grounds, by the Mayor and Corporation, at whose invitation the union will meet at Guildford.

Papers will be read by Mr. Henry Bury, on the relation of the river Wey to the Blackwater and the Arun; Mr. E. A. Martin, on results of dewpond investigation; Mr. J. G. N. Clift, on the Pilgrims' Way between Farnham and Albury; Dr. W. Martin, the interpretation of maps of the sixteenth and seventeenth centuries; Dr. Vaughan Cornish, waves in sand and snow; Mr. J. W. Tutt, colour in insects; Mr. A. R. Horwood, the extinction of cryptogamous plants; and on Saturday evening, June 11 (after the congress), Mr. F. Enock will lecture on aquatic autocrats and fairies. There will be several excursions and receptions, and a loan museum, which promises to be of exceptional interest. The local secretary is Mr. Frank Lasham, 61 High Street, Guildford, who will send further particulars on inquiry.

IN the issue of the Archæological and Ethnological Publications of the University of California for March Mr. T. T. Waterman gives an elaborate account of the ritual of the Diegueño, or, as they call themselves, the Kawakipai, tribe occupying the extreme south of the peninsula. It is remarkable that they have a distinctive cultus of their own, bearing only a slight resemblance to that of their blood-kin the Mohave, or their immediate neighbours the Luiseño. These rites depend little upon their belief in spirit agency. They are based on one or other of two conceptions. The first is that in early infancy, and also at adolescence, persons of both sexes are in a condition of peculiar receptivity, children and young men and women being specially liable to external influences, both good and evil, the former being encouraged, the latter repelled by appropriate ceremonies. The second conception is the belief in the continued existence of the soul after death. Hence their mourning customs depend upon the fear of injury from the spirits of the dead, whom they endeavour to propitiate by various means, such, for instance, as by burning the goods of the dead man so that his property, in an etherealised form, may pass on for his use to the world of spirits.

DR. COMANDON gives details of the application of the kinematograph to the photography of micro-organisms in a paper published in the *Bulletin de la Société d'Encouragement pour l'Industrie nationale* (T. 113, No. 3, p. 318). Dark-ground illumination was adopted with sixteen views per second, the exposure being 1/32 of a second. Such objects as trypanosomes and spirilla in blood seem to lend themselves well to the method. It is to be noted that Mr. Duncan in this country several months ago had taken kinematograph views of the circulation of the blood in the frog's web, &c.

THE Bulletin of the Johns Hopkins Hospital for March (xxi., No. 228) contains several papers of scientific interest, notably one by Major F. Russell (Medical Corps, U.S. Army) on anti-typhoid vaccination. No untoward results occurred in a series of 3640 vaccinations, and the author believes that the procedure undoubtedly protects to a very great extent against the disease, and is a useful adjunct to other prophylactic measures. In the April number of the Bulletin (No. 229) Drs. Marine and Zenhart make the interesting observation of the occurrence of gôitre (active thyroid hyperplasia) in fish. The fish were principally pike and bass of Lake Erie, and it is of interest that, in the same district, human gôitre is prevalent, suggesting that the disease is in some way associated with water, an hypothesis long held in connection with gôitre in man.

THE Bulletins of the Sleeping Sickness Bureau for March and April (vol. ii., Nos. 15 and 16) contain the usual useful summary of investigations on trypanosomes, sleeping-sickness news, &c. The latter number contains a translation of an important memoir by Dr. Carlos Chagas on the new human trypanosome discovered in Brazil, and already referred to in NATURE (vol. lxxxi., 1909, p. 46). The parasite seems to be conveyed by a species of bug (probably *Conorrhinus megistus*, Burm.), the developmental cycle occupying a period of at least eight days. Monkeys and small animals are easily infected. The record of human cases is at present meagre; in fact, laboratory work in this case seems to have outpaced the clinical. The Bureau has also issued a "subject-index" to the "Bibliography of Trypanosomes," with corrigenda, compiled by Mr. C. A. Thimm.

SOME experiments described by Mr. G. T. Atkinson in the last number of the Journal of the Marine Biological Association will be of interest to naturalists engaged in fishery research work. In a previous number of the same journal Mr. Atkinson showed that the plaice taken from the recently exploited fishing grounds in the Barentz Sea has a much slower growth-rate than similar fish in the North Sea, and also that the males and females did not become mature until much older than in home waters. In the course of a recent voyage to the Barentz Sea in a Hull steam trawler, Mr. Atkinson brought back a number of living plaice, and marked and liberated these fish in the North Sea in the vicinity of the Dogger Bank. The experiment was highly successful, and in the course of a year about half the plaice had been recaptured. The growth was very rapid when compared with that of normal North Sea plaice, and there was a great improvement in the "condition," this always having been characteristically poor in plaice caught in the Barentz Sea and in Icelandic waters. Such experiments as these point to the possibility of a future rational regulation of the sea-fisheries. Traditional methods of the control of the industry—restriction of fishing gear, fishing apparatus, inspection, and the like—have proved to be rather futile proceedings, and investigations such as that now under notice point to the practicability of the actual cultivation of the truly sea fishes. It is pointed out by Mr. Atkinson that not only plaice, but even the valuable halibut, may possibly be transplanted into the North Sea, and that even such comparatively expensive operations as these are likely to be would be better economy than glutting the market with plaice of such poor quality that they sell for less than one-tenth the price of good North Sea fish, while many have actually had to be used for manure.

AN important contribution to the vexed question of the cytology of yeast is made in a beautifully illustrated paper published in the *Annals of Botany* (January), by Messrs. Wager and Peniston. In general confirmation of the earlier work of Mr. Wager, the authors regard the nuclear apparatus of the cell as consisting of the characteristic vacuole, which is so prominent a feature of this organism, together with a nucleolus, which is a homogeneous spherical or oval body lying outside, but in close contact with, the vacuole, and consisting of a plastin-like substance having very little affinity for nuclear stains. The vacuole contains a clear sap and a nuclear network, and both this and the nucleolus may become more or less impregnated with chromatin. This occurs to the greatest degree during the period of highest fermentative activity, and at the same time the chromatin, previously diffused throughout the cytoplasm, disappears. Other remarkable changes in the nuclear apparatus also accompany the process of fermentation, and it is clear that the nucleus is actively concerned in the phenomenon. In bud formation the nucleolus divides amitotically, and one portion passes into

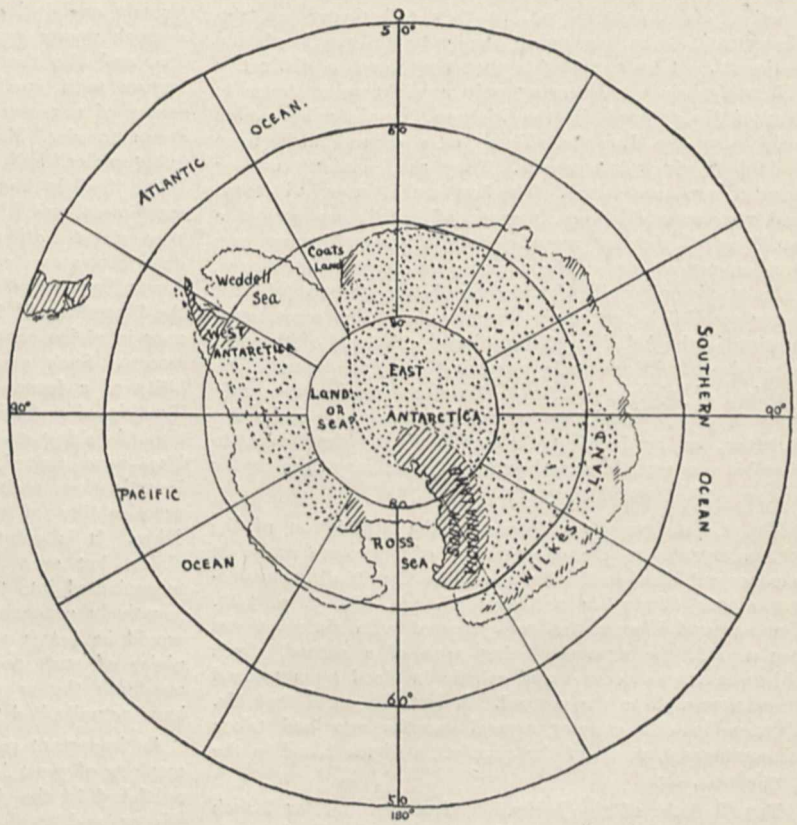
the daughter-cell, together with a portion of the vacuole and chromatin. In spore formation the vacuole disappears, and the nucleolus then divides, forming two nearly equal portions, between which the granular chromatin is shared, and which again divide. Volutin granules occur in the cytoplasm and vacuole, and glycogen is deposited in vacuoles in the cytoplasm, and appears and disappears with astonishing rapidity under varying conditions of nutrition.

AN account by Mr. F. Pitcher of Victorian vegetation in the Melbourne Botanic Gardens, which appears in the *Victorian Naturalist* (vol. xxvi., No. 11), was prepared with the three-fold object of pointing out a few specimens of trees dating back to pre-settlement days, supplying a list of native plants under cultivation in the garden, and recommending a few of these as suitable for general cultivation. Of the last, the small flowering shrubs, for the greenhouse, are *Bauera rubioides*, *Bossiaea cinerea*, *Grevillea ericifolia*, *Hibbertia stricta*, *Leucopogon virgatus*, and *Tetratheca ciliata*.

AMONG the remarkable instances of plant dispersion cited by the Rev. G. Henslow in a lecture addressed to the fellows of the Royal Horticultural Society, the most striking is that of *Oxalis cernua*. This is a bulbous plant, indigenous to South Africa, that has spread to the Bermudas, Canaries, and Madeira, as well as along the north and south coasts of the Mediterranean. It appears to have been originally introduced to Malta, where it now carpets roadsides, covers old walls, and is generally ubiquitous. The plant in its native habitat is trimorphic, but in Malta and along the Mediterranean only one, the short-styled, form occurs, so that propagation is effected entirely by bulbs, borne on thread-like stems that proceed from the parent plant. In rich soil the stems may also grow above ground, forming runners. Further details will be found in the journal of the society (vol. xxxv., part iii.), where the lecture is published.

THE Bureau of Entomology of the United States Department of Agriculture adopts the very useful plan of issuing bulletins in which full accounts are given of the various insect pests troublesome to farmers, market gardeners, and fruit growers. Mr. Webster describes the lesser clover-leaf weevil (*Phytonomus nigrirostris*, Fab.), a fairly common European insect that appears to have got into the States some forty years ago, but is not yet very widely distributed there. It is, however, capable of doing so much damage if once it is thoroughly established that a careful watch is rightly being kept. A fungus (*Empusa* [*Entomophthora*] *sphaerosperma*) was found to destroy the pupæ. Mr. Phillips deals with the slender seed-corn ground-beetle (*Clivina impressifrons*, Lec.), which attacks recently planted maize seed in swampy, peaty soils. It is a native of the eastern States, and, of the whole genus, is the only species that lives on plants, the others being carnivorous, according to our present knowledge. Dr. Chittenden describes the parsnip-leaf miner (*Acidia fratria*, Loew.), the parsley-stalk weevil (*Listronotus latiusculus*, Boh.), an insect usually associated with aquatic or semi-aquatic vegetation, but found occasionally on terrestrial plants, and the celery caterpillar (*Papilio polyxenes*, Fab.), which attacks practically all umbelliferous plants—celery, carrot, parsley, parsnip, and so on. The larvæ are very conspicuous, and are readily picked off the plants; moreover, certain ichneumon flies destroy the insect in its pupal stage. Another bulletin, by Mr. Sanders, is devoted to the Euonymus scale (*Chionaspis euonymi*, Comstock), which can be kept in check by kerosene emulsion.

THE current number of the *Zeitschrift* of the Geographical Society of Berlin (1910, No. 3) includes statements as to the aims of the projected German Antarctic Expedition by the leader, Lieut. Filchner, and by Prof. Penck, and a message of goodwill from Prof. Otto Nordenskjöld. The plan of the expedition is based on the hypothesis that the



Sketch-map illustrating the possible connection of the Ross and Weddell Seas.

Ross Sea is directly connected with the south-western part of the Weddell Sea by a narrow belt of sea separating the main area of Antarctica from the land which is assumed to connect Graham Land and King Edward the Seventh Land. This possibility, and also the view that the Antarctic land to the south of the Pacific consists only of an archipelago, must have occurred to all who carefully considered the results collected by the expeditions of Captain Scott and Sir Ernest Shackleton. The meteorological evidence and the apparently well-marked westward trend of the land which drove Sir Ernest Shackleton on to the South Polar plateau seem, however, not very favourable to the idea of the direct connection of the Ross and Weddell Seas. Indications of any such connection might also have been expected from the tidal observations of the *Discovery*.

The evidence, however, is so uncertain that all geographers will hope that Lieut. Filchner will settle the problem by direct observation. Prof. Penck insists that to determine this question is much more important than reaching the Pole. His letter closes with the announcement of a contribution by an anonymous donor of 300,000 marks.

IN the monthly meteorological chart of the North Atlantic Ocean for May, issued by the Meteorological Committee, we note with pleasure two advances of considerable importance in maritime meteorology:—(1) Synoptic charts for barometer and wind have been drawn for the Atlantic and adjacent coasts, for 7h. a.m. daily, for current dates, based upon telegraphic reports for north-western Europe, reports by radio-telegraphy from the Atlantic, and information given in the Paris *Bulletin international*. These data cannot fail to be of great use in elucidating the conditions which affect the weather changes of our own region. (2) Charts showing the temperature of the sea surface, also for recent dates, are drawn for the North Atlantic for consecutive periods of seven days, with isotherms for each 10° F. As these means correspond to those given for the land in the *Weekly Weather Report*, they will be available for tracing any connection which may exist between sea temperature and the weather over the British Islands. We also note that the area of the monthly chart relating to the Indian Ocean has been extended from lat. 15° S. to 35° S., thus embracing the region traversed by vessels trading to India, China, &c.

Cosmos of April 23 states that Chile has fallen in line with Japan, Italy, Austria, Germany, France, Russia, the U.S.A. and other countries by establishing a Seismological Service. The director is the distinguished seismologist Comte de Montessus de Ballore. Earthquake-observing stations now exist between Tacna and the South Shetlands, that is, along a meridian nearly 3000 miles in length. At five of these heavy Weichert's pendulums have been established, while seismoscopes have been installed at thirty secondary stations. Altogether 550 observers note earthquakes at 430 different localities. During six months 740 different shakings have been recorded. This means that Chile, as an earthquake-producing country, runs neck and neck with Japan. At the central station in Santiago an arrangement of P. Maccioni has been set up. We are told that this instrument responds to electromagnetic waves, and gives warning of approaching earthquakes. This installation is said to be the first of its kind. Other instruments which have been installed, besides those mentioned, are the Bosch-Ōmori and Staittesi pendulums. Instruments of the type adopted by the British Association, although they yield more records of undoubted seismic origin than any other type of instrument, do not appear to find a place in the Chilian programme.

A LARGE proportion of the *Electrical Review* for April 29 is devoted to the problem of electrically driving the machinery of cotton and other textile mills. It appears that a considerable number of mills in Lancashire and Yorkshire have recently discarded mechanical in favour of electrical driving, the usual method being to instal a separate motor in each room. There appears to be no doubt that an increase of output has been obtained, but the figures given vary considerably. Two well-illustrated articles deal with the equipment of one of the mills mentioned, and with that of a mill in Germany. In the latter almost every machine is provided with its own motor, so that no shafting is to be seen in the rooms of which views are given.

THE April number of the *Journal de Physique* contains a communication made to the Société française de Physique in December last by MM. Buisson and Fabry on the application of their interference method of measuring small differences of wave-length to the problems of solar physics. It will be remembered that in their method the light to be investigated is sent through an interferometer consisting of two plane surfaces lightly silvered, and produces a system of light and dark rings, which are focussed on the slit of a grating or prism spectroscope by means of a lens. Each ring produces in the field of view of the spectroscope two points of light the distance apart of which may be determined directly or by measurement of a photograph. When two wave-lengths are to be compared it is only necessary to measure with precision the difference of the distances of these points of light apart. On comparing the iron lines of the solar spectrum with those of the arc in air, the authors find that for some lines the solar is greater, for others less, than the arc wave-length. The solar wave-length is in every case greater, however, than that for the arc *in vacuo*. The authors conclude that if the latter differences are due to the pressure in the reversing layer of the solar atmosphere, that pressure is 5 to 6 atmospheres.

CONTINUING their physico-chemical studies on phosphorus, Messrs. Ernst Cohen and Katsuji Inouye give an account in the current number of the *Zeitschrift für physikalische Chemie* (April 26) of the solubility of ordinary phosphorus in carbon bisulphide, as the previous work on this subject by Giran indicated either the formation of a compound between phosphorus and the solvent or the formation of a new allotropic modification of white phosphorus. The purity of the materials and the method of determining the concentration of the phosphorus in the solutions were carefully controlled, and solubility determinations carried out for nine temperatures between +10° C. and −10° C. The solubility curve found furnished no indication of the compound suggested by Giran, neither was any hitherto unknown allotropic modification of phosphorus obtained.

Science Progress for April contains the two first articles, by Dr. H. W. Wiley and Dr. R. Vincent, of a general series dealing with the ethics of food. The question is one of such great national importance, and so much has been talked and written on it of late years, that it is eminently desirable to have serious and unbiased criticism published under authoritative names. Dr. Wiley's legislative crusade in the United States in favour of pure food has made him the centre of a storm of indignation and attack from the threatened interests, but he has maintained his attitude that all considerations other than scientific truth and the public welfare are to be set aside in dealing with the purity of food. No doubt there is much need of a similar crusade in this country, but perhaps the initiative should come from the general public, backed by the manufacturers of repute, rather than from the analytical chemist, as appears at present to be the case. Dr. Vincent's article on milk should be studied by all who have to do with the feeding of children. He makes a very strong point of the fact that recent developments in the milk trade have been distinctly retrogressive, and unhesitatingly condemns the boiling and pasteurising of milk.

A NEW experimental steam engine has been installed at the Glasgow and West of Scotland Technical College, and was described by Prof. A. L. Mellanby at the meeting of the Institution of Engineers and Shipbuilders in Scotland on April 26. The engine was made by Messrs. Cole, Marchent and Morley, of Bradford, and is of the horizontal, compound, side-by-side type. The high-pressure cylinder is 12 inches, and the low-pressure cylinder

21 inches, in diameter, the stroke being 30 inches. Each cylinder is fitted at each end with separate steam and exhaust valves of the drop-piston type. A steam engine uses considerably more steam than is shown by the indicator to be present in the cylinder at any part of the stroke. This loss has been generally attributed to initial condensation, but more recently the belief has been held that valve leakage is responsible for much of the extra steam used. It is hoped that the trials upon this engine may be used to supplement the work done in other laboratories in elucidating this point. Thus the Armstrong College engine has slide valves; the Manchester Municipal School of Technology engines have permitted of work being done upon Corliss, double-beat drop, and slide valves; the drop-piston valves fitted to the new Glasgow engine should therefore afford opportunities of making useful comparisons.

OUR ASTRONOMICAL COLUMN.

COMETARY ORBITS.—Messrs. Crawford and Meyer give new elements for Halley's comet in Bulletin No. 179 of the Lick Observatory, based on observations made on September 17 and December 16, 1909, and February 28, 1910. The perturbations due to Mars in January were found to be ineffective, and the time for perihelion is finally given as April 19·67760 G.M.T.

When it became known that other computers found great difficulty in computing an orbit for comet 1910*a*, Miss Levy and Mr. Meyer, of the Berkeley Astronomical Department, decided to test a method devised by Prof. Leuschner. For this purpose photographic observations secured by Dr. Curtis, with the Crossley reflector, on February 1, 2, and 5, were selected, and a very satisfactory result obtained from the direct solution for an approximate orbit. Other observations were then considered, covering the period January 18 to March 13, and final parabolic elements calculated by the same method. These are given, with an ephemeris, in Bulletin No. 179, and the ephemeris indicates that the comet is still a little west of the Great Square, and is very faint. Observations by Dr. Aitken on April 13 gave corrections of −0·9s. and −4″. Elliptic elements for Daniel's comet, 1909*e*, published by Sturla Einarsson and R. Young in the same Bulletin, give a period of 6·48 years.

Recently published elliptic elements for comet 1910*a* give periods of 202·6 and 41 years respectively.

MEASURES OF DOUBLE STARS.—No. 175 of the Lick Observatory Bulletins contains the measures of 136 double stars made by Mr. Olivier with the 12-inch and 36-inch refractors of the Lick Observatory. Generally, the stars measured are neglected pairs in the southern hemisphere, such as can be observed from lat. 38° N., or pairs which show signs of motion. Eleven new doubles are included, and of the 136 stars observed, 15 are separated by less than 1″, 56 between 1″ and 2″, and 30 between 2″ and 3″. It is interesting to note that the 12-inch refractor was generally employed, and leaves nothing to be desired as regards definition; a power of either 500 or 625 was always used, and doubles down to 0·6″ in distance could be readily measured.

MAXIMUM OF MIRA, 1909.—*Astronomische Nachrichten* No. 4403 contains two notes on the most recent maximum of Mira. The first is by Herr May, of the Kasan Observatory, who finds that the maximum took place on September 9, 1909, the magnitude being 3·14. The second is by Herr Landwehr, Münster, and gives September 4·7 and 3·15 respectively. According to Guthnick's ephemeris, the epoch of maximum was September 6·9, and the magnitude should have been 3·27.

PARALLAX OF THE PLANETARY NEBULA G.C. 4373.—From a photographic determination, Dr. Bohlin finds that the parallax of the planetary nebula G.C. 4373 (H iv. 37) is $-0.170'' \pm 0.042''$, and the correction for the aberration constant is $-0.043'' \pm 0.042''$ (*Astronomische Nachrichten*, No. 4406, p. 232).

HALLEY'S COMET AND METEOROLOGY.

Proposed Meteorological Observations during Progress through the Tail of Halley's Comet.

THE International Commission for Scientific Aëronautics had arranged a series of ascents of kites and *ballons-sondes* for May 11–13, but seeing that it is possible that the earth may pass through the tail of Halley's comet on May 19, the members of the commission have agreed to postpone the ascents to May 18–20. A circular from Prof. Hergesell, the president of the commission, gives particulars of the proposed ascents, the times mentioned being as follows:—May 18, 7 a.m. and 10 p.m.; May 19, 2.30 a.m. and 7 a.m.; and May 20, 7 a.m. Observations should be made at the earth's surface, and *ballons-sondes* should be sent up about half an hour before these times, so that the balloon for the principal ascent should reach its greatest height about the time when the earth passes through the tail of the comet; one ascent should also precede, and one should follow, the principal ascent by precisely similar intervals of time.

Messrs. Assmann and Teisserenc de Bort suggest that it might be possible to carry out ascents of manned balloons as well as of *ballons-sondes*, and it is suggested that the aëro clubs of different countries should cooperate in the observations. A letter has also been sent out by M. Teisserenc de Bort describing the apparatus he has designed and used for several years for collecting samples of air from great heights. The use of Aitken's dust counter is recommended in connection with the ascents of manned balloons, and similar observations should be made at the earth's surface. Though it is unlikely that the passage of the earth through the tail of a comet will cause any measurable change of temperature in the upper air, yet it is felt by those engaged in the investigation of this subject that such a rare occurrence should not be allowed to pass without some notice.

Meteors from Halley's Comet.

Mr. Denning writes:—

"During the first week in May the weather was unsettled and stormy, and Halley's comet could not be well observed, nor could its supposed meteoric shower from Aquarius be suitably watched. Several meteors were seen, however, at places where the sky was clear or partially so, and they were directed from the radiant point of the comet, though no brilliant display of these phenomena seems to have been witnessed in England.

"There is a probability of an abundant display of meteors on the morning of May 19, when the earth may encounter the comet's tail, but this is doubtful. The sky should be carefully watched, however, on the morning named with the view of observing any meteors or peculiar auroral effects that may be visible.

"A rich display of meteors is reported to have been witnessed at Cape Town on the morning of May 7 between 2 and 5 a.m. There was no very active shower seen in England on the date mentioned, and further particulars will be awaited with interest.

"A fireball, presumably connected with Halley's comet, was noticed at Guernsey and other places on the morning of May 3 at about 2.50 a.m. As viewed from the Channel Islands, it had a long path ascending from just under β Pegasi to under β Cassiopeiæ, with a duration of four seconds.

"The real path of the meteor was from sixty-seven to forty-six miles in height, and its position over the English Channel from near Dieppe to south-west of the Isle of Wight, and its course, of some 137 miles, was traversed at a velocity of about thirty-four miles per second. This is a slower rate of speed than calculation implies to the Aquarids, but atmospheric resistance evidently moderated the meteor's native velocity. From the south coast of England—especially Sussex and Hampshire—the object must have been a splendidly luminous one, presenting a very long and graceful flight along the southern sky, but I have not hitherto received any observations from this particular part of the country.

"That the meteor was really a fragment of Halley's comet cannot be absolutely proved, but it is suggestive and significant that it was directed at the correct date from the computed radiant of the famous comet now visible. It is hoped that further observations will be furnished of this and of any similar objects which made their apparitions at the important time when the earth passed near the cometary orbit."

Observations of Halley's Comet.

Mr. Gustave Gillman, writing from Aguilas on May 2, says:—

"I enclose a chart showing Halley's comet as seen at 4 a.m. this morning, and the extent to which the tail could be traced, *i.e.* to slightly beyond θ Piscium. I have seen it on two previous days, but there were too many clouds to be certain of the extent of the tail. I could see no bifurcation."

Dr. A. C. Jordan writes:—

"At Broadstairs yesterday morning, Sunday, May 8, I had a good view of Halley's comet. There was a slight mist over the horizon, but I was able to keep the comet in view from 2.50 until 3.25. It was easily visible to the unaided eye, and was brighter than Algenib (γ Pegasus), the nearest bright star. Through an ordinary binocular the contrast between this clearly defined star and the nebulous-looking comet was very well marked. Toward 3.30 the approach of day rendered this part of the sky so bright that it was no longer possible to keep the comet under observation."

Further details as to the appearance of Halley's comet, as seen at Malta with naked eye and field-glasses, are sent to us by Mr. C. Leach. The comet was seen by several people, and Mr. Leach found that both nucleus and tail were easily picked up without optical aid on April 24, 25, 26, 27, and 30. He states that it was seen best between 3.45 and 4 a.m., and faded in the dawn at 4.10 a.m. The tail is described as lengthening and getting more elegant, its length being a little greater than the distance separating the comet and Venus; this would mean an apparent length of about 7° or 8°, and an actual length of about ten million miles. The nucleus, on April 30, is described as being sharply defined and at the very beginning of the comet, its brightness being about equal to that of α Andromedæ (mag. 2·1). A rough sketch sent by Mr. Leach represents the comet as having a straight, narrow, bifurcated tail, reminding one of the Paris drawing of the great comet of 1843.

Mr. Gruning, of Ealing, reports having seen the comet on several occasions with field-glasses, and twice, on May 7 and 8, with the naked eye. To know where to look for it the first time, he observed Altair emerge from behind a chimney the previous evening, and then, by a simple calculation, found the time, and the position with regard to the same chimney, for the comet's appearance next morning.

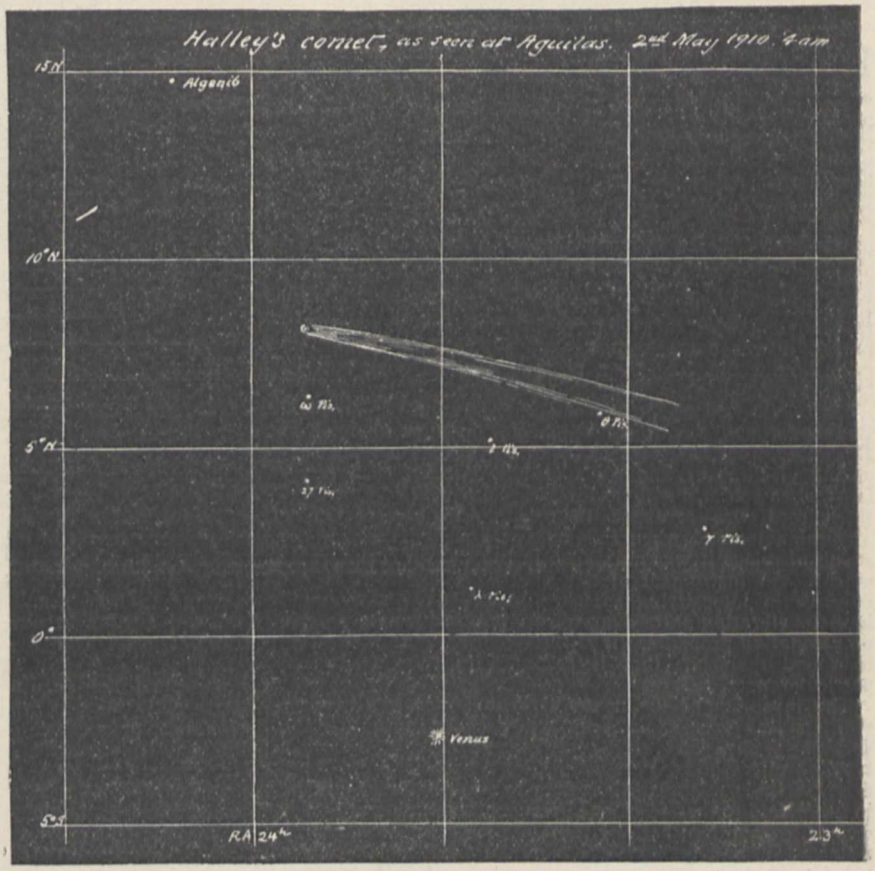
Mr. Bellamy reports to the *Daily Mail* that the comet was observed at Oxford University Observatory from 2.40 to 4 a.m. on May 9. It was visible without a telescope, and was estimated to be about as bright as a second-magnitude star. Observations were also made at Greenwich with the altazimuth.

According to a correspondent of the *Daily Chronicle*, observations at the Milan Observatory, on May 8 or 9, showed a straight tail some twenty degrees in length, or, actually, about 14½ million miles long. A tail of this length would probably reach to the earth at the time of transit.

Observations of the comet during its near approach to Venus on May 2 were prevented, at English observatories, by bad weather, so that the possible magnetic-attraction phenomena mentioned by Prof. Birkeland could not be looked for.

In an address delivered on Monday evening at the annual meeting of the Victoria Institute, Mr. Crommelin directed attention to one or two possible references to the comet in historical writings, citing the "almond rod" mentioned in Jeremiah i., 11–14, as a possible allusion to the comet's tail seen rising before the head. He also directed attention to the improbability of our being able to detect the presence of the tail should the earth pass through it. In suggesting that the comet would afford a good display during the evenings of the last ten days in May, he warned his hearers not to expect such a spectacle as was afforded by the great comet of 1882.

In the *Atti della Pontificia Accad. Romana dei Nuovi Lincei* (February 20) Dr. Pio Emanuelli points out that the velocities of Halley's comet at perihelion and aphelion are often exaggerated, and, using Mr. Crommelin's elements, he determines the true values. These he finds to be 55 km. and 0·9 km. (35·6 and 0·56 miles) per second



Halley's Comet as seen at Aguilas on May 2, 1910, at a.m.

respectively. Dr. Smart, using Pontecoulant's elements, obtained 31·3 and 0·62 miles per second.

Messrs. Cowell and Crommelin have been awarded, jointly, the Janssen medal of the Société astronomique de France, for their precise determination of the orbit of the comet for this present apparition.

A number of interesting representations of comets, some certainly of Halley's, are reproduced in the May number of the *Bulletin de la Société astronomique de France* from the "Theatrum Cometicum" of Lubienietz. Each drawing is accompanied by a note explaining it, and directing attention to contemporary occurrences; in concluding the article, M. Flammarion suggests that great comets were of more frequent occurrence in early times than they are now.

A NEW TELEPHONE RELAY AND ITS APPLICATIONS.[1]

EVER since the introduction of the telephone a real need was felt for a telephone relay, for the distance over which telephones could be used was found to be comparatively limited. Edison, soon after his invention of the carbon button transmitter, caused an electromagnet to act upon the iron diaphragm, and thus turned it into a relay, but it was not a success. Hughes (Proceedings of the Royal Society, vol. xxvii., p. 362, 1878), in his paper before the Royal Society in 1878, describing his extremely delicate microphones, stated that a telephone receiver, if included in the microphone circuit and placed upon the resonant board, caused a continuous sound to be produced. It follows, he said, that the question of providing a relay for the human voice in telephony is thus solved. Unfortunately, it was not solved; he had shown how to make a relay that would magnify a noise or musical note, but not one that would intensify articulate speech.

Sir Oliver Lodge (Journal of the Institution of Electrical Engineers, vol. xxvii., p. 799, 1898), in a paper read in December, 1898, before this society, described a relay consisting of three or four reeds or tuning-forks, each carrying carbon contacts and working in series with one another. Each reed was arranged to resonate to one particular musical note, and when this note was passed through the string of relays it was multiplied in power to a considerable extent. An instrument of this character, however, is not effective in intensifying speech. An articulate relay must have its vibrating parts damped, or, in other words, possess no resonating properties; it is therefore far more insensitive to sound than one that is arranged to resonate to one particular note.

The invention of the powerful granular transmitters of the Hunning type stimulated further efforts to obtain the speaking relay, and some progress was made with this type of microphone, particularly in America. I will not describe these relays further than to say that they consist in combining the telephone receiver and the granular carbon transmitter; both of these are designed as efficiently as possible, and in some cases automatic means are provided to shake up the granules should they become packed. These relays are only partially successful. Their advantages are not decisive. They require relatively powerful currents to work them; that is to say, when the telephone currents become sufficiently feeble to require their services, it is at this point that the carbon instrument fails to work. The telephone relay to be successful has to magnify in a continuous manner varying currents that are too feeble to affect properly a Bell telephone receiver. Such currents would be of excessive weakness, say of the order of the one one-hundred millionth of an ampere (10^{-8} ampere), and the mechanical movements produced by such currents, which have in their turn to bring about the increased electrical changes, are therefore microscopic in dimensions.

The author's telephone relay has had to be developed along quite new lines. It takes as its basis the researches of J. J. Thomson, Earhart, Kinsley, and others, with regard to the flow of electrons across a microscopic air-gap between two conducting surfaces at different potentials (see "Conduction of Electricity through Gases," J. J. Thomson, chap. xv.). Earhart made a series of experiments on the difference of potential required to produce sparks the length of which is comparable with the wave-length of sodium light, and he found that when the distance between the metal electrodes falls to less than about 3×10^{-4} cm., the spark potential falls off rapidly with the distance, and seems to become proportional to the distance; that is to say, when the electrodes are placed very close together, within a distance such that the average intensity of force F between the electrodes reaches a value of about a million volts per centimetre, the discharge or

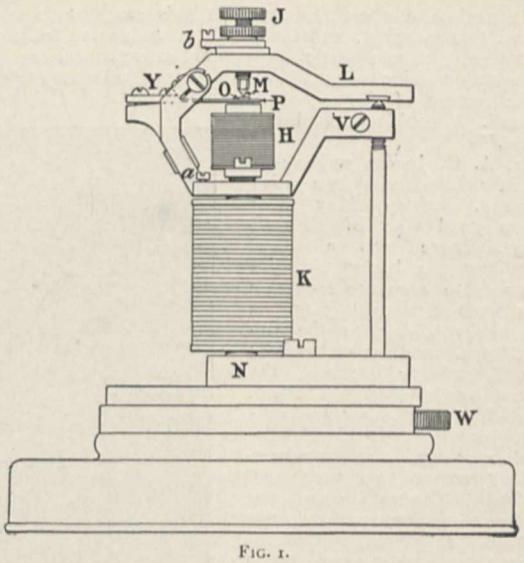


FIG. 1.

current passing is determined by the condition that F, which is V/d, reaches this value (where V is the potential difference and d the distance between the electrodes). If the metallic circuit of a dry cell be interrupted by a minute opening or space of the order of 5×10^{-7} cm., the metal at the point of interruption being platinum, the current will continue to flow round the circuit and across the opening, and any slight alteration in the length of the space, which I shall call the conduction space, will vary its resistance and greatly affect the value of the current that flows round the circuit. This conduction space is therefore exactly what is wanted for the current-varying device of a telephone relay, where microscopic mechanical movements are to be transformed into large current changes. The dimensions of the conduction space are so small that it is difficult to ensure and maintain it by direct mechanical means. The current that flows across the space was therefore made to do its own adjustment, very much in the same way as the current that passes through the arc of an arc lamp is made to strike and maintain the length of the arc.

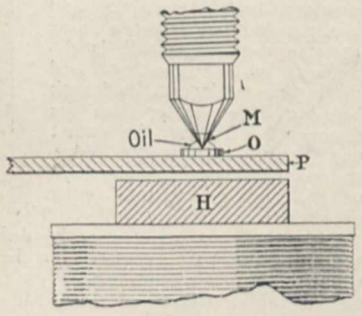


FIG 2.

Fig. 1 is a side view of the instrument with the brass cover removed. N is a permanent magnet, continued by soft iron poles right up to, but not touching, the "invar" steel reed P. Round the soft iron pole extensions are wound the two sets of coil windings H and K. The telephone currents to be magnified circulate round the winding H, and thus, by varying the magnetism, set the reed P in vibration. M, O are the top and bottom metal contact-pieces, which are opened to an infinitesimal degree to form a microphone by the fine adjusting screw W and

[1] From a paper read before the Institution of Electrical Engineers on May 5 by Mr. S. G. Brown.

by the action of the local current passing through the contact and round the winding K. It is by the action of the local current operating through this winding that the conduction space is formed and afterwards maintained. So good is the automatic adjustment that the instrument may be turned upside down, producing hardly any noticeable alteration in the value of the local current and without any effect on the working of the relay. The regulating winding K must not act when traversed by the rapidly varying telephonic currents; this is brought about by surrounding the iron under the coil by a closed circuited

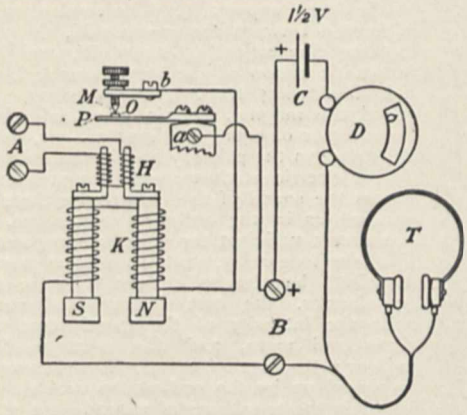


FIG. 3.

copper sheathing. Eddy currents set up in this sheathing by mutual induction destroy the self-induction of the coil.

Fig. 2 is an enlarged view of the reed P and the contact-pieces M, O. In the present instrument the contact is made between metal pieces of hard osmium iridium alloy. The top contact is pointed; the lower one is flat, and is soldered to the reed; both are polished, and work under a small drop of thin oil.

In earlier instruments the lower contact O was carried by a thin iron disc; the relay was then very susceptible to outside noises. For this reason a reed is now used; it exposes such a small surface to the air that it is practically unaffected by extraneous sound.

Fig. 3 shows the connections of the relay. C is a dry cell (this is the normal voltage, which is as high as it is

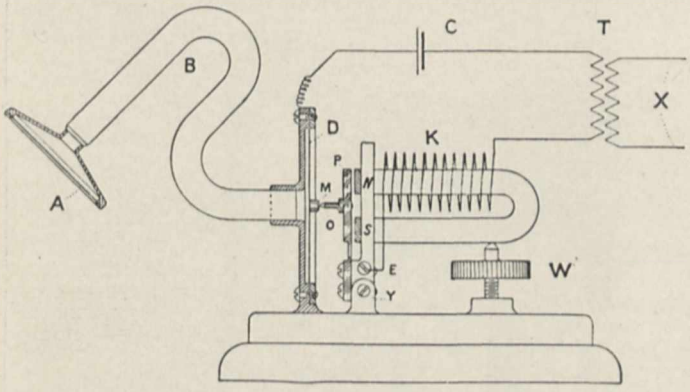


FIG. 4.

desirable to employ), K the low resistance regulating winding, T the receiving telephone or telephone head-piece of approximately 40 ohms resistance, D is an amperemeter or current indicator; when the microphone contact is opened so as to cut down the local current to half its maximum value, the relay is usually at its best adjustment. The telephone currents to be magnified enter by the terminals marked A, and circulate through the winding H.

The relay will magnify the very feeblest telephone currents. Speech or signals that are too faint to be heard in the ordinary Bell receiver may be heard clearly through the relay. If a watch be held against the ear-piece of a Bell telephone the induced currents produced when passed through the instrument will reproduce the ticking in the receiver attached; this is a severe test.

This property of magnifying feeble telephone currents has made it particularly useful in wireless telegraphy. On replacing the telephone by the relay the increased sensitive-

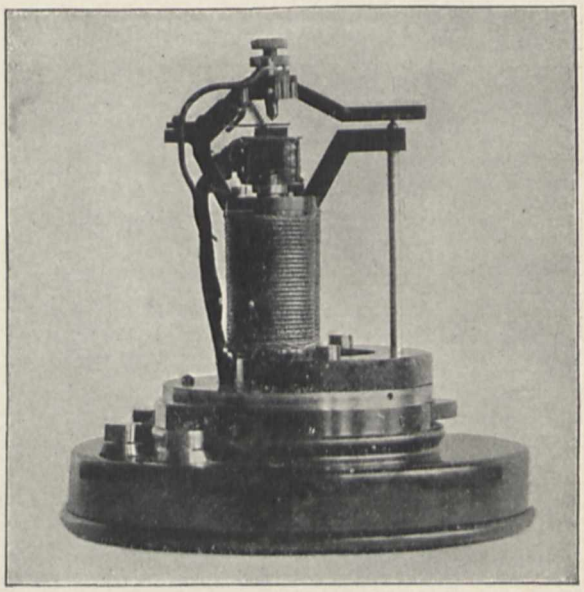


FIG. 5.—The Telephone Relay.

ness thus obtained doubles the distance over which it is possible to receive signals. Its utility in this direction has been tested, among others, by the Admiralty and the Post Office. In a wireless receiving station, messages, the very existence of which was not even suspected, owing to their extreme feebleness, when listened for under former conditions with the relay in circuit, were easily read. At the invitation of Mr. Marconi I took two instruments to the Haven Hotel, Poole. In one of the tests (Clifden, in Ireland, sending with the Marconi musical spark) the signals were heard in the telephone, directly connected, as a faint but clear and pleasing series of musical notes; but with two relays joined to the system and working in series the notes were rendered so loudly as to be heard clearly by everyone in the room, and an operator listening at a distance of several yards from the instrument could have deciphered the message. The relay is not easily affected by extraneous noises and vibration. It can thus be carried on board ship and worked in all weathers.

As regards its utility on ordinary telephone lines, speech may be magnified many times in loudness without perceptible loss in the articulation, and it will work with large currents to a point at which the Bell receiver in its local circuit is responding with uncomfortable loudness. In experimenting over a 20-lb. standard cable and speaking only one way, it has been proved that, when the relay is applied, thirty miles may be added to any length through which it is possible now to speak direct. For instance, supposing the length of the core for direct speaking be twenty miles, this may be increased to fifty miles for the same loudness and approximate clearness when the relay is in circuit, either as a single repeater at the end of the first twenty miles or as a receiver at the end of the fifty miles.

These tests prove that the telephone currents must be

increased in strength to the extent of something like twenty times. If still greater magnifications are required than can be obtained with one relay, the simplest method would seem to be to employ two relays working in tandem. Their combined power would then be 400 times. In the majority of cases it is not necessary to add to the natural electrical damping of the reed, but if a piece of soft rubber be made to touch it, the voice can be transmitted with greater clearness even than if the conversation were taking place ordinarily in a room. This may be due to the complete absence of echoes.

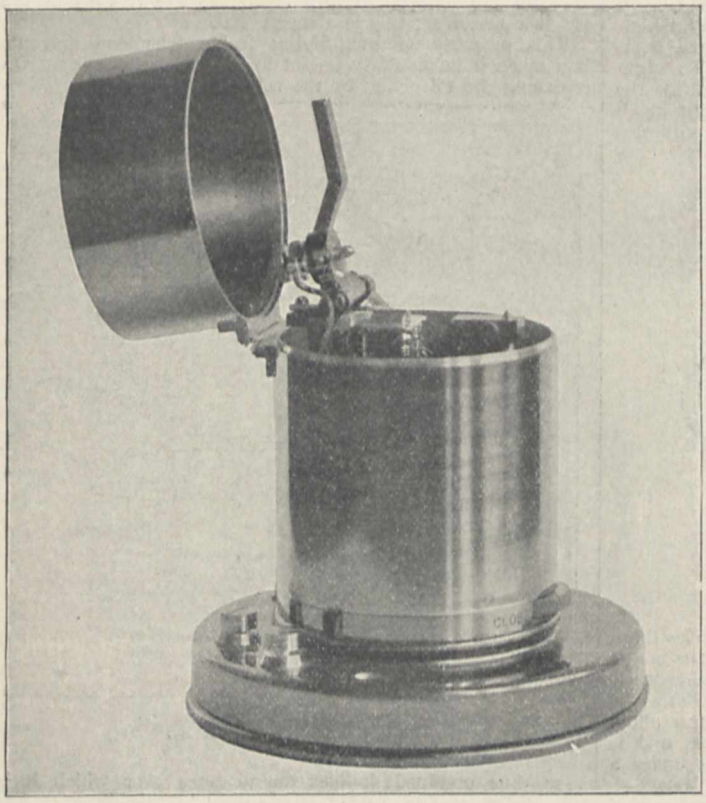


FIG. 6.—Telephone Relay in brass case with upper arm raised for cleaning the contents.

By means of the local regulating winding (see Fig. 2) the metal contact M, O is transformed into the most exquisitely delicate microphone, more sensitive, there is every reason to believe, than could be formed by light pressure between carbons. Such a microphone has rendered possible the construction of an electric stethoscope, an instrument by the use of which the sound of the heart or other internal organs may be greatly magnified. This, I have been informed, may render it possible to detect in the earlier stages heart disease, aneurism, and gall-stones.

Fig. 4 is a diagrammatic illustration of the stethoscope. A is the front part, and consists of a shallow brass cell faced by a thin ebonite diaphragm. A is placed upon the part of the body to be examined, say the heart; the beating of the heart is communicated to the ebonite diaphragm, then to the air inside the tube B, and thus the metal diaphragm D is set in vibration. M, O, as before, are the osmium-iridium contact-pieces. M is mounted on the diaphragm, and O on the steel reed P. The magnet N, S and the reed are carried by a brass frame E, which is pivoted or hinged at the lower support Y. The conduction space is formed between the contacts M, O by turning the fine adjusting screw W, and by the automatic action of the local current from the cell C flowing through the winding K and round the magnet. T is a special telephone transformer of equal windings of, say, 20 ohms resistance in the primary and in the secondary.

The electric stethoscope in its present form causes the sound of the heart to be three times as loud as in the ordinary stethoscope. This is scarcely sufficient for practical purposes; but if a telephone relay, such as I have previously described, be attached to the wires x of the transformer, the two instruments combined raise the intensity of the sound some twenty times and more, and this is ample for all ordinary purposes. The sound to be examined is picked up by the end of the tube A, and is heard in the telephones of a head-piece attached to the relay.

At the invitation of two physicians I took the complete instrument, stethoscope and relay, to the London Hospital, where it was tested upon a number of diseased heart cases. Not being a doctor myself, I cannot discuss the merits of the instrument with regard to its medical value, except to say that it seemed to render diagnosis particularly easy and revealed some phenomena only previously suspected. From a sound-magnifying point of view the general results were as follows. When the instrument was applied directly to the heart the sound of the beats given out in the telephones was uncomfortably loud, and easily heard by the patient and all those that stood round, and this even if the telephones were in position on the head of the operator. The stethoscope as used increased the heart-beats to the almost complete exclusion of the shriller or breathing

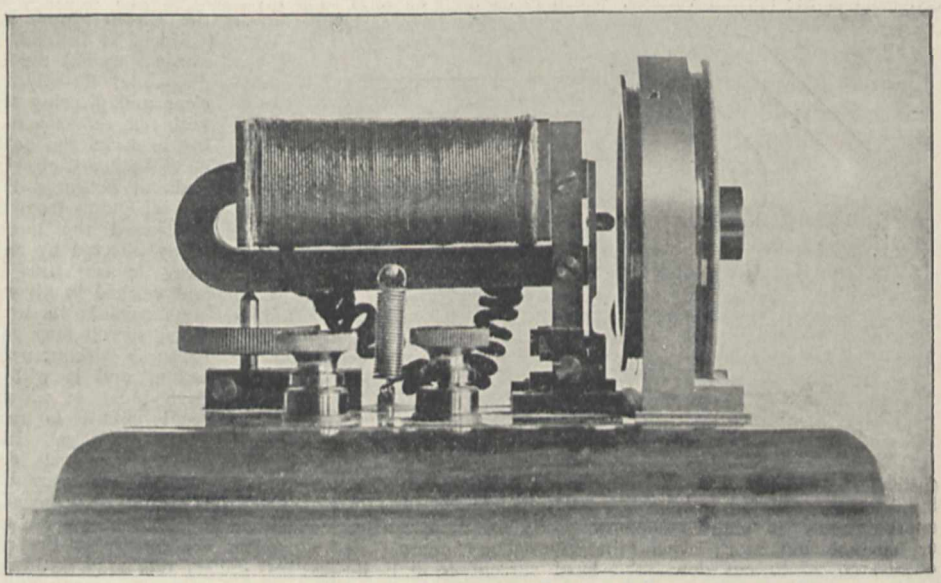


FIG. 7.—Electrical Stethoscope.

sounds. This has been brought about by mechanically tuning the disc D and the reed P of the telephone relay to the corresponding low note, and by a proper proportioning of the volume of air enclosed by the tube B. On other occasions, during private experiments, the instrument has been tuned so that nothing but the breathing sounds were audible; the passage of air through the lungs was heard as the roar of the wind through a forest of trees. This power of discrimination should be of service in allowing the independent examination of various organs of the body.

Replacing the telephone head-piece by a transformer, the stethoscope has been joined to the telephone service in my house, and, for the sake of experiment, the sound of the heart has been transmitted over several miles of telephone line to doctors in various parts of London and to other friends who were interested. All of them reported that the sounds received in the telephone were as loud and clear as when heard locally. The line, therefore, does not appear to produce much loss or distortion. This trial proved that it is now possible for a specialist, say, in London, to examine a patient, say, in the country, stethoscopically, and to arrive at a correct diagnosis.

The instrument must of necessity, to replace the ordinary stethoscope, be more sensitive to sound than the human ear. This is proved by slight noises made in the room being heard in the telephones as loud noises. In consequence of this, the apparatus is padded and guarded, so far as is possible, from all outside disturbances, and the patient should be examined in a quiet room. If the instrument is provided with a small funnel in place of the tube B, it will pick up and magnify the slightest sound, and ordinary speaking may be increased to a deafening shout in the telephone. Such an instrument, when properly constructed for the purpose, may be of use to those who are afflicted with deafness.

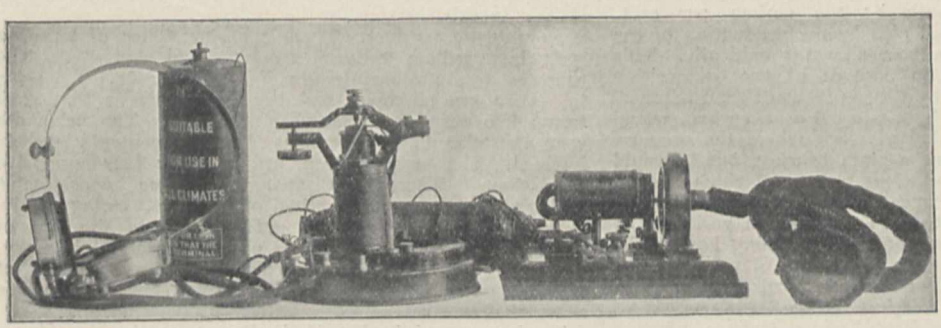


FIG. 8.—Electrical Stethoscope and Telephone Relay ready for use.

The relay has been used on the electrophone system, and by its aid, damping the reed with a piece of rubber, the speaking and music from the theatres are rendered with loudness and greater clearness than it is possible to have on the telephones supplied by the company, and by adding a loud speaker with trumpet the sounds can be heard in the room.

THE IRON AND STEEL INSTITUTE.

THE annual general meeting of the Iron and Steel Institute was held on Wednesday and Thursday, May 4 and 5, at the Institution of Civil Engineers. The retiring president—Sir Hugh Bell—inducted the president-elect, His Grace the Duke of Devonshire. After presentation of the Bessemer medal to Mr. E. H. Saniter, of Rotherham, for scientific services rendered to the iron and steel industry, the Duke of Devonshire gave his presidential address. In the course of a long and detailed account of the rise and progress of the coal, iron, and steel industries in this and foreign countries, the president also reviewed the social and economic conditions over the period from 1869, when the institute was founded under the presidency of the seventh Duke of Devonshire, to the present time. Conditions of work are now safer and more sanitary; wages are better, and working hours lighter. Housing is better, and a host of improvements in traffic, lighting, education, and public assistance have made for the comfort, health, and enlightenment of the people. Taking increase in wages paid to the worker, and also the increased spending power of these wages, into account, His Grace quoted statistics showing a net increase, for the period mentioned, of 90 per cent.

The meeting then proceeded with the reading and discussion of papers, thirteen of which were presented. Owing to lack of time, several of these had to be taken as read. In the case of those actually presented at the meeting, the time allowed to the author for explaining the contents of his paper was in each case ten minutes. The institute is to be congratulated on the high standard and importance of the papers presented, but we think that it will be difficult to maintain this standard unless in future more time is placed at the disposal of the authors at the meetings.

Mr. D. Selby Bigge, in a paper on the development in the production of electric power, pointed out that considerable progress had been made in the cost at which electricity can now be produced in iron and steel works having at their disposal waste gas, waste heat, and waste steam. One of the means by which low cost of production has been attained is the mixed pressure steam turbine. Such turbines differ from exhaust steam turbines in that the latter are intended to derive their supply of steam from engines which run continuously, such as blowing engines and pumping engines. Mixed flow turbines may work with reciprocating engines which are only in action intermittently. A continuous supply of steam is obtained for the turbine by adopting a form of regenerative accumulator, the action of which is as follows. The exhaust steam is taken from the engines and mixed with water, both coming to the same temperature. Supposing, now, a drop in pressure of 1½ to 2 lb. per square inch to take place in the accumulator, owing to the exhaust steam supply being cut off, the water in the accumulator at once gives off vapour, thus keeping up the supply to the turbine. Any sudden rushes of exhaust steam from the engine are utilised in storing heat in the accumulator, and will be drawn on for supplying the turbine during the next pause in the supply of exhaust steam.

The turbine is built in stages, one set being designed for the working pressure of the existing boilers, and so constructed as to give off the full output of the turbine upon live steam when required; the other set is designed for the utilisation of exhaust or low-pressure steam received from the accumulator in the case of engines working intermittently, or direct from the exhaust of engines running continuously. The low-pressure end of the turbine is also designed to give out the full rating or output upon low-pressure steam alone. Should the full supply of exhaust steam fail from any cause, live steam is automatically admitted to make up the temporary deficiency in the exhaust steam available. Further, high-pressure steam is admitted when required to the high-pressure stage without the intervention of a reducing valve. To secure efficiency, a high vacuum must be secured, and the selection of a suitable condenser must be carefully considered. Various types of turbines, gas engines, and electrical installations for steel works are described by the author in the paper. The adoption of any particular system must obviously depend on the circumstances; each case must be considered on its merits. It is of interest to note that the Duke of Devonshire in his address cited the economy effected last year at the Barrow Works, where the installation of eight gas engines to replace the steam-driven engines produced an immediate saving of 1500 tons of coal weekly.

An interesting paper on the cutting properties of tool steel was contributed by Mr. Edward G. Herbert, of Manchester. It is well known that a high-speed steel tool with

a light cut and a high speed will keep its sharp edge better than a carbon-steel tool. The durability of all steels, without exception, is very low at low speeds under light cuts, and increases as the speed is raised, the durability being measured by the amount of metal cut away before the tool becomes blunt. The engineer usually requires the steel that will remove the greatest amount of metal per hour without requiring too frequent sharpening, and it is useful to express the "duty" of a tool steel by the product of metal removed and corresponding cutting speed, thus obtaining a quantity which is proportional to the time rate of removing metal and to the durability of the tool.

To account for the fact that an increase in the cutting speed is accompanied by an increase in the durability of the tool, it has been suggested that the evolution of heat, and consequent rise in temperature of the cutting edge, may be the influencing factor, and experiments are described in the paper giving confirmation of this view. In these experiments heat was applied artificially to the tool while cutting by means of hot water, and tests were made at different temperatures. A law has been deduced from the results which may be stated thus: for constant durability of the cutting tool the speed varies as the cube root of the product of area of cut by thickness of shaving. Experiments were also made on the effects of temper and of the percentage of carbon on the durability of carbon steel, and on the effect of the cooling process in the case of high-speed steels.

Prof. J. O. Arnold, in his paper on uniform nomenclature of iron and steel, earnestly pleads with metallographists strongly to support Prof. le Chatelier in his effort to abolish personal names for the constituents of steel. Mr. Sydney A. Grayson, of Birmingham, gives the results of some recent investigations on case-hardening, from which it appears that it is necessary to classify case-hardening compositions both by the carbon per cent. obtained in the "case," and also by the graduation of the carbon diffusion, which is best shown graphically. This classification is necessary on account of one composition being more suitable for certain kinds of work than another. A high carbon "case," such as 1·10 per cent. carbon, would be very efficient for the kind of work where the pressure was fairly constant, such as a plain bearing, but it would be very unsuitable and inefficient for parts which had to resist repeated shocks, because of the strong tendency of the high carbon "case" to chip, or even to peel off. It is advisable, where all kinds of case-hardening have to be done, that two compositions be used, one of them to produce a high carbon wearing surface, and the other to produce a medium carbon wearing surface.

Mr. C. A. M. Smith, of East London College, adds to his previous work on the elastic breakdown of certain steels an investigation of the possibility of non-axial loading occurring in test-pieces held in the testing machine on spherical seats, and shows that, in the case of a 50-ton machine in which the radius of the seats is 1½ inches, the eccentricity may amount to 0·15 inch, with a coefficient of friction of 0·1. The ratio of maximum to mean stress would then be at least 2·2, and in one test where eccentricity was known to exist, a ratio of 2·96 was found.

A GEOLOGICAL SURVEY OF COLORADO.[1]

THE State of Colorado is one of the most famous in the history of American mining, but though its Geological Survey was created in 1872, and has included on its staff some distinguished men, it has done comparatively little, for it remained practically without funds until 1908. The Survey has now been provided with an annual subsidy and a staff, Mr. R. D. George being State geologist with sixteen assistants. Its first annual report has been issued, and shows that the Survey has been organised on sound lines, for it contemplates cooperation with the Federal Survey and private local geologists, and the advancement of local education by presenting a collection to illustrate the mineral wealth of Colorado to every high school in the State.

The first volume consists of five valuable memoirs upon the geology of Colorado, illustrated by geological and topographical maps. The stratigraphical geology of the foothills is described in a memoir by Mr. J. Henderson. They consist of a foundation of Archean and Algonkian rocks, which are covered by a long succession of sediments, representing continuous deposition from the Carboniferous to the Laramie, at the end of the Cretaceous. This succession consists of 10,000 feet of strata, partly marine and partly terrestrial, and apparently all conformable. The beds were laid down in the course of a slow subsidence of the country, so that the higher members of the series overlap one another on to the older rocks to the west. After the Laramie there was a break, and the chief Cainozoic deposits are of Miocene age.

The other memoirs deal with economic geology. Each is well arranged, and accompanied by a useful bibliography. Mr. R. D. George and Mr. R. D. Crawford contribute an outline survey of the Hahns Peak mining field, thirty miles from the railway terminus at Steamboat Springs. Hahns Peak itself is a porphyry laccolite, once covered by Cretaceous rocks. The goldfield is one of those interesting cases in which no certain source has been discovered of the gold in rich placer deposits. The lode mines hitherto found yield silver-lead ores, and their working has not been remunerative. The popular local belief as to the source of the gold is that it has come from the porphyrites, of which the junction with the sediments is generally mineralised; but it has also been attributed to conglomerates at the base of the Dakota formation and to pre-Cambrian metamorphic rocks.

Mr. George contributes a valuable memoir on the tungsten area of Boulder County, accompanied by notes on the intrusive rocks by Mr. R. D. Crawford. It includes a brief account of the tungsten deposits throughout the world, and of the technical uses of the metal. The Boulder tungsten field consists of gneiss of sedimentary origin, which is seamed by dykes of pegmatite, which the author claims, in this instance, to be an intrusive rock and not a pneumatolytic product. There are also dykes of latite, a rock intermediate between trachyte and andesite. The tungsten ores are mostly found in the granite; the veins in gneiss are narrower and less profitable, as that rock forms less open channels when disrupted. The veins are very irregular in arrangement, but are generally steeply inclined. The tungsten was introduced by four successive depositions. There has apparently been considerable difficulty in the concentration of the ore, owing to its extreme friability, and the author suggests the use of magnetic methods, which have proved successful in Cornwall. This report is illustrated by a series of plates, of which six are especially useful, as they show the various types of ores.

The last report is by Mr. H. B. Patton, on the Montezuma district of Summit Country. The rocks of this mining field are the Archean schists and gneiss of the Front Range, injected by acid and diabase dykes. The ores are replacement veins composed of quartz containing lead, zinc, and a little copper and some silver and gold. Unlike some Colorado mining fields, descending water appears to have had very slight effect upon the ores, and there has been little secondary sulphide concentration. The porphyritic dykes are of Cretaceous date, and the ores were introduced later than the formation of any rock in the district. The distribution of the ores appears to be quite independent alike of the dykes, pegmatite veins, and cleavage. The ore bodies lie along joint planes, on which there may have been some movement by strike faults. There is, however, no direct evidence that the ores were connected with faulting, for the cross-faults are barren, and the joint planes may have been mineralised simply because they were planes of weakness, which offered the ore-bearing solutions the readiest channel to the surface. J. W. G.

[1] Colorado Geological Survey. First Report, 1908. By R. D. George. Pp. v+243; 22 plates, 4 maps. (Denver, 1909.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Mr. C. L. Boulenger, of King's College, Cambridge, has been appointed to the lectureship in zoology rendered vacant by the resignation of Mr. Leonard Doncaster.

Dr. Leonard Parsons has been appointed assistant lecturer in pathology and bacteriology to succeed Dr. Leonard Mackey.

CAMBRIDGE.—On account of the death of his Majesty the King all invitations issued for the laying of the foundation-stone of the New Museum of Archæology and Ethnology are cancelled.

The increased entry in the University is shown by the fact that on May 3 seventeen undergraduates matriculated. This brings the total number of students for the academic year 1909–10 up to the present date up to 1217, as contrasted with 1163 at the same date last year.

The Special Board for Geographical Studies has reported on the financial position of the Department of Geography. The University makes an annual grant to the Board of 200*l.*, and the Royal Geographical Society makes a grant of a similar sum. This latter sum is primarily assigned to the stipends of a university lecturer in regional and physical geography and a university lecturer in surveying and cartography, who are called the Royal Geographical Society's lecturers in their respective subjects. The department has, however, grown, and the Special Board is of opinion that a further 200*l.* a year is the smallest additional sum with which it will be possible to make adequate provision for the study of the subject. The Board is of opinion that further accommodation for the department is urgently required. Application has already been made for the assignment of a lecture room, a laboratory, and some private rooms in the block of buildings now under construction. In order that geography may assume its due place in the studies of the University the Board looks forward to the appointment of a professor and of a reader with three lecturers under them.

Mr. Cyril Strickland, of Gonville and Caius College, has been appointed assistant to the Quick professor in place of Mr. H. B. Fantham, who has resigned the post.

Dr. T. G. Longstaff will deliver a lecture in Cambridge on Thursday, May 19, at 5 p.m., on "Glacier Exploration in the Eastern Karakoram Himalayas." The lecture, illustrated by lantern slides, will be given in the Sedgwick Museum.

Mr. E. Torday will give a lecture on his investigations among the Bushongo of the Kasai basin on Thursday, May 19, at 8.30 p.m., in the Museum of Archæology and Ethnology.

OXFORD.—Dr. G. C. Bourne, Linacre professor of comparative anatomy, and Mr. E. S. Goodrich, fellow of Merton College, have been appointed representatives of the University at the eighth International Congress of Zoology, to be held at Graz in August next.

MR. W. FISCHER WILKINSON has been appointed principal of the newly constituted School of Metalliferous Mining (Cornwall). Mr. Wilkinson's duties will not commence until the next session in September, but he has already associated himself with the governors in drafting the prospectus of the new school, which will be issued shortly. Mr. J. J. Beringer, who for twenty-eight years has been principal of the Camborne Mining School, will join the staff of the School of Metalliferous Mining and will take charge of the metallurgical subjects.

Science announces that Johns Hopkins University has received an offer of 50,000*l.* from the General Education Board for the purpose of aiding the University in its efforts to put into operation certain extensions and improvements that have been under consideration for several years, including the erection of new buildings. This sum will be contributed conditionally on the raising of a supplementary sum of 125,000*l.* by the University by December 31, 1910. The University, however, is endeavouring to raise 400,000*l.*, half for new buildings, while the other 200,000*l.* will be used for endowment. Among the extensions contemplated are a school of engineering, a department of preventive medicine, and a building for pathology. From the same source we learn that a joint hearing on the Bills to appropriate 130,000*l.* for new buildings for the College of Agriculture and 26,000*l.* for new buildings for the Veterinary College at Cornell University was given last month by the finance committee of the Senate and the ways and means committee of the assembly.

THE seventh annual meeting of the central council of the Association for the Advancement of the Scientific Education of Indians was held in Calcutta on April 14. We learn from the *Pioneer Mail* that the resolutions were carried unanimously to the following effect:—That the Government be asked to fulfil its promise of starting graduate classes in mechanical and electrical engineering, mining and industrial chemistry, in connection with the Sibpur Engineering College at an early date; that Indian capitalists be appealed to to start industries and employ Indian experts in preference to foreign experts; that this council strongly urges upon the University and the Government to insist upon the training of the hand and eye of students attending schools; that Indian capitalists may, with every prospect of success, start the following industries, which have proved successful in Japan:—matches, pencils, porcelain, enamel, tobacco, sugar, hosiery, soap, perfumery, paper, glass, umbrellas, biscuits, leather, and printing-ink, industries for which experts trained by the association are available; that a syndicate be formed to raise 25 lakhs of rupees from the people of Bengal for starting industries to give employment to the large number of students who have been sent to foreign countries for industrial education.

IN view of the fact that the Union Government will have to take over higher education shortly in Cape Colony, Prof. A. S. Kidd, of Rhodes University College, has prepared a brochure of forty-eight pages on the subject, and it is published by Messrs. Grocott and Sherry, of Grahamstown, at the price of one shilling. Prof. Kidd first explains the Higher Education Act of 1874, deals with the recommendations of the commission of 1879, and then describes the various colleges of the west and east of Cape Colony. His concluding section is concerned with the future of higher education in South Africa, and urges that one of the first duties of the Union Parliament should be to appoint a commission to inquire into and to report upon the whole subject. The chief work of the commission, Prof. Kidd thinks, should be the consideration of the following points:—which of the existing colleges deserve to be recognised as State colleges receiving generous support; what should be the constitution and functions of the various college councils; the special lines on which each college should be encouraged to develop; the salaries, good service pensions, and status of professors; the advisability of having some system of triennial inspection of college progress and efficiency; and the existing debts on colleges in Cape Colony, endowed chairs, bursaries, and scholarships.

As has been announced already in these columns, the third International Congress for School Hygiene is to be held in Paris from August 2 to August 7. The president of the congress is Dr. A. Mathieu, the honorary president being the French Minister of Public Instruction. The business of the congress will be transacted in ten sections, as follows:—educational buildings and furnishings, president, Prof. Courmont, of Lyons; hygiene of residential schools, president, M. Jules Gauthier, director of secondary education to the Minister of Public Instruction; medical inspection of schools and individual health records, president, M. Le Gendre; education and physical training, president, M. Cazalet; the prevention of contagious diseases in schools, president, Prof. Hutinel; out-of-school hygiene, president, M. E. Petit; the hygiene of the teaching staff, president, M. G. Lyon, rector of the University of Lille; teaching of hygiene, president, Prof. Pinard; teaching methods and syllabuses in relation to school hygiene, president, Prof. G. Lanson; and special schools for abnormal children, president, M. Gasquet, director of primary instruction to the Minister of Public Instruction. The general secretary of the congress is Dr. Dufestel, 10 Boulevard Magenta, Paris. Sir Lauder Brunton, Bart., F.R.S., is the president of the English organisation committee, and Dr. James Kerr and Mr. E. White Wallis are the honorary secretaries, to whom inquiries should be addressed at the Royal Sanitary Institute, 90 Buckingham Palace Road, London, S.W.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, April 19.—Dr. S. F. Harmer, F.R.S., vice-president, in the chair.—Stanley **Kemp**: Notes on the photophores of decapod Crustacea.—J. Lewis **Bonhote**: Variations of *Mus rattus*, founded on an

examination of the forms of that species found in Egypt. The author pointed out that on examination of the hind-foot measurements of a considerable number he found that the curve showed three distinct apices, and that two of these apices belonged, respectively, to the two forms found in Egypt, these forms being also more easily distinguished by their colour characteristics. The author in dealing with the rats of this species from the Oriental region had some years ago subdivided them into three subgroups, and it was now shown that the size of the feet typical of the three Oriental subgroups corresponded with the three apices in the curve of the Egyptian forms. He was inclined to think that these apices represented centres of variation, and were probably inherited as Mendelian characters, for were this not the case the smallest apex would have become swamped, and a regular curve would result. It was, however, evident that the small foot character was present and ready to become the dominant form in a very short time should conditions giving advantage to a small foot arise. On comparing the curve of the hind feet of *Mus norvegicus*, three apices were also observed, showing that in this species the "hind-foot character" was also present, but as there were no corresponding colour differences it was impossible to tell to which group any particular individual belonged. The author drew the following conclusion, viz. that there was considerable *prima facie* evidence that the size of the hind foot and the colour of the hairs on the underparts were Mendelian characters, and pointed out that the former character was also found in another species, *Mus norvegicus*, and the latter in a third species, *Mus musculus*.—G. E. **Bullen**: An example of posterior dichotomy in an Aylesbury duckling. A detailed account of a dissection performed on a duckling having supernumerary legs. In addition to a re-duplicated pelvis and the usual condition of the limbs presented in posterior dichotomy, it was found that the specimen showed evidence of a further re-duplication of the part dichotomised.

Royal Microscopical Society, Apr. 20.—Mr. E. J. Spitta in the chair.—E. M. **Nelson**: What did our forefathers see in a microscope? The author dealt with the subject of what sort of image would be seen in a microscope of the highest type before 1825, about which date the achromatising of objectives was begun. After describing various old forms of microscope, particularly Dr. Robt. Smith's catadioptric microscope, the author gave examples with modern instruments.—E. M. **Nelson**: Critical microscopy. The author described the image of an object as being critical when it had been obtained by means of an objective of fine quality which had been placed in correct adjustment for that object, and when the illumination was critical. An object was said to be illuminated critically when it was placed at the apex of a solid axial cone, the aperture of which was not less than three-quarters of the N.A. of the objective.

Institution of Mining and Metallurgy, April 21.—Mr. Edgar Taylor, president, in the chair.—W. **McDermott**: The elements of slime concentration. In this paper the author gave a brief review of certain factors in the problem of slime concentration which seem to be established by practice, and then proceeded to draw conclusions from that review which would show the lines on which inventive and constructive development should proceed. He made a broad classification of the types of machine in use into five groups having different functions, and from that went on to analyse the conditions essential to efficiency, these being, respectively, time required for settling, smoothness of surface in final separation, speed of the washing water, and the special shaking motion necessary for settling and separation. Following these points was a consideration of the direction likely to be taken in future improvements, which may or may not provide for the production of a middle product, while the desirability or otherwise of classification under commercial conditions also received notice.—J. M. **Campbell**: The origin of laterite. The author dealt more especially with occurrences of laterite in West Africa, which he had observed and studied, though he sought to establish a similarity of origin for the Indian laterites, also in contradiction to the generally accepted theories of the Geological Survey of India. His definition was, briefly, to the effect that laterite is a porous rock, formed above low water-level in the strata on low-lying gentle slopes, by the gradual removal of some or most of the mineral constituents of either alluvium or rock *in situ*, and of the deposition therein of ferric and aluminous hydrates from mineralised water coming from below, the deposition being determined by contact with atmospheric oxygen.—J. M. **Campbell**: Native iron smelting in Haute Guinée (West Africa). This is a brief note compiled from observations of some native furnaces which are probably survivals of an ancient system of iron smelting, no record of which appears to exist. Their chief interest consists in the method of operation by natural draught only, induced by the introduction of clay tuyers, which convey air to the combustible matter, so dispensing with artificial blast. The note is of historical interest only, as the method of smelting is now almost extinct.—H. B. **Williams**: Hammer drills in overhand stoping and raising. In this paper the author gives particulars of the construction, operation, and work performed by a hammer drill operated by compressed air, which has been in practical use for some time in some gold mines in British Columbia, and has shown some distinct advantage over hand labour and ordinary piston drills in certain classes of work.

Challenger Society, April 27.—Dr. A. E. Shipley in the chair.—A. **Earland**: The Foraminifera collected by the fishery cruiser *Goldseeker*, with special reference to the survival of boreal species in a southern locality. These Foraminifera had been dredged in the area of the Moray Firth and North Sea to the east of Scotland as far north as the extremity of Shetland, and eastwards to about 150 miles from the Scottish coast. Off Buchan Ness large and typical specimens of *Polystomella arctica*, P. and J., were obtained. In the deep "gully" off Burghead, Moray Firth, *Botellina labyrinthica*, Brady, was found in abundance, and *Hippocrepina indivisa*, Parker, a truly Arctic type, was frequent. From these records, and from the gigantic size attained by many arenaceous types in the comparatively shallow water of the central North Sea, the author considered that the present rhizopod fauna of the North Sea was of Arctic origin, surviving from the comparatively recent geological times when the North Sea had no connection with the Atlantic in the south. The immigration of warm-water types by way of the north of Scotland was regarded as further proof of the correctness of the geological theory, and many instances of such rhizopod types occurring in the northern area of the Moray Firth, but nowhere south of it, were mentioned.

Geological Society, April 27.—Prof. W. W. Watts, F.R.S., president, in the chair.—R. G. **Carruthers**: The evolution of *Zaphrentis delanouei* in Lower Carboniferous times. The simple corals that belong to the gens of *Zaphrentis delanouei* are of common occurrence in the Lower Carboniferous rocks of Scotland. Their distribution is sporadic, but it is possible to collect over areas of which the stratigraphy is known. Many specimens have been got together from horizons scattered throughout the sequence. The ontogeny has been investigated by serial transverse sections. The evolutionary changes observed are confined to the disposition of the septa, which has influenced the shape of the cardinal fossula in a marked manner. *Zaphrentis delanouei* is typically a Tournaisian species, and it has a wide fossula, expanded inwardly. When the gens first appears in the Scottish rocks *Z. delanouei* is the predominant form, but is associated with a mutation in which the fossula is parallel-sided. In the higher limestones of Lawston Linn another mutation appears, which is regarded as a sport from the direct line. In the succeeding Lower Limestone group the gens undergoes further modification. Adults of the two Cementstone species are extremely rare, and the predominant form has a fossula which narrows rapidly to the inner end. In the still higher horizons of the Upper Limestone group the last-mentioned mutation becomes predominant, and persists up to the Millstone Grit, where the septa become more

amplexoid. All these mutations in neanic life have characters seen in adults of the preceding form. Mutational percentages are given for many localities in the Carboniferous Limestone series of the Central Valley, together with an analysis of the data so obtained.—A. **Wilmore**: The Carboniferous limestone south of the Craven Fault (Grassington-Hellifield district). Some of the beds are massive, coarsely stratified limestones, made up largely of crinoids, or corals, or shells; others are well bedded, almost flaggy, black limestones made up of comminuted matter, with abundant foraminifera. The strata are much disturbed everywhere. A series of folds strike roughly north-east and south-west, and are somewhat complex. The well-known knolls ("reef-knolls") are discussed. Their beds and those in the neighbourhood are much disturbed. Irregular coarse bedding, folding, and weathering will explain their structural peculiarities. A typical knoll is dissected, and it is seen to consist of folded, faulted, grey, coarsely bedded limestone, with great joints and much internal weathering. It is not easy to work out the exact zonal sequence, because of the disturbed character of the strata and the prevalence of glacial and fluvio-glacial drifts. The strata are apparently all Viséan (and probably there is nothing lower than Middle or Upper S). In some beds, and in some circumstances, fossils are exceedingly plentiful. Some corals receive special notice.

MANCHESTER.

Literary and Philosophical Society, April 5.—Mr. Francis Jones, president, in the chair.—R. L. **Taylor**: A preliminary note on the action of carbon dioxide and of air on bleaching powder and similar substances. Contrary to what is generally supposed, carbon dioxide, in presence of moisture, liberates no hypochlorous acid from bleaching powder, either solid or in solution, but only chlorine. Similarly, carbon dioxide liberates nothing but bromine from a mixture of a bromide and a hypobromite. When air, freed from carbon dioxide, is passed through a solution of bleaching powder, it slowly sweeps out hypochlorous acid, which is present in the free state in the solution, being produced by the action of water on the calcium hypochlorite. If, however, moist air containing the usual small amount of carbon dioxide is passed through bleaching powder, either solid or in solution, a mixture of chlorine and hypochlorous acid is given off, the chlorine usually largely predominating. In the case of the solid substance, after the moist air has been passed through for a considerable time, and the bleaching powder has thus become quite wet, there is no hypochlorous acid produced, but only free chlorine. When bleaching powder is heated with water and boric acid, practically pure hypochlorous acid is given off, no matter what proportion of boric acid is used. This forms a convenient method of preparing a solution of hypochlorous acid. Under similar conditions, a mixture of a bromide and a hypobromite evolves nothing but bromine.

April 20.—Mr. Francis Jones, president, in the chair.—G. P. **Varley**: The state of magnetisation of the iron boundary fence on the ridge between Black Sail Pass and the top of the Pillar Fell in the Lake District. The heavier iron uprights, which were firmly fixed in the rock, showed a north polarity below and south polarity above, while the floating uprights used for spacing the wires had, with few exceptions, the south pole below and the north above. The magnetisation of the heavy fixed bars was what one would expect from the action of the earth, but that of the floating uprights was not readily explicable.—Prof. S. J. **Hickson**: A new octoradiate coral. Some corals observed by Mr. Standen, of the Manchester Museum, in a bottom deposit obtained by Mr. Townsend at a depth of 156 fathoms in the Gulf of Oman (Persian Gulf) were submitted to the author for examination, and were found to belong to a genus that had not previously been described. It was therefore proposed to name them *Pyrophyllia inflata*, from the resemblance of the undulating septa to flames issuing from a cauldron. The zoological position of this coral could only be considered fully when its structure had been more carefully studied. All that could be said at present was that there were only two recent corals that seemed to approach it at all in the system of Zoantharia. These were *Guynia annulata*, Duncan, from the Adventure Bank in 92 fathoms of water, and *Haplophyllia paradoxa*, Pourtales, from off the coast of Florida in 324 fathoms of water.

EDINBURGH.

Royal Society, March 21.—Dr. R. H. Traquair, F.R.S., vice-president, in the chair.—Dr. J. R. **Milne**: A photometric "paddle-wheel." This apparatus has some resemblance to the well-known rotating sector, but possesses the advantage that the brightness of the light can be altered and the intensity recorded without the wheel being stopped. In its simplest form it consists of a disc fixed to the axle of a small electromagnet, and furnished with a number of vanes projecting beyond the edge of the disc, and set paddle-like with their planes parallel to the axis. When the axis of the disc is set parallel to the beam of light the vanes move in succession across the field edge on, and intercept very little light. If, while the wheel is rotating, the axis is inclined to the direction of the beam, the vanes will intercept a certain amount of light, depending upon the inclination of the axis to the beam. The paper contained graphical tables, from which the percentage of light transmitted can be found for various forms of vane and different angles of inclination of the axis. The position of the wheel can be recorded by a simple device, which in no way interferes with the rotation. The observer adjusts the rotating wheel until the intensity of the beam is brought to the right value, marks the position by means of a needle prick upon a strip of paper, and then proceeds to the next comparison without removing his eye from the eye-piece of the telescope.—Dr. J. R. **Milne**: A photometer on the flicker principle. The chief novelty of the instrument lies in a part consisting of a small telescope, in front of which two semi-circular glass wedges are rotated by an electric motor in such a way that there is made to fall alternately on the observer's eye first the light that has passed through the absorbing solution and then the light that has passed above it. The brightness of the latter beam is cut down by means of the photometric paddle-wheel described above until it is equal to the brightness of the former, this equality being shown by the absence of flicker.—D. P. **Macdonald**: A chemical investigation into the nature of the clay substance in the Glenboig fire-clay. The results obtained show that the clay substance contains 1·5 per cent. of water in excess of that required to satisfy the formula for kaolinite, and that the mineral is almost entirely decomposed by boiling in concentrated hydrochloric acid for thirteen hours.—W. A. **Caspari**: Contributions to the chemistry of submarine glauconite. Glauconite grains, when subjected to the action of acid, followed by that of alkali, disintegrate with formation of colloidal suspension of glauconite, whence pure amorphous glauconite may be coagulated. The pure glauconite prepared from grains found off Panama and the Cape of Good Hope answered to the formula $KFeSi_2O_6.H_2O$, where K_2O is largely replaced by MgO and FeO. Glauconite grains contain a small percentage of organic matter closely resembling alkali-soluble humus. This and other facts indicate that humus may well play a part in the formation of glauconite. Experiments on the absorption of water by glauconite show that it belongs in this respect to the same class as zeolites or colloidal silicates.

PARIS.

Academy of Sciences, May 2.—M. Émile Picard in the chair.—J. **Violle**: The fight against hail in the Beaujolais. The conclusion drawn by M. André in a recent note was to the effect that hail cannon serve no useful purpose. The author criticises the statistical methods of M. André, and states that during the six years 1901–6 the annual losses in the districts provided with hail cannon were only 0·24 of the average annual loss for the preceding twenty years. In the whole department the losses were 0·76 of the previous annual average.—C. **Guichard**: A mode of generation of triple orthogonal systems with spherical lines of curvature in a single system.—The perpetual secretary announced the death of Édouard van Beneden, correspondant for the section of anatomy and

zoology.—Ernest **Esclangon**: The changes in Halley's comet. On April 27 the most brilliant part of the nucleus was very close to a seventh-magnitude star in brightness, but the comet as a whole would appear to be of a higher magnitude to the naked eye. In the nebulous mass surrounding the nucleus there are two clearly marked surfaces of discontinuity, meeting at the nucleus at an acute angle.—J. **Haag**: Certain triple orthogonal systems. —P. E. **Gau**: The integration by the method of M. Darboux of the partial differential equations of the second order of the form $s=a(x, y, z)p+b(x, y, z)q+c(x, y, z)$.—A. **Chatelet**: The summation of continued arithmetical fractions.—Jean **Chazy**: The differential equations deduced from certain invariants of linear forms.—S. **Lattès**: The convergence of the relations of recurrence.—Léon **Lichtenstein**: The general definition of analytical functions.—André **Léauté**: Superintensities and supertensions due to the working of switches on the switchboard.—Eugène **Bloch**: The curves of saturation in the Hertz photo-electric effect.—M. **de Broglie**: The ionisation of gases by the actions of mechanical division of liquids: active and inactive bodies.—A. **Besson** and L. **Fournier**: The action of the silent discharge on chloroform and carbon tetrachloride in presence of hydrogen, and also upon methyl chloride. The products isolated from the first of these reactions include tetrachlorethylene, trichlorethylene, hexachlorethane, hexachlorpropylene, and higher boiling products. Methyl chloride (without hydrogen) gave a complex mixture which proved to be very difficult to separate by repeated fractional distillation.—G. **Dupont**: The isomerides of some acetylene γ-glycols. The glycols examined included

$$CCl_3.CH(OH).C\equiv C.CH(OH).CCl_3,$$
$$C_6H_5.CH(OH)—C\equiv C.CH(OH).C_6H_5,$$

and

$$(C_6H_3)(CH_3).C(OH).C\equiv C.C(OH)(C_6H_5)(CH_3),$$

two isomers of each glycol being described.—H. **Gault** and G. **Thirode**: The condensation of the secondary amines with γ-bromodimethylacetic ester.—J. F. **Thorpe** and G. **Blanc**: The product of the methylation of diacetoapocamphoric ester of M. G. Komppa. It is shown that the diketocamphoric ester of M. Komppa, one link in the synthesis of camphoric acid, has not the constitution assigned to it.—G. **Vavon**: The addition of hydrogen to essence of turpentine. The fractions from French, German, and American turpentine boiling under 165°, on treating with hydrogen in presence of platinum black, all gave a hydrocarbon with the same density, boiling, and melting points. Hence both α and β pinenes give the same hydride.—A. **Arnaud** and S. **Posternak**: The partial hydrogenation of the acids of the steorolic series and the isomerism of their addition compounds with hydriodic acid. —M. **Bièler-Chatelan**: The function of micas in arable soil.—H. **Sérégé**: An experimental study of the specific action of the Vichy springs employed in thermal therapeutics.—A. **Moutier**: The *rôle* of the arterial wall in the measurement for clinical purposes of the arterial pressure. —H. **Vallée** and L. **Guinard**: The physiological properties of extracts of the Koch bacillus, condensed and rendered sensitive. A study of the physiological properties of the precipitate obtained by adding serum from a horse which had been subjected to a special immunising treatment to culture solutions of the Koch bacillus.—Gabriel **Bertrand** and M. **Rosenblatt**: The temperature at which the plant tyrosinases lose their diastatic activity. The temperatures found varied between 60° and 95°, and these differences cannot be attributed to the nature of the solvent, but rather appear to be a specific property of the diastatic substances.—L. **Launoy**: Certain protoplasmic enclosures of the normal hepatic cell of the rabbit. The author describes under the name of pigmented lipoid bodies certain hitherto unnoticed corpuscles of complex structure in the hepatic cell of the adult rabbit.—Jean **Boussac**: The tectonic interpretation of the flysch of central and eastern Switzerland.—F. **Grandjean**: Remarks on the siphon of the ammonites and belemnites. The envelope of the siphon consists chiefly of calcium phosphate, and not calcium carbonate, as hitherto supposed.

CALCUTTA.

Asiatic Society of Bengal, April 6.—E. **Brunetti**: Review of our knowledge of the Oriental Diptera. The paper is a comparison between our present knowledge of the Oriental Diptera and that possessed by entomologists at the date of Van der Wulp's "Catalogue of South Asiatic Diptera" (1896).—Lieut.-Colonel D. C. **Phillott**: Vocabulary of technical and sporting terms in Urdu, Persian, and Arabic.—E. R. **Watson**, Monohar **Gupta**, and Satish Chandra **Ganguli**: A chemical examination of the butter-fat of the Indian buffalo.—E. W. **Vredenburg**: *Chondrodonta bosei*, a new species of fossil lamellibranch from the hippurite-bearing beds of Seistan. The first bivalve mollusc described in the Records of the Geological Survey, vol. xxxviii., part iii., proves to be a Chondrodonta, here named *Chondrodonta bosei*.—Hem Chandra **Das-Gupta**: Palæontological notes on the Gangamopteris beds of Khunmu (in Kashmir). On a visit to Khunmu, in Kashmir, remains of a palæoniscid and an ichthyod orulite fish were found, which are briefly described.—H. E. **Stapleton**: Contributions to the history and ethnology of north-eastern India, ii. This paper deals with the coinage of Assam in its relation to the history of Assam as given in the *Buranjis*. The chief materials on which it is based are:—(*a*) the find of nearly 1000 coins made in 1906 at the Daflating Tea Garden, near Jorhat, in Assam; (*b*) the cabinet of Assamese coins in the possession of Mr. A. W. Botham, C.S.; (*c*) the recent catalogue of Assamese coins in the British Museum, published in the *Numismatic Chronicle* by Mr. J. Allan; and (*d*) the writer's own collection of Assamese coins.

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