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The Fate of the Energy of the Universe: a Tangled Skein.

THE two outstanding conceptions of the nineteenth century were undoubtedly the principle of the conservation of energy, and the closely allied and supplementary principle of the dissipation of energy. Energy was conserved amid all its protean changes, but at each change its availability was lessened. On these two foundations rests the whole structure of thermodynamics. Neither of these conceptions stands exactly where it did, though a good deal of strong evidence will be required to shake the former. In a remarkable paper, read before the Cambridge Philosophical Society only a few months before his death, Prof. Liveing, at the age of ninety-five, threw out a challenge to the latter. Looking back over an active career covering in point of time almost the whole of what we now call science, the veteran felt that the dissipation of energy was not the whole truth. This universe could not be destined to subside into a tideless sea of unavailable energy, moved by no currents, stirred by no ripple, changeless and unchangeable. Somewhere, by some unknown process, the degraded energy must be undergoing a process of renewal and reintegration, to play its part once more in the physical world.

It is interesting to find from the report of a recent address given to the Radio Society by its distinguished president, Sir Oliver Lodge, that similar conclusions have been reached by still another scientific worker of long and ripe experience. In view of his more than youthful energy and freshness of outlook, it would be absurd to call Sir Oliver a veteran, but it cannot be denied that he has had a longer experience of scientific thought than most. His suggestions are always worthy of consideration, and, moreover, are always made in such concrete and positive form as to leave no doubt as to what they are.

Of the earlier parts of Sir Oliver's address it is not necessary to give any account. Towards the end of his discourse, however, after reviewing the principal facts of atomic structure, of photo-electricity, of thermionics, and of radio-telegraphy, he leaves the beaten track of accepted theory and experiment and launches forth on new and dangerous seas of thought. For Sir Oliver Lodge is not content with expressing a belief in the reintegration of energy; he also has a definite theory, or at least the beginnings of a theory, as to how this reintegration is accomplished.

Sir Oliver is at the present time the doughtiest of the champions of the ether, as against the mathematicians of the relativistic school, who, if they do not actually deny its existence, have at least no use for such a medium; and it may be that in times to come this

insistence that a basis for the universe must be sought in a physical medium rather than in a set of equations will be regarded as not the least of his contributions to physics. To him the electron and the proton are local modifications of this all-embracing fluid; knots, or, perhaps, bubbles in the ether, a conception already made familiar by Sir Joseph Larmor. Thus matter, which is built up of protons and electrons, is just a manifestation of local peculiarities in the ether. The protons and electrons attract each other. "A little friction will disturb and separate them," Sir Oliver reminds us, "but they will get together again as soon as they can. Whenever they approach each other, they radiate. The more violent the clash, the more vigorous the radiation. Do they ever actually inextricably clash, and annihilate each other? It is not known that they ever do; there seems to be something which keeps them apart. Things on earth seem too staid and quiet to allow of an actual destructive clash, or anything like mutual extermination. But the operation is conceivable, and as we now know that some of the stars have a temperature to be reckoned in millions of degrees, strange and violent things may be going on there."

"We can," continues Sir Oliver, "at least contemplate the process and ask what would happen if they did; the answer is clear enough. The two opposite charges would vanish in a puff of radiation; all that would persist of them would be their energy; there is no destroying that. The energy would no longer be localised in specks of matter, it would now wholly and obviously belong to the ether." Sir Oliver thus accepts the transformation of matter into radiant energy, which has been postulated by Jeans and others to account for the intense radiation from the stars; and further suggests that the energy for this colossal output of radiation is supplied by the liberation of the potential energy stored up in the knots or strains in the ether which constitute electrical charges. "Dr. Jeans tells us that the sun loses 4,000,000 tons of matter every second. That is the rate at which it is radiating ether waves—converting matter into ether energy and radiating it away." It may be that Sir Oliver's theory from one point of view adds nothing to Einstein's postulate of the equivalence of matter and energy. It does, however, provide a conceivable picture of the method of transformation, and to the physicist who thinks in pictures rather than in formulæ, this is no small boon.

The crux of the address, however, lies in the succeeding paragraph. "What I want to ask is," says Sir Oliver, "is there any reciprocity about this process? Matter can turn into radiation. Can radiation turn into matter? I surmise that it can, but not under ordinary conditions. I guess that the waste radiation careering through space from all the innumerable suns and through innumerable millenniums must have some result. I imagine them to be generating matter in the far depths of space; which matter can then by gravitation fall together and reproduce or keep in maintenance the whole material cosmos. I see no ultimate dissipation of energy in the universe. I see energy passing from matter to ether and back again."

These singular speculations, which we have recorded so far as possible in the author's own words, open up interesting vistas. If, as Sir Oliver suggests, these knots possess the property of re-forming themselves when untied, they are indeed ethereal strains wafting to this tangled skein of which we form a part, the promise of an immortality not only in the future but also in the past. But, as Sir Oliver himself reminds us, speculation is comparatively useless unless it can be tested, and we are sure that he would not have published this unless he had glimpsed some way in which it might be put to the test of experiment. An address to a popular audience did not, perhaps, afford a suitable occasion for the fuller exposition of these matters, which we hope he will shortly give us. In the meantime we may be grateful to Sir Oliver Lodge for his challenge to lift our eyes to the wider horizons. It is good to be reminded, in this age of scientific progress, how little we really know.

Population and Evolution.

Malthus and his Work. By Dr. James Bonar. Second edition. Pp. viii+438. (London: G. Allen and Unwin, Ltd., 1924.) 12*s.* 6*d.* net.

"IN October 1838, that is, fifteen months after I had begun my systematic enquiry, I happened to read for amusement Malthus on Population, and being well prepared to appreciate the struggle for existence which everywhere goes on from long continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed."

In these words, Darwin in the well-known autobiographical sketch acknowledged his debt to Malthus. It is also well known that Wallace made a similar acknowledgment. In a letter to Prof. Newton he referred to the matter as follows:

"The most interesting coincidence in the matter, I think, is, that I, as well as Darwin, was led to the theory itself through Malthus—in my case it was his elaborate account of the action of 'preventive checks' in keeping down the population of savage races to a tolerably fixed but scanty number. This had strongly impressed me, and it suddenly flashed upon me that all animals are necessarily thus kept down—'the struggle for existence'—while variations, of which I

was always thinking, must necessarily often be beneficial, and would cause those varieties to increase while the injurious variations diminished."

On another occasion, Wallace commented upon the fact that, whereas in his own case it was the recollection of his previous reading of Malthus, which came to him while puzzling over the problems of organic life during an attack of fever when on a visit to the East, Darwin chanced to read Malthus when he had for some time already had the problem of evolution in mind.

This difference is of no moment; the profoundly interesting fact is that both the authors of the famous papers read to the Linnean Society on July 1, 1858, afterwards acknowledged their debt to Malthus. It is also an example of the fame of Malthus's book that two specialists in quite another field should have read the book more than forty years after the publication of the first edition. We may guess, however, that they did not pick up the book wholly by chance. They probably had some previous idea as to its contents, and were led to study it because they suspected, even if only half consciously, that the theme had some reference to their own studies. This turned out to be very much the case. Malthus was not a biologist or a naturalist, though it is perhaps worth noting that his father was an amateur botanist and specifically disposed in his will of a box of plants given to him by Rousseau. By training a mathematician (he was ninth wrangler in 1788), Malthus was by taste interested in social problems. At Cambridge he was "remarked for talking of what actually exists in nature or may be put to real practical use" rather than for abstract speculations. When, therefore, after leaving Cambridge, friendly discussions took place between him and his father, who looked kindly upon Jacobinism, the views of Godwin and prospects of "perfectibility," it is not surprising that the younger man "threw little stones" into his father's garden. The son saw practical difficulties in the way of "improving society" and concentrated his attention upon the difficulties connected with population as among the most serious.

Malthus was thus led to put his views in the form of an essay, which was much expanded in later editions. In the opening chapter, stress is laid upon "the prolific nature of plants or animals," to which there is no bound "but what is made by the crowding and interfering with each other's means of subsistence." Malthus, however, was not interested in plants or animals other than man, and it is with the consequences of man's power of multiplication that he is concerned. This hint, nevertheless, was of the utmost value to Darwin. "A struggle for existence inevitably follows from the high rate at which all organic beings tend to increase," he says in the famous third chapter of the "Origin of Species." The very phrase "struggle for existence" was, it is interesting to note, used by Malthus himself. After some further amplification of the idea of the struggle for existence, Darwin goes on to say that "it is the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms."

The influence of Malthus upon Darwin and Wallace is not merely a matter of historical interest. It reminds us of the fact that many social problems are, at the bottom, biological problems. There is nowadays a strong revival of interest in the question of population, and we may distinguish between problems connected with the quantity and problems connected with the quality of population. Upon both of these problems biologists have much of value to contribute. Indeed, for the solution of many problems of pressing practical importance, further biological research is urgently required. We know little, for example, regarding the comparative fecundity of different races and regarding the influence of variations in the food supply upon the fecundity of members of the same race. There are hints that crowding has an important, though an obscure, influence upon the power of multiplication. Upon these and other important points bearing upon the quantity of population, we await progress in biological inquiry. The problems regarding the quality of population, which were formerly much neglected, are now receiving attention and biologists are "throwing little stones" into the gardens of our modern counterparts of the old believers in "perfectibility." They could, however, take far more effective aim if they were furnished with more extensive and accurate data such as further research alone can provide.

The widespread interest in population which Malthus aroused gradually died away. To those concerned with social economics it came to seem a remote problem, and biologists had not advanced the study of inheritance far enough to be able to contribute much that was of value. Interest has now revived; the War has made certain aspects of pressing importance, and we may be sure that this time the problem has come to stay. Thus a warm welcome is ensured to the new edition of Dr. Bonar's well-known book. First published in 1885, it has long ago taken its place as a standard work and will now draw a still larger circle of readers. As the author says, it is not a treatise on population, but an account of one writer on population, and, we may add, a very illuminating and sympathetic account. There is a certain resemblance between Malthus and Darwin both in character and achievement. They were both retiring in disposition, courteous in manner, and capable of inspiring deep affection. They both

attained sudden fame by the publication of a single book; they were greatly maligned and, while feeling the attacks made upon them, were recompensed by the knowledge that they had in general gained the assent of the eminent men of their day to their views. Lastly, they both sought to avoid controversy and devoted themselves to gathering fresh evidence, leaving their supporters and detractors to fight it out among themselves.

Dr. Bonar has somewhat expanded the bibliographical section of his book. Otherwise it remains as it was, with the addition of certain notes. It is a book with which all those who interest themselves in population problems, and among them are nowadays many biologists, will wish to make themselves acquainted. A. M. C.-S.

Relativity and Cosmology.

(1) *Einstein's Theory of Relativity.* By Prof. Max Born. Translated by Henry L. Brose. Pp. xi + 293. (London: Methuen and Co., Ltd., 1924.) 12*s.* net.

(2) *Space and Time: an Experimental Physicist's Conception of these Ideas and of their Alteration.* By Prof. Carl Benedicks. Pp. xiv + 98. (London: Methuen and Co., Ltd., 1924.) 4*s.* net.

(3) *The Theory of Relativity.* By Dr. L. Silberstein. Second edition, enlarged. Pp. x + 563. (London: Macmillan and Co., Ltd., 1924.) 25*s.* net.

IT is nearly twenty years since Einstein wrote his epoch-making paper on the electrodynamics of moving bodies, in which the fundamental principles of the theory of relativity were first clearly enunciated, and apparently the theory is now approaching the completion of the stage of formal development on one hand and of popular exposition on the other. Writers are beginning to turn their attention to work of a more critical character on the roots of the theory — its logical bases and fundamental concepts — and to the detailed investigation of its outlying branches, spreading far into distant regions — the quantum theory, cosmological theories, and so forth. The three books under review are typical of this process in some respects, and each is well worthy of the reader's attention.

(1) The first book, by Max Born, the successor of W. Voigt in the chair of mathematical physics at the University of Göttingen, and himself well known for researches in the theory of relativity, is considered by some to give the best popular exposition of Einstein's theory in the German language, and for this reason alone an English translation is very welcome. It arose out of a course of popular lectures on the subject delivered in the winter of 1919–1920 to an audience without any knowledge of the technique of either mathematics or physics, and, although naturally the treatment has been modified somewhat with a view to publication, the result is an eminently readable account of the subject. No doubt it will in its English guise prove very useful, not only to the general reader and to the popular lecturer, but also to the university student in his first or second year with only a slender equipment of mathematics and physics. The treatment in the main follows the historical order of development, but always with special reference to questions of absolute and relative motion and similar changes. The first twenty-five pages are devoted to a brief sketch of Newtonian mechanics and Newton's ideas of absolute space and time, the next fifty to the fundamental laws of optics, including optical effects in moving bodies, and about sixty more to the fundamental laws of electrodynamics up to and including the theories of Hertz and of Lorentz, and an account of the Michelson-Morley experiment. On this broad foundation the special theory of relativity is expounded in fifty pages, and the general theory in a further forty pages, both mainly on the lines laid down by Einstein. The translation is good, misprints are conspicuous by their absence, and the print and style of production excellent.

(2) In the second book, Carl Benedicks, the eminent Swedish metallographist, deals with the fundamental principles of space and time measurements from the point of view of the experimenter rather than the logician or mathematician. He prefers the traditional views as to the absolute character of space and time and their independence of one another, and considers the reasons put forward by Einstein and his school for changing them to be quite insufficient. Without in the least minimising the value of Einstein's explanations of such residual effects as the deflexion of light by the sun and the advance of the perihelion of Mercury's orbit, he does not consider them to be decisive tests of the theory. He directs attention to a remark of Poincaré's to the effect that "if one explanation of a phenomenon is found, there are also an infinite number of other ones to be found," and points out that other explanations of both effects have been given already—by Von Soldner a hundred and ten years before Einstein for the deflexion of light, and by G. Bertrand recently for the perihelion effect. He inclines to the opinion that an emission theory of light, on the lines of the ideas put forward by W. Ritz just before his decease, might be constructed in such a way as to meet these difficulties without necessitating complete changes in the traditional concepts of space and time; for example, on this view an electron is regarded as the "centre of an iterated explosion." Whatever one may think of the author's conclusions, one must admit that this

book of some hundred pages contains much that is interesting and suggestive, and raises several questions well worthy of the attention of relativists, such as the realisation of a true plane by the engineer's method of constructing three mutually fitting face-plates, the synchronisation of two distant clocks by the mechanical device of two wheels connected by an axle free from torsion, etc. It can be strongly recommended to any one interested in the logical bases of mechanics and physics.

(3) The third book, by L. Silberstein, is in many respects the most important of the three, at any rate for the relativist, but no doubt it presupposes a much more extensive mathematical and physical equipment than the other two; it is the second edition, and at the same time an extensive development of the book on the theory of relativity published by the same author in 1914, and reviewed in NATURE of December 10 of that year. That book is reprinted practically without change and forms the first ten chapters of the present work, so that nothing further need be said about this portion, The six added chapters with a number of miscellaneous notes at the end, amounting to about two hundred and sixty pages, or a little less than one-half of the whole, deal with the extensions made in the theory since 1914, mainly in connexion with the general theory of relativity and gravitation, with detailed reference to its cosmological applications. The old and new parts of the book together constitute what is perhaps the most complete text-book in the English language on the theory of relativity and gravitation in all its ramifications, certainly the fullest on its cosmological aspects. It is worthy of a place beside the standard treatises of Eddington and of Weyl, but not quite as mathematical as the former and perhaps wider in scope than the latter, and written from rather a different point of view than either, so that the three books are in a sense complementary to one another.

The author has evidently been at great pains to make the physical meaning of each step in his argument and of every mathematical result as clear as possible, even to a reader not possessed of the very considerable mathematical equipment needed for a thorough understanding of the general theory of relativity. To expect complete success in this respect would, however, be unreasonable, seeing that there are plenty of mathematical processes and results in the theory, about the geometrical and physical meaning of which even experts are not yet fully agreed. We ought to bear in mind what were the conditions respecting the geometrical interpretation of the axioms and concepts of Euclidian geometry before the times of Gauss, Bolyai, and Lobatschewsky, or the physical interpretation of the concepts and laws of Newtonian mechanics before the time of Mach, particularly in view of the great age of these branches of knowledge as compared with the twenty years of relativity.

Coming to details we note that the first of the new chapters, the eleventh of the whole book, gives a very readable account, without any formidable array of mathematical symbols, of the logical and historical development which led Einstein from the special to the general theory of relativity. The metrical tensor of the field is introduced, its geometrical and physical implications are considered summarily, and the world geodesics are defined and their physical interpretation is explained. The twelfth chapter is purely mathematical; in fifty pages a brief account of the tensor calculus is given, Levi-Cività's concept of parallelism is explained, and the Riemann-Christoffel tensor is introduced in much the usual way. Naturally, the limitations of space imposed by the plan of the book make this chapter difficult for any one not already acquainted with the subject; full references are given to the original authorities, but it might have made it easier for the beginner if reference had also been made to fuller text-books on this particular branch, like those of Galbrun and of Rothe.

The thirteenth chapter deals in some twenty pages with the physical interpretation of geodesics in detail, and is noteworthy in two respects. In the first place, it is shown that in the rest system of a freely moving particle the equations of motion of Einstein become identical with the Newtonian equations, not merely approximately, as is generally known, but rigorously. Secondly, the treatment of the light paths, or rays, is novel and is utilised to obtain the theory of the experiments reported to have been carried out by Michelson at the Yerkes Observatory with the object of testing Einstein's theory by an absolutely direct method. The fourteenth chapter, of fifty pages, treats of the gravitational field equations and the material energy tensor in much the same manner as in other books, attention being confined, however, to the centrosymmetrical solutions and to Einstein's approximate method. Within these self-imposed limits the author gives an exceptionally complete treatment, including, as he does, an account of de Sitter's geodesic precession and also of Grossmann's critique of the perihelion effect.

The fifteenth chapter deals with electromagnetism and gravitation by a little-known method due to Kottler and based upon Minkowski's exposition of the special theory. In about twenty-three pages the author works out the field of a gravitating electric particle, as it were from first principles, a method of treatment which possesses certain advantages from the student's point of view over the usual method based on the principle of least action. The last seven pages of this

chapter contain a very brief sketch of variational methods, of which the author does not appear to be particularly enamoured; but he gives full references to the original authorities with the exception of de Donder, whose "Gravifique Einsteinienne" is not so well known as it deserves. The five new chapters so far considered cover the ground usual in text-books on the general theory of relativity, but in some respects the treatment is novel and more complete than usual, as we have pointed out here and there. The chief peculiarity of the book, however, lies in the very complete account of the cosmological aspects of the general theory of relativity, which fills nearly one-third of the additional space, about eighty pages.

The author devotes the first thirty pages of the sixteenth and last chapter to a very detailed critical discussion of Einstein's cosmology, based on the assumption of a finite elliptic space filled with matter, uniformly distributed on the average. He explains very clearly how this cosmology leads unavoidably to the existence of singularities of the metrical field—antisuns—at places where there need be no concentration of matter at all, and is therefore untenable, a conclusion in which he agrees with other writers. The remaining thirty or more pages of this chapter are devoted to a detailed study of de Sitter's cosmology, to which the author is evidently favourably disposed. He discusses de Sitter's spectroscopic distance effect, as well as the more general combined Doppler effect, due both to distance and to radial motion of a celestial object—star, nebula, or cluster—in considerable detail, in the light of Slipher's table of radial velocities of spiral nebulæ and Shapley's tables of the radial velocities of globular clusters. Finally, there are fifteen pages of miscellaneous notes dealing mainly with questions relating to world-curvature and cosmology, but also with some recent experimental results regarding the solar spectrum shift, the deflexion of light by the sun, and spectrum shifts of distant celestial objects. Although most relativists would perhaps be loth to lay so much stress as the author does on observations relating to very distant celestial objects, on account of the very speculative character of some of the interpretations put upon them, yet it must be conceded that there is much to be said in favour of the author's view that these observations do lend substantial support, so far as they go, to de Sitter's cosmology, which treats space as finite, elliptic, and generally void of matter, except for the presence here and there of isolated singularities, such as the sun and the stars.

This brief survey sufficiently shows that we have before us a book of great interest, which deals with many of the problems arising in the general theory of relativity in a detailed, novel, and up-to-date manner. It may be objected that it is premature to devote so great a proportion of the whole book as one-sixth to so speculative a branch as cosmology, but there is good reason to be thankful to the author for giving us so full an account of this usually neglected portion of the theory. For this and many other reasons, Dr. Silberstein's book is one which no one interested in the theory of relativity can afford to ignore.

The Canadian Arctic.

(1) *With Stefansson in the Arctic.* By Harold Noice. Pp. 270 + 16 plates. (London, Calcutta and Sydney: G. G. Harrap and Co., Ltd., 1924.) 7*s.* 6*d.* net.

(2) *The Arctic Forests.* By Michael H. Mason. Pp. xiii + 320 + 53 Plates. (London: Hodder and Stoughton, Ltd., 1924.) 20*s.* net.

(1) THE facile pen of Mr. Vilhjalmur Stefansson has already made us familiar with the Canadian Arctic islands and his views on the friendliness of Nature in the polar regions, but we may say without prejudice to the leader of the expedition that one needed the opinions and feelings of a rank-and-file member of the party to drive home the theories of the enthusiast. Mr. Noice tells in a frank and pleasant way the events of many months of intimate companionship with his leader, and incidentally unfolds his gradual conversion to the beliefs of Stefansson in a way which carries more conviction than the calm and scientific statements of "The Friendly Arctic" could do. There are also many gaps in the earlier narrative which are filled up in this, and new sidelights are thrown on some aspects, as, for example, on the insubordination which so frequently marred the plans and diverted the purpose of the expedition.

To British readers, accustomed now to Antarctic ventures, which of recent years have held the field, the expedition presents many unique features. The various headquarters of the expedition were rarely more than 300 miles from the Canadian mainland and not much more from the settlement at Herschel Island. In consequence, there were frequent opportunities for refitting from visiting whalers, or of dashing across to find new men or ships, a convenience which proved of doubtful value. Although it enabled the leader to buy or charter no fewer than four ships at various times, it also meant taking with them several men whom he could have done better without. The method of employing Eskimo men and women, though not new, was very thoroughly carried out, several women being at an advanced headquarters within 300 miles of the farthest point reached.

The most unprecedented feature of the expedition was the reliance for food on what could be found on the

land and under the ice, and the proof positive that for many parts of the region visited there is no need for any one to die of starvation so long as he is able to hunt. The abundance of animal and vegetable life is little short of amazing, and the demonstration carried out over some five years, that white men can live and hunt in the Eskimo method, is perhaps the greatest service the expedition has rendered to polar exploration.

The claim made in some quarters that this has ended the days of expeditions going out fully equipped from civilisation cannot be said to be substantiated, or at all events must not be accepted without challenge. To one who has served on what Mr. Stefansson humorously calls a "groceries" expedition, where little thought and the minimum of time was given to the daily food problem, the chief and lasting impression of these two narratives is the amount of time which has to be given up to hunting and cooking, and, one may also add, the number of caribou or ovibos (musk ox) required to support a party of three or four men with dogs. That a man of the mental calibre of Mr. Stefansson should have to spend day after day hunting for the party may have proved the efficiency of the white man, but at the same time it must have robbed us of a vast amount of skilful scientific observations.

It is true that the loss of time spent in hunting was to some extent made up by the rapid methods of travel which the parties used, and their ability to travel in almost any weather. The mileage travelled by Noice himself and by others is astonishing, though, owing to unforeseen circumstances, a great deal of it was spent in mere message-taking from one party to another. While the loss of two experienced men on one of the journeys warns us that the friendliness of the Arctic is strictly a relative term, there is no doubt that Mr. Noice's book supports the earlier one in demonstrating that life in the Canadian Arctic islands can be pleasant and exploration a mere matter of time, provided that Eskimo, and white men trained to Eskimo methods, are taken.

(2) In Mr. Mason's book we have the same kind of tale, though in slightly more favoured latitudes. The rapid development of the Alaskan territories and the amenities of life there now are little known to us in the Old World, who are apt to look to the tales of hardship in the early days of the "Yukon" for our ideas on the subject. The book perhaps attempts too much, in that it ranges from anthropological classifications through true and thrilling stories of camp life to imaginative tales of death and disaster. Each section is well written, but cannot claim its full effect when side by side with the others, and indeed conveys the impression of a guide-book compilation, which it is not. But the author most certainly succeeds in his purpose of giving an "accurate general idea" of the country, and will doubtless convert many readers to his firm belief in its future. We too are ready to dream of first-class dining-cars running to the shores of the Arctic Ocean during the summer, since the mineral wealth of the country is able to pay for them, but we hesitate to follow so readily the author's claim that it is only a matter of time before cereals will be acclimatised so as to feed the growing population without dependence on outside sources.

F. DEBENHAM.

Applied Chemistry.

The Constituents of Coal Tar. By Dr. P. E. Spielmann. (Monographs on Industrial Chemistry.) Pp. xii+219. (London: Longmans, Green and Co., 1924.) 12*s.* 6*d.* net.

Aniline and its Derivatives. By P. H. Groggins. Pp. vii+256. (London: Chapman and Hall, Ltd., 1924.) 18*s.* net.

THESE two books present a sharp contrast which is of particular interest at the present time, when many people are concerned to notice in some of our educational institutions a tendency towards early specialisation and the consequent granting of degrees and diplomas to students who have not received, and have not had time to receive, a thorough training in the sciences underlying the branch of applied chemistry they have chosen to adopt. For, after all, applied chemistry is applied *chemistry*, that is to say, it is a branch of chemistry, not a science of itself, and a chemist is, or should be, a *chemist* before he elects to follow any of the numerous branches of the parent science which will enable him to adopt an adjectived or hyphenated title. It is scarcely possible to insist too strongly on this point because it is difficult adequately to acquire the fundamental principles of a science in later life, and the early neglect of a suitable foundation leads to personal limitations which are difficult to overcome and are apt to hamper the usefulness of the individual not only to himself but also to the community at large.

One of these books is by an English author; the other is by an American. The shock is, therefore, not so great when one reads in the preface to the American book that chemistry is a branch of the engineering profession.

We in Great Britain are still in the throes of producing a chemical engineer or an engineering chemist fully armed and equipped from out of our universities, and we are not yet all agreed as to how it can best be done in the time available, or as to whether the engineer is to be superimposed on the chemist or the chemist on the engineer. Indeed, many of us think that

the term should only be applied to those chemists who have had at least five years' works practice. In the United States there appears to be no such problem, and many of the universities in that country have granted degrees in chemical engineering for some time past.

(1) In his introduction to the series of monographs on industrial chemistry, Sir Edward Thorpe stated definitely that "they will serve to show how fundamental and essential is the relation of principle to practice," and, now that seventeen volumes of the series have appeared, it is possible to realise how closely this wise provision has been followed. It is sometimes urged by reviewers and others that the volumes do not deal with industrial chemistry at all, but are merely compilations of academic interest. This is not the case, and the present volume by Dr. Spielmann is an instance in point. It was not intended that these volumes should "cover the whole ground of the technology of the matters to which they relate" or be "concerned with the technical minutiæ of manufacture except in so far as these may be necessary to elucidate some point of principle." They are intended for the use of chemists in the real sense of the word, whether academic or industrial, who wish to acquaint themselves with the general practice and most recent development of the branch of applied chemistry under treatment. In these ways Dr. Spielmann's book is a notable addition to the series and will be welcomed by all who desire to follow the most recent advances in coal tar chemistry.

The book is well printed and the formulæ are clear, but to any reader who is not an expert organic chemist they may cause trouble, because there appears to be no uniformity of treatment. For example, sometimes the formulæ are written in full as in chrysene (p. 103), sometimes in abbreviated form as in naphthacene (p. 104). Often the aromatic nuclei are represented as simple rings without adornment (naphthalene, p. 72), often the Kekulé double valencies are included (quinaldine, p. 159). Sometimes hydrogen atoms are placed at the angles of the benzene hexagon either without the double valencies (coumarone, p. 135) or with them (indene, p. 73). The effect even on the expert reader is apt to be irritating, and the author might well consider an alteration in this connexion for future editions. Had this book been discovered in Tutankhamen's tomb and constituted the sole evidence of the type of graphic formulæ used by the ancient Egyptians, no Rosetta stone would have enabled modern men of science to solve the problem.

(2) It is stated in the preface of Mr. Groggins' work that this book is intended "for the student of chemical engineering as well as the graduate engineer or works chemist." It is not clear if the "or" in the above sentence implies that the last two terms are synonymous, but, in any case, it is certain that the author intends his book to appeal to a wide circle. It constitutes a sharp contrast to Dr. Spielmann's book, which is written essentially for the educated chemist and would, in all probability, prove irksome to the usual engineer manager. In other words, it is an outcome of the view that the engineer without fundamental chemical training can be supplied with a sufficient working knowledge of the chemistry and physics of a process to enable him to carry through without the aid of a competent chemist. The book is, therefore, replete with drawings of plant and the technical minutiæ of aniline manufacture.

It is not the writer's object to quarrel with the method employed, but only to wonder if a book of this kind is really of educational value or whether it is not rather a book of reference. So far as the treatment is concerned it is admirable, and it represents the last word in the technology of aniline manufacture. The chemical theory is a bit scrappy, and if a firm were to rely on the technical information supplied in order to start the manufacture of the base it would, in all probability, have spent all its spare capital long before it had decided on which process to adopt. Nevertheless, as a record of the chief processes involved, the book is of real value, and of special importance and utility are the chapters on cost factors (p. 91), and on thermal factors (p. 104), for these are matters, essential to engineers and chemists alike, to which too little attention is given; the article on the chemist's budget (p. 97) is particularly noteworthy and will well repay attention. The chapter on aniline poisoning (p. 117) provides some startling facts, and that on general chemical and physical data (p. 131) gives information not readily available elsewhere. The book is readable and well set up. It should be read by all who have an interest in the subject with which it deals.

J. F. T.

The Teaching of Physiology and Pathology.

(1) *A Text-book of Physiology*. By Prof. H. E. Roaf. Pp. viii + 605. (London: E. Arnold and Co., 1924.) 25*s*. net.

(2) *Text-Book of Pathology*. By Prof. Robert Muir. Pp. vii + 774. (London: E. Arnold and Co., 1924.) 35*s*. net.

(1) PROF. ROAF'S volume is based on the course of instruction given at the London Hospital Medical School, and represents, presumably, a scheme for the presentation of the facts of physiology which he has found to be more satisfactory in its results than the traditional method, for it marks to some extent a new departure in text-books on the subject.

Hitherto it has been usual to consider as a group or system those organs of the body which act together for a common end. Thus the physiology of the alimentary system has embraced a description of all those organs the main function of which is to bring about digestion and absorption of an animal's food. They have been compared and contrasted as regards their structure, function, and the means whereby their function is regulated in order to further the ends for which they are designed and to assist in the co-ordination of the body as a whole. In the work under review this method is not adopted, but, instead, the subject of animal physiology is approached from the point of view of the chief activities which an animal displays. Mechanical aspects are dealt with in the first section, chemical activities in the second, regulative mechanics come next and occupy the largest section of the book, and, finally, a special section is devoted to the maintenance of the individual and reproduction.

However logical this method may appear in theory, it is not always satisfactory in practice. If there is one subject more than another in physiology in which the thermal, chemical, electrical, and mechanical phenomena associated with its action have contributed as a whole to the understanding of its mechanism, it is that of muscle. It would seem best, therefore, in dealing with the physiology of muscle, to consider these phenomena in succession in order to show what light each has thrown on the working of a muscle. This, however, has not been done. The thermal, mechanical, and electrical changes are described in one section and chemical changes in another, where they are grouped with processes of absorption, excretion, and secretion, with which they have little in common except that in each there is a degradation of energy. Other examples illustrating the difficulties of this scheme of treatment might be given. On the other hand, there is much to be said for a book modelled on these lines, in that it gives the student a new point of view and directs his attention to fundamental likenesses in many aspects of bodily activity which might well escape him in reading text-books written on more familiar lines. Were the book a text-book of general physiology, then it could certainly be conceded that the method of treatment adopted by the author is the right one.

Here and there some lack of perspective is shown regarding the space devoted to certain subjects. For example, the reaction of sugars with phenyl hydrazine is spread over a page and a half, whereas the depressor nerve and its functions receive only half a page. The book is well illustrated and contains some new and useful diagrams.

(2) Prof. Muir's book is founded on the course in pathology given at the University of Glasgow. The earlier chapters deal with general disturbances of nutrition and of the circulation, the phenomena of inflammation and its sequelæ, and infection, immunity, and fever. Then follows a section devoted to the description of tumours and their causation, and finally, the lesions which are met with in the various systems of the body—circulatory, respiratory, alimentary, etc.—are discussed. Although there is thus a division of the subject into general and special pathology, it is not apparent in reading the book that any real separation under these two heads occurs. That is one of its virtues. It is sometimes said that pathology is the study of physiological processes which have "gone wrong," and there is a good deal of truth in this somewhat bald statement. What it implies is that many phenomena met with in pathology are really the result of physiological reactions proceeding, it may be, to excess or in an abnormal direction. Prof. Muir rightly emphasises this in his introduction, and, what is more, makes practical application of it in his method of teaching. Wherever one turns in the book, this underlying idea can be discerned. We feel, therefore, that the student who has just completed his course in physiology and has then begun his study of pathology, guided by this book, will find a natural sequence in description, explanation, and discussion which is too seldom met with in books devoted to subjects of the medical curriculum. The book thus makes a useful bridge to the gap, which in the past has been too apparent, between the subjects of the second M.B. examination and those of the later period of the medical student's course.

Accounts are given in appropriate places of the investigation of pathological processes by other means than the microscope. This instrument has rendered inestimable services in the past and it will no doubt do so in the future, but other methods are available as adjuncts to it, and the experimental investigation of pathological processes is likely to be fruitful in helping to elucidate the initial causes of disease and to explain disturbances of function which result from them. The discussion of the results of such methods is not common in text-books of pathology and is therefore to be commended.

The book is admirably proportioned and the illustrations are one of its special features. The author is to be congratulated on them. They are all reproductions of photographs which have been made with great technical skill, and it is obvious that they have been carefully selected. We feel sure that the book will be widely welcomed by both students of medicine and those engaged in teaching and clinical practice.

H. S. R.

Our Bookshelf.

PSYCHOLOGY.

Crime and Insanity. By Dr. W. C. Sullivan. Pp. vii+259. (London: E. Arnold and Co., 1924.) 12*s.* 6*d.* net.

As Medical Superintendent of Broadmoor Asylum, Dr. Sullivan is in a position to speak with authority on a subject which is now arousing considerable interest, not only in medical men and jurists, but also among the general public. There is no lack of literature dealing with disorders of conduct from the point of view of the alienist, and with criminal responsibility of the insane considered on the standards imposed by the law. The efforts of the author of "Crime and Insanity" have been directed towards presenting the abnormalities of conduct which are dependent on mental disease, as clinical features demanding a study of their nature and origin; and this book is a proof that when approached on these lines, the more special question of criminal responsibility becomes less complex and loses much of the obscurity with which legal subtleties have cloaked it.

Responsibility is rightly recognised as being a purely legal question; the law expresses the attitude of the ordinary man of common sense, living at this time and in a particular country. The McNaughten rules, which are always applied as the law of England, though they bear the dignity neither of parliamentary enactment nor judicial decision, enunciate the opinion of the bench of judges in the year 1843. It must be agreed that they do not represent the general feeling of public opinion to-day, and it is widely recognised by lawyers and medical men that they are inadequate; their interpretation by judges is variable and they are rarely applied rigidly. Dr. Sullivan points out that the test is unsatisfactory because it is based on a misconception of the facts; he advocates the adoption of a simpler test of responsibility, the admission of qualified responsibility, and the establishment of a system for providing the court with expert evidence concerning the mental state of the accused.

Most of this book is devoted to clinical material, and there are numerous descriptions of cases illustrating the criminology of the various types of mental disorder. It is an important and practical contribution to the literature of insanity.

VIIth International Congress of Psychology, held at Oxford from July 26 to August 2, 1923, under the Presidency of Charles S. Myers. Proceedings and Papers, edited by the President. Pp. xxv+388. (Cambridge: At the University Press, 1924.) 12*s.* 6*d.* net.

THE various papers collected in this report have a high intrinsic value, but the greatest interest of such a collection is to be obtained by comparing the different points of view rather than by studying the individual contributions. The discerning reader can thus obtain a trustworthy insight into the recent progress of psychology, a knowledge of its present position, and even perhaps a prognostication of its future development. The collection is representative of modern psychological thought, containing, as it does, papers from most of the leading British psychologists and from many eminent foreigners. The editorial succeeds in emphasising the cordial international relationships which were so evident to all who attended the congress, but it seems unfortunate that no allowance was made for British linguistic ignorance by adding an English summary of the foreign papers.

Particularly interesting to the general reader are the various symposiums—"The Nature of General Intelligence and Ability," "The Conception of Nervous and Mental Energy," and "The Principles of Vocational Guidance"—but where there are so many valuable papers it seems invidious to particularise. All who wish to be abreast of the times in psychological thought will find this volume a necessary addition to their shelves.

Special Talents and Defects: their Significance for Education. By Prof. Leta S. Hollingworth. (Experimental Education Series.) Pp. xix+216. (New York: The Macmillan Co., 1924.) 7*s.* 6*d.* net.

OUR eyes turn naturally towards the unusual; the one exception to the rule is often more interesting to study than the ninety-nine corroborating cases. There is certainly scientific value in such a study, for a fruitful suggestion is often obtained by comparing the normal with the abnormal to find their common factor.

Prof. Hollingworth writes of the exceptional child who shows a particular gift or deficiency in some scholastic subject not to be expected from his general mental level. The subject is introduced by a helpful discussion on the nature and causes of abilities and of their inter-relations, and then proceeds to a consideration of the neural base involved. The main part of the book is devoted to a detailed presentation of extreme variations of ability in the ordinary school subjects. A chapter each is given to reading, spelling, arithmetic, drawing, and music; cases are cited, and causes and remedies are discussed.

Every teacher of experience has met children who astonished him by some such unexpected gift or defect. This book is valuable for its clear explanations and practical advice in connexion with such phenomena.

NATURAL HISTORY.

(1) *Everyday Doings of Insects.* By Evelyn Cheesman. Pp. 245. (London, Calcutta and Sydney: G. G. Harrap and Co., Ltd., 1924.) 7*s.* 6*d.*

(2) *The Great Little Insect.* By Evelyn Cheesman. Pp. 256. (London: Hodder and Stoughton, Ltd., 1924.) 6*s.* net.

THESE two books, as may be gathered from their titles, are written essentially for the instruction and entertainment of lay readers. Their author, who is curator of insects at the Zoological Gardens at Regent's Park, London, is well qualified to enlighten the public as to many of the facts and theories respective to insect life. In her official position she is enabled to judge to a large extent what type of book will meet the demands which she is catering for. Both volumes are written in a clear, attractive style and with a "freshness" that comes as the result of a first-hand acquaintance with the objects concerned.

(1) The little book entitled "Everyday Doings of Insects" is written with the intention of supplying answers to some of the questions that are often asked concerning the exhibits in the Insect House at the Zoological Gardens. It is more especially addressed to boy inquirers with the view of encouraging their interest in entomology. The photographs and sketches have been made from the living insect in almost every case, and they add greatly to the attractiveness of the volume.

(2) "The Great Little Insect" is intended for older readers, and consists of a series of essays discussing various activities of insects and the laws which we believe govern them. In these chapters the author has brought together many facts which, although well known to the entomologist, seldom reach the lay public. Such facts are weaved together in an interesting manner, and the volume is a fascinating one for the fireside reading of winter evenings.

Illustrations of the British Flora: a Series of Wood Engravings, with Dissections, of British Plants. Drawn by W. H. Fitch, with additions by W. G. Smith and others. Fifth revised edition. Pp. xxvii+338. (London: L. Reeve and Co., Ltd., 1924.) 12*s.* net.

THE appearance of the fifth revised edition of the "Illustrations of the British Flora" completes the republication of "Bentham's Handbook of the British Flora." It is universally acknowledged that both the text (now called the Handbook) and the illustrations have been of great use to several generations of botanical students, especially beginners. It is, however, unfortunate that the two volumes have been reissued without more drastic alterations having been made. A considerable number of serious mistakes are perpetuated, as, for example, in Fig. 933, where the leaves of *Populus canescens* are figured as *P. alba*, and in Fig. 935, where the catkins of one species and the leaves of another are figured under the name of *P. nigra*.

The common vernacular names and, for many species, a letter to indicate the flower colour have been added to the botanical names for each figure. A new index has been compiled, giving, in single sequence, the generic and common names. A summary of family characters and an analytical key to the families and anomalous genera are reproduced from the Handbook. Several new figures are incorporated, but they are not up to the standard set by Fitch.

The Teaching of Biology in Schools and Training Colleges. By Ethel M. Poulton. Pp. xv+112. (Birmingham: Cornish Bros., Ltd., 1924.) 5*s.* net.

BIOLOGY, as here considered, is not that of the specialist in zoology or botany, but rather that for which a place is claimed in the general education of all pupils, and especially of those in primary and secondary schools. In addition to minor, but not unimportant, objects, the chief aim of such general biology is rightly stated to be the stimulation of interest and curiosity, and to produce enjoyment, both æsthetic and intellectual, of Nature. The opening chapters of this useful little book contain an eloquent *apologia* of biology, based upon a consideration of its values and aims, and of the psychological factors which should influence the selection of material and the methods of teaching. The teacher who would be ready to give an answer for his faith in biological teaching will find here his brief set out in excellent style. In subsequent chapters the author has constantly in mind the students at training colleges. Though, perhaps, she says nothing that is entirely new on courses of Nature study and the more advanced work, she has nevertheless done good service to all teachers of biology in bringing together, and more or less codifying, the general principles by which all should be guided, and not less in pointing out the many pitfalls that beset the path of the inexperienced. Stress is very properly laid on the importance of presenting biology as a study of *living* things.

BACTERIOLOGY.

Practical Bacteriology: an Introductory Course for Students of Agriculture. By Andrew Cunningham. Pp. vii+188. (Edinburgh and London: Oliver and Boyd, 1924.) 7*s.* 6*d.* net.

A LARGE amount of information is contained in this small book, which is well planned and very readable. Bacteriological technique is described in the earlier sections: preparation and sterilisation of culture media, the use of the microscope, and staining methods and cultivation. A series of exercises then follows, each dealing with some particular subject or process, and so arranged that the student becomes familiar by easy stages with bacteriological methods.

The bacteriology of milk and dairy products, of soil and manure, is then similarly dealt with, some of the special reactions applied to milk being also included, namely, the catalase, curd, and other tests.

In the final chapters some of the more important bacterial plant and animal diseases are described, and classification and formulæ are given in appendices. The practical exercises for the most part are simple and easily carried out in a short time, and have been chosen with commendable discretion; any one who worked through the lessons with some supervision should possess a considerable grip of bacteriology. The book is well produced and illustrated.

Elements of Water Bacteriology: with Special Reference to Sanitary Water Analysis. By Prof. S. C. Prescott and Prof. C. E. A. Winslow. Fourth edition, rewritten. Pp. ix+211. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1924.) 11*s.* 6*d.* net.

THE work under notice is, on the whole, an excellent monograph on water bacteriology. First published twenty years ago, the present edition has been revised throughout. The procedures outlined are those of the Committee on Standard Methods of the American Public Health Association, and in some respects differ from those current in Great Britain. Chapters on the bacteriology of sewage and sewage effluents and the bacteriological examination of shell-fish are included. Much information has been collected on *Bacillus coli* and its variants and methods for their detection and isolation, though some of the fermentation reactions of the allied organisms are incorrectly given. One of the most important chapters is that on the significance and interpretation of bacteriological examinations of water, and the position taken is a thoroughly sound one. A bibliography running into twenty-nine pages completes this useful book.

Louis Pasteur. By Prof. S. J. Holmes. Pp. vi+246+4 plates. (New York: Harcourt, Brace and Co., 1924.) n.p.

THIS short biography gives all the essential facts of Pasteur's life and work. Commencing with his early days, the salient features of his researches and discoveries are summarised in chronological order, and for the uninitiated reader explanatory paragraphs are introduced where necessary. The text is very readable, and is illustrated with several figures and some good portraits. A sympathetic account is given of the celebrations on Pasteur's seventieth birthday and of his last days, and we leave the great veteran sleeping in the beautiful little chapel in the basement of the Pasteur Institute, where "four angels watch over him, Faith, Hope, Charity, and Science, and in the laboratories above his tomb, his great work is going on."

METALLURGY.

Practical Microscopical Metallography. By Dr. R. H. Greaves and H. Wrighton. Pp. x+125+28 plates. (London: Chapman and Hall, Ltd., 1924.) 16*s.* net.

THE authors state in their preface that their intention is "to provide, within a small compass, a set of typical photomicrographs suitably annotated and accompanied by an account of such related matters as might profitably occupy the minds of students during the necessarily long hours—many of them spent in purely mechanical operations—devoted to microscopical work," and that the book is intended both for metallurgical students and for students of engineering who study metallography.

We feel some doubt as to whether the book will be found useful. So far as metallurgical students are concerned, it is so restricted in scope that it could not serve as an adequate introduction even to microscopical metallography. None of the chapters deal with the construction of the equilibrium diagram and thermal methods of investigation which, in conjunction with microscopical work, constitute the experimental data on which the diagrams are based. With respect to engineering students, it is necessary to face the fact that the properties of any metal or alloy cannot be deduced from its microstructure. The polyhedral structure, characteristic of a pure metal, holds equally for tough and ductile metals on one hand, and for brittle metals on the other. Even the most skilled metallographer confronted with a photograph representing the microstructure of a metal or alloy, of the chemical composition of which he was unaware, could say very little about the mechanical properties it would be likely to possess. We doubt whether any student of engineering, in the absence of previous knowledge of the subject, could grasp the real implications of the equilibrium diagrams reproduced in the book, and whether he could form a true mental picture of the facts which they convey. It seems to us that the book cannot do much more than awaken an interest on the part of metallurgical and engineering students in the subject of microscopical metallography, and a desire to study the subject in a much broader way such as is afforded by one of the numerous text-books of metallography already available.

The Planning, Erection, and Operation of Modern Open-Hearth Steel Works. By H. Hermanns. Pp. vii+307. (London: Ernest Benn, Ltd., 1924.) 42*s.* net.

MR. WESLEY AUSTIN has performed a valuable service to English metallurgy in translating Mr. Hermann's important work on the planning and operation of modern open-hearth steel works. Technical literature is rich in works which concern themselves with descriptions of the metallurgy of steel production in open hearths. The auxiliaries, however, which serve to carry out the metallurgical work and to lighten or cheapen the mechanical operations, have been given only secondary attention. They are of equal economic importance to the processes, and in great measure not only render these possible, but also assure their efficiency. The point driven home in this book is the economy which results from excellences in furnace design and equipment, from attention to practical expediencies in the general arrangement of plant, and from a careful lay-out of storage, handling, and transport facilities. Every type of equipment for open-hearth steel production is described in detail and very clearly illustrated, not only from Continental practice but also from a very close study of English and American practice. The book is intended on one hand for the steel works staff and managers and, on the other hand, for technical and higher grade students. In addition, it should provide hints for designers and draftsmen. It is abundantly illustrated by clear drawings, which are one of the best features of the book. We think that Mr. Hermann's work would repay careful study by the management of every open-hearth steel works in Great Britain.

Arc Welding Handbook. By C. J. Holslag. Pp. xi+250. (London: McGraw-Hill Publishing Co., Ltd., 1924.) 10*s.* net.

THIS book is intended to serve as a simple and practical manual of instruction in arc welding. An attempt has been made—and made successfully—to describe the methods step by step in a clear and practical manner so that the beginner may understand both the equipment and the processes. The author has also kept in mind those men who may supervise the work, so that there may be no mystery to them about what the welding operator is trying to accomplish. The book is very clearly written and illustrated by numerous figures.

The early chapters deal with the various types of welds that can be produced. Regard is paid both to thin and heavy sections. We have found the chapter on the welding of cast iron and malleable iron particularly interesting. There is an illustration on p. 125 of a 15-ton cast iron gear housing which had been broken in eight pieces and was afterwards mended by arc welding. A total length of 190 feet of welding 1½ inches thick was required. Considering the brittleness and low tensile strength of such iron, this must be regarded as a remarkable achievement. Later chapters deal with the welding of structural steel, sheet iron and non-ferrous metals, electric arc cutting, and the welding of alloy steels. The book is full of useful information and may be heartily recommended to those for whom it is intended.

First (Experimental) Report to the Atmospheric Corrosion Research Committee (of the British Non-Ferrous Metals Research Association). By W. H. J. Vernon. Presented to the Faraday Society, December 17, 1923; with Full Report of Discussion. Pp. 839-934. (London: The Faraday Society, 1924.) 7*s.* 6*d.* net.

THE research by Mr. W. H. J. Vernon on the tarnishing and fogging of metals, presented to the Faraday Society on December 17, 1923, of which some account has already appeared in our columns (NATURE, February 2, 1924, p. 178), has now been published with a full report of the discussion which took place on that occasion, together with certain communications since received. The discussion is of a thoroughly broad and representative character, and many points of view and interesting items of information were contributed. Mr. Lancaster mentioned that although it was generally considered that the purest zinc was the most difficult to dissolve in acids, Mr. Rigg, late of the New Jersey Zinc Company, had found that the purest zinc they had produced for the United States Bureau of Standards was almost explosive under acid treatment; in other words, the rate of solution was very rapid. Taken as a whole, the discussion and contributions add decidedly to the value of the report, and general unanimity was expressed that the most hopeful way of solving the practical problem of preventing the tarnishing and fogging of metals was to attack it by laboratory experiments carried out on fundamental lines of scientific inquiry.

ELECTRICAL ENGINEERING.

Small Electric Generating Sets Employing Internal Combustion Engines. By W. Wilson. Pp. 161+16 plates. (London: Ernest Benn, Ltd., 1924.) 18*s.* net.

MANY are interested in the small electric generating sets that are used for country-house lighting and for supplying electric power for kinematographs, radiographic outfits, etc., in isolated localities. The invention of the tungsten lamp and recent developments in internal combustion engines have made small installations highly desirable in many cases. Most of the books which deal with this subject are now becoming antiquated, so we welcome Mr. Wilson's volume, which describes the best modern practice.

The author has hit the happy mean between a book overburdened with elementary theoretical matter and one that goes into highly technical details, which are only of interest to the manufacturer. So far as lighting current is concerned, electricity can be generated by the consumer at a cost little more expensive than that charged by a public company. But if it is used for heating and power purposes, it compares very unfavourably with a city supply. For many purposes in connexion with farming, electricity can be economically employed. For illuminating yards, stables, and outbuildings it is most valuable, but it is essential to use suitable water-tight fittings. It has now been conclusively proved that the low productiveness of the hen during the winter months is not due to the want of heat, but to the want of light. The lack of daylight in winter can easily be made up by installing a fifty-watt lamp in the fowl-run. It is required from 5 A.M. until dawn and from dusk until 9 P.M. The switching can easily be done by an automatic device. Under these conditions the hens continue to lay almost as in summer, having the requisite time to take more nourishment.

Alternating Current Rectification: a Mathematical and Practical Treatment from the Engineering View-point. By L. B. W. Jolley. Pp. xviii+352. (London: Chapman and Hall, Ltd., 1924.) 25*s.* net.

THE conversion of alternating current into current pulsating in one direction is a problem which electrical engineers have been studying for many years. In the early days of the industry, a serious drawback to the use of alternating currents for supply distribution was that there was no accumulator suitable for storing the electrical energy, and hence the alternators had to run night and day. Electrolytic valves were then invented to rectify the alternating current, so that it could be used for charging cells. In polyphase systems of supply, this was accomplished mechanically by machines called rotary converters. At the present moment mercury vapour rectifiers are employed in many towns to get direct current from an alternating supply. In connexion with radio engineering all kinds of rectifiers are used. It will be seen, therefore, that the field is a wide one and it is continually expanding.

Mr. Jolley's book opens with a good discussion of wave form, and Fourier's analysis is applied to several problems in an instructive way. The mechanical rectifiers are next discussed, including a brief description of the Highfield transverter. Then we have descriptions of mercury-vapour rectifiers and vacuum tubes. Interesting descriptions are also given of point to plate discharge, vibrating flame rectifiers, corona rectifiers, and photo-electric cell rectifiers. Finally the author discusses the conduction of electricity through liquids, a knowledge of which is necessary in order to understand electrolytic rectifiers and radio rectifiers. Numerous helpful references are given to papers and books. The book can be recommended to research engineers.

Railway Electrification: a Complete Survey of the Economics of the Different Systems of Railway Electrification from the Engineering and Financial Points of View. By Prof. H. F. Trewman. (The Specialists' Series.) Pp. xii+244. (London: Sir Isaac Pitman and Sons, Ltd., 1924.) 25*s.* net.

THIS book gives a survey of the economics of the different systems of railway electrification from the engineering point of view. It is pointed out that for the last thirty years electricity has been successfully employed all over the world to operate tramways. At the beginning of the century it was adopted for elevated and tube railways. Then came the electrification of the suburban railways, and finally, mainly on the Continent and in the United States, the electrification of the main line railways. It is universally admitted that electrification of the main line railways in Great Britain is feasible; the only question about which opinions still differ is the financial one. Were it not for the War, at least two British main lines would have been rapidly extending their systems of electrification. Apparently they have adopted a policy of waiting, and so we are continuing to burn an unnecessary quantity

of coal. Many who have considered the problem with great care are in favour of electrification. This book is written for engineers and contains much valuable data from the point of view of the economics of the problem, but we think that the author could have made out a stronger case for electrification. There are not many cases—we know of none—where a railway once electrified has gone back to steam locomotives, but we do know that the electrical staff on most of the English railways is in ludicrous disproportion to the mechanical engineering staff. In Chapter ii. the author states that it can be proved mathematically that the best site for a power house from the point of view of transmission costs is the centre of gravity of the load. This theorem has been recently proved to be erroneous. It requires the unwarrantable assumption that the percentage loss of power in the minimum case is the same for all the distributing mains.

MISCELLANEOUS.

Animal Nutrition. By Prof. T. B. Wood. Pp. viii+226. (London: University Tutorial Press, Ltd., 1924.) 4*s.* 6*d.*

THE issue of a text-book on animal nutrition from the Cambridge Research Institute marks a new era in the application of science to the feeding of live-stock in Great Britain. For so many years have we been in thrall to German and American literature that to be in possession at last of an authoritative work of native origin, however modest its scope and pretensions, induces feelings so pleasurable as largely to disarm criticism. We hope that the present modest volume may be regarded as but the forerunner of the more ambitious and comprehensive works that should follow in due course from the Cambridge workers.

It is a companion volume to Prof. Wood's "Chemistry of Crop Production," these works being admittedly of elementary character, and although designed to meet the needs of the elementary student, bear obvious signs that the possibility of a circulation amongst advanced farmers has not been entirely outside the mind of the writer. This dual aim would seem to have a strong fascination for the agricultural writer—or does the pressure come more from the side of the publisher?—and the result is rarely entirely satisfactory to either class of reader. Few writers possess the genius of Prof. Wood for this class of work, but we venture to think that even he has only attained his end through some sacrifice of the interests of each class of reader. Had he been writing solely for the student, who is assumed to have some knowledge of chemistry, he would doubtless have given a rather more advanced treatment of the subject matter of his introductory chapters, whilst a great deal of the detailed experimental work that is embodied in the text might also have been more usefully collected into an appendix or a separate practical manual. For the farmer reader, on the other hand, much of this experimental work must necessarily be unintelligible and consequently redundant. These criticisms, however, in no way preclude a very favourable opinion upon the treatment of the subject. In his later chapters, in which he turns to practical applications, Prof. Wood is excellent, and this part of his book will be read and used by a far wider circle of readers than that for which it is primarily intended. Special reference may be made to his extension to fattening animals of the system of "rationing by performance," which is proving so successful in the case of dairy cows. This is a very real advance, for which all concerned with the difficult task of giving advice on practical feeding problems will be grateful.

The book is well produced and issued at a low price, and may be warmly commended to all agricultural students and others concerned with the feeding of live-stock.

Clockmaking, Past and Present. With which is incorporated the more important portions of "Clocks, Watches and Bells," by the late Lord Grimthorpe, relating to Turret Clocks and Gravity Escapements. By G. F. C. Gordon. Pp. viii+232+35 plates. (London: Crosby Lockwood and Son, 1925.) 16*s.* net.

To the makers and lovers of clocks this volume will be a welcome addition to their bookshelves. Though not intended to be a complete treatise on the subject, the author deals systematically with the materials, tools and mechanisms of clock-making and gives much excellent advice. The plates are a notable feature of the book, and though naturally most of them are devoted to various forms of clocks and clock cases, not the least interesting are those illustrating wheel-cutting machines, pinions and their collets, new and old screws, and the clock hands of various periods. There is one omission that should be pointed out. On p. 58, when dealing with compensation balances, it would have been well to explain that the necessity for compensation arises mainly through the change in the elasticity of the spring of the balance due to alteration in temperature, and not through the variation in the dimensions of the balance.

There is a good chapter on the question of restoration and repairs to clocks and clock cases. In a short note on British clocks for export, the author offers some criticism of clocks sent abroad, and suggests that if the British Horological Institute were to issue designs and detailed specifications for three or four types of clocks, it would confer a great benefit on all concerned. A bibliography is given containing some 80 or 90 books and pamphlets on clocks published since the appearance of Derham's "The Artificial Clockmaker" of 1696.

Around the Horn to the Sandwich Islands and California, 1845–1850. Being a Personal Record kept by Prof. Chester S. Lyman. Edited by Prof. F. J. Teggart. Pp. xviii+328+16 plates. (New Haven: Yale University Press; London: Oxford University Press, 1924.) 16*s.* net.

PROF. C. S. LYMAN was connected with Yale University for thirty-two years as professor of physics and astronomy and director of the observatory. He died in 1890 at the age of seventy-six. This book is the diary which he kept as a young man during several years in the Sandwich Islands and California. The long sea voyage round Cape Horn occupies only a few pages. His observations on the people of the Sandwich Islands are of value as a record of past conditions, and there is a good account of the volcano of Kilauea. Most of the diary has little scientific interest, though some of the descriptive matter is vivid. There are many interesting illustrations taken from old prints.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor 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 Exploded Ether.

THE idea of a universal physical æther seems to be getting terribly in the way. According to Dr. Jeans, in the Supplement to NATURE of March 7, p. 362, "It was something more than a coincidence that Newton, Kelvin, Clerk Maxwell, and Faraday [the advocates of an æther] were all British, while Boscovich, Einstein, and Weyl are not." Descartes is not mentioned.

One notices that the reason for supplanting Maxwell by Weyl is based on the original form of "Weyl's electromagnetic theory," which aims at absorbing electric fields into space—a theory which Einstein has steadily and consistently rejected, for the reason that its "two-foot rule" changes its length as it wanders through space, so that when it comes back to its starting-place it does not recover its original length, and (metaphorically) you don't know where you are.

Seizing on an idea of Eddington's, and utilising the Principle of Minimal Action, which is fundamental in physical formulations, Einstein has himself developed a theory analogous to Weyl's: but he has to admit that it cannot in his hands explain electricity by atomic electrons. It has, however, been claimed by another investigator that this can be got over by use of a widened foundation, and the question perhaps deserves further scrutiny by experts. A quotation is here relevant, from Prof. De Donder of Brussels, the most recent exponent of this interesting but very complex algebraic analysis: "En lisant les trois notes qu'Einstein a consacrées à la gravifique de Weyl-Eddington, on remarque que la confiance que lui inspire cette théorie va en diminuant. C'est ce qui m'a conduit à lui demander son avis actuel, afin de pouvoir le communiquer au cours de mes conférences à la Sorbonne. J'extrais de sa lettre (Leiden, 4, xii. 1923) la phrase très importante: 'Deshalb neige ich jetzt dazu, der ganzen theoretischen Entwickelung, welche auf einer Verallgemeinerung der Riemann'-schen Metrik durch Verallgemeinerung der $\Gamma^{\sigma}_{\mu\nu}$ beruht, überhaupt keine *physikalische* Bedeutung beizumessen.'"

If there is a distinctively British view of the æther, it is the one that was promoted, in his usual fragmentary and erratic manner, by Kelvin, the inspirer, along with Faraday, of Clerk Maxwell. It identifies the æther as the substratum, with physical qualities, in which all matter subsists as a limited number of possible types of atomic structures, and which, moreover, binds these discrete atoms into a cosmos by their necessary interactions across it. Being the medium which makes atomic matter possible, it is not itself matter, and is not limited by any analogy to matter. It makes no essential difference whether one visualises it as an active physical medium or alternatively describes it as "space," or a "fourfold extension," endowed with physical qualities. The earlier analogies introduced waves of light and the electric field by contemplating displacement of the small parts of the æther, a varying displacement involving strain with its energy of elastic deformation. The newer representations become feasible through introducing the cognate notion of "parallel displacement" of the varying "space," as defined by the algebraic formulations of Prof. Levi-Civita. The relevant problem, as above indicated, is to carry the ideas through as far as possible, and so test the extent and appropriateness of their analogy with physical reality.

Fundamental space and time ought, one would think, to be uniform, the same everywhere. As soon as the qualities of space are made to depend on the presence of adjacent portions of matter, it ceases to be pure space and becomes an interconnecting medium with physical properties. But this subject, on its epistemological side, is far from having yet been exhausted.

JOSEPH LARMOR.

Cambridge, March 7.

Ether and Matter and Relativity.

IN the most valuable supplement to NATURE of March 7, through his Kelvin lecture to the Institution of Electrical Engineers, Dr. Jeans gives a splendid summary of the present position in physics, showing how Lord Kelvin's "two clouds" obscuring the connexion of radiation and matter, instead of dispersing, have expanded to fill our scientific vision. Incidentally, Dr. Jeans makes it clear that in his view the terms ether and force are unnecessary, since all that they connote can be represented equally well by pure geometry, and indeed much better than by Lord Kelvin's curiously mechanical mode of attack. It is marvellous what hyper-geometry can be made to express, and what high reasoning about reality can be thus carried on. But here comes the point: I suppose that much the same can be said about the non-necessity of the idea of matter. That too can be expressed geometrically, and apparently dealt with analytically, as the impenetrable centre of a warp in space, and as $G^{\nu}_{\mu} - \frac{1}{2}g^{\nu}_{\mu}G$; an expression which Prof. Eddington says behaves exactly like matter, except that it is more continuous than atomic, adding that the mind could scarcely recognise anything simpler as substantial and permanent ("Math. Theory of Relativity," p. 120). If relativists will grant that ether and matter can be *equally* dispensed with, a supporter of the ether need have no conflict with them: for ultimate questions about reality and existence can be left to philosophers.

OLIVER LODGE.

March 10.

The Source of Stellar Energy.

THE source of a star's energy is debated in recent letters by Prof. Lindemann and Dr. Jeans (NATURE, Feb. 14 and 28). Dr. Jeans's conclusion is that the liberation of energy from the sub-atomic store occurs at a rate independent of temperature and density; and if one star liberates energy more slowly than another, it is solely because the former has exhausted the more prolific material. I think that there are grave astronomical objections to this view.

First, it requires that the rate of emission of radiation by the star shall be very largely dependent on its previous history, whereas the astronomical indications are that it is so closely correlated to the present mass that there is little scope for outside factors. Consider, for example, two stars, each of which has radiated $\frac{2}{3}$ of its original mass, so that they are in the same stage of exhaustion: the first, originally of mass 3, is now of mass 1; the second, originally of mass 12, is now of mass 4. Their rates of radiation should accordingly be in the ratio 1 : 4; but both theory and observation seem to show that a star of mass 4 always radiates much more than 4 times as strongly as the sun.

Secondly, this hypothesis seems to make the stars unstable. The energy E which is liberated must be

got rid of by radiation, and the radiation L is fixed by the mass and (to a comparatively small extent) the radius of the star. By hypothesis, E cannot be altered by a change in the physical conditions, so that the star must adjust its radius to bring L to the right amount. If initially $E>L$ the star is gaining energy and therefore expanding; the physical theory indicates that an increase of radius diminishes L, so that the discrepancy becomes worse. The star expands indefinitely.

The first objection is particularly evident when applied to the components of double stars which must contain material of the same age and, therefore, of the same degree of exhaustion. The hypothesis requires that these shall emit energy proportionately to their masses—a result which is not verified. The particular case of the sun and the earth is referred to by Dr. Jeans, who meets the objection with a suggestion that the material forming the earth was not an average sample of the material of the sun at the time of separation. A short time ago I would have admitted this possibility; but I have recently found (in an article in the *Observatory* for March) that the rotation of a star must necessarily lead to circulatory currents in the interior which would keep the material well mixed. The argument is based on an extraordinarily general formula discovered by H. von Zeipel, and I do not think the conclusion can be evaded. It follows that when a star divides, each part has the same chemical composition, and if Jeans's rule were true the two parts would continue to be similar through all subsequent time.

It is very difficult to find a law of liberation which will satisfy astronomical requirements. In abandoning the contraction hypothesis we seem to have jumped out of the frying-pan into the fire—not that I see any conceivable prospect of returning to our former refuge. A direct dependence of the rate of liberation on density and temperature seems to be ruled out. On calculating the numerical magnitudes concerned (after taking into account all possible exhaustion-effects), it is found to give the star a kind of over-stability which would rapidly magnify the smallest disturbance into a large pulsation. This pulsation is supposed to occur in cepheid variables, but these are limited to a well-defined range of mass and density. With the hypothesis here considered cepheid variation would be more widespread.

At present, I see no insuperable objection to the following hypothesis; I scarcely recommend it in its present form, but some theory on these lines seems to be the one way out of an almost hopeless deadlock. We must consider two processes: one of evolution, the other of disappearance, of certain destructible forms of matter. The former is supposed to be dependent on density and temperature: the latter to be independent. It must be understood that the two processes are not the reverse of one another. The first is a transmutation absorbing or releasing comparatively little energy; the second is an annihilation of matter releasing great quantities of energy. The first is a synthesis involving the bringing together of constituents; its rate therefore depends on physical conditions. The second is a spontaneous degeneration in which only an isolated atom is concerned. The destructible elements are supposed to have lives ranging from a few minutes to many years, but most of the released energy comes from the long-lived products. A quiescent star will be in a steady state, except for the slow alteration of mass; the amount of self-destroying material and consequent generation of heat is thus dependent on temperature and density. Pulsation of the star will affect the rate of liberation only through the short-lived products; it should thus be possible to obtain stability without over-stability. It is necessary to admit exhaustion-effects also in this scheme, in order to reconcile, for example, the rapid liberation of energy in Capella with the slow liberation in the sun, notwithstanding the higher temperature and density in the latter.

I believe it is widely thought that the comfortable phrase *sub-atomic energy* ought to make the astronomer entirely happy; it gives him a long enough time-scale, and all is plain-sailing. Attempts to guess the *modus operandi* are regarded as mere speculation in an unlimited field. No doubt it is highly speculative to try to predict the processes by extrapolation of the modern theories of atomic physics; but the approach from the astronomical side is merely the prosaic procedure of empirically deducing unknown laws from observational data. Stellar astronomy is largely occupied with determining the rate of liberation of the mysterious source in conditions of temperature and density (both static and disturbed) which are now reasonably well known. Either the astronomer must leave this mass of data uncorrelated, or he must try to feel his way towards the disentanglement of the unknown agencies.

A. S. EDDINGTON.

Observatory, Cambridge,
March 4.

The Ages and Masses of the Stars.

CONCERNING Mr. Schumann's comments (NATURE, January 24) upon Dr. Jeans's paper (December 6) on "The Ages and Masses of the Stars," I should like to direct attention to the point of view expressed in my paper on "The Age of the Stars" which was read before the National Academy of Sciences on November 11 last, a few days before the meeting at which Dr. Jeans presented his work to the Royal Astronomical Society. It was there emphasised that the decrease of mass as a result of radiation is a necessary consequence of the theory of relativity. If relativity be accepted this must be so, independently of the mechanism involved in the change of mass as *matter* into mass as *radiation*. The fact that a star radiates means that it loses mass in this way: whether all the mass lost is lost by radiation is another matter. My paper, which is to appear in the Proceedings of the National Academy of Sciences for February, goes into the point more fully than I can here.

EDWARD CONDON.

Physics Department, University of California,
February 14.

Late Palæolithic Art in the Cresswell Caves.

No one could welcome the results of Messrs. Garfitt and Armstrong's exploration of Cresswell Crags more than I do myself, especially as they relieve the Palæolithic inhabitants of these islands from the unmerited reproach of an indifference to art. I only wish they had been made in time for recognition in the last edition of "Ancient Hunters."

In the light of these recent discoveries, the problem of the Cresswell "horse" assumes quite a different aspect, and I feel all the more bound to offer an explanation of the statement for which I am responsible, referred to by Sir W. Boyd Dawkins in NATURE of March 7, p. 336. It arose out of a conversation with the Rev. A. M. Mullins, rector of Langwith-Bassett, well known by his exploration of the Langwith Cavern, which is situated within easy reach of Cresswell Crags. Happening to refer to the almost complete absence of any artistic work in the Palæolithic deposits of this country, I mentioned

the famous horse as the only known exception to the general rule, when Mr. Mullins at once interposed with the remark, "And that is no exception," and proceeded to inform me that it had been introduced surreptitiously into the cave, more than one person—as I understood—having been involved in this nefarious proceeding. He demurred, however, and as I thought very naturally, to my request for names, but assured me that he spoke of his own personal knowledge.

Any reflexion on the good faith of any of the explorers of the cavern—particularly my old and dear friend the Rev. Magens Mello, the actual finder of the engraving—would have at once aroused my indignant resentment; but there was no hint of this, and as Mr. Mullins's statement not only disposed finally of what I had always regarded as malicious gossip, but was also in general harmony with the state of knowledge at the time, I felt that I ought to make it public, even if only in a modest footnote.

It is to be regretted that Mr. Mullins is no longer with us to add his explanations to mine. All I can do now is to withdraw the controverted statement and to delete it from the footnote at the earliest opportunity.

Perhaps I may be permitted to refer to another discovery which was made too late for notice in my last edition. It is of great importance, since it affects not merely a locality but a whole industry. I allude to the finding by M. Peyrony in a Solutrean layer at Les Eyzies of a slab of limestone bearing a carving in high relief of two oxen (*Bos primigenius*). When I examined this last Christmas I was much impressed by its skilful modelling, fidelity to Nature, and artistic feeling. It recalls, though less bold, the famous bisons of Tuc d'Audoubert.

Hitherto the Solutrean age has afforded no objects of art, and this has always been regarded as a remarkable fact, for the Solutrean people were the first to introduce that new method in the working of flint which produced the most beautiful weapons of the Palæolithic age, and afterwards found its culmination in the wonderful productions of Neolithic Egypt and recent North America. It was supposed in explanation that the Solutreans were a war-like invading race, who concentrated all their attention upon the perfection of their weapons, and had none left to bestow on purely artistic effort. We now see how far this was from the truth. W. J. SOLLAS.

University College, Oxford,
March 10.

Transmission of Stimuli in Plants.

MR. SNOW'S letter on this subject in NATURE of January 17, p. 82, suggests the following considerations:

The fact that the velocity of the movement of coloured fluids in transpiring shoots and leaves is often much slower than the transmission of stimuli can scarcely be used as an effective argument against the rapid transport of hormones in the transpiration current. When a shoot, or leaf, is cut across and supplied with stain, the whole, or most, of the cross-section of its wood may be utilised by the current, and the velocity of flow may be comparatively slow; whereas, if the water transpired is made good through a conduit consisting of one or two tracheæ only, the velocity may be very great. It is significant that Mr. Snow himself attributes the transmission of a stimulus at a velocity of 52 cm. per minute to the movement of water in the vessels (Snow, R., Proc. R.S. B, vol. 96, p. 358).

Mr. Snow refers to his Experiment 11. In this experiment the wood of the petiole of a "stem and leaf preparation" was severed by a single cut of a razor. The tension of the water in the wood was relieved by the submergence of the preparation in water, and yet, after a rest of several hours, a stimulus was observed to be transmitted across the cut to the pulvinus. It still seems to me possible that the movement of the motile tissue at the base of the pinnules forced water containing the hormone through the distal tracheæ and that some of this was drawn (really pressed by the atmosphere) into the tracheæ below the cut. The continued expansion of the cells adjacent to these tracheæ by turgor would give space for this movement. Thus relief of the tension might not preclude motion in the tracheæ.

In any case, the experiment requires careful confirmation. It appears from Mr. Snow's description that the experiment was attempted with 40 stem and leaf preparations. The exact depth of cut required, just severing the continuity of the wood, was attained in only 5 of these. Of these 5, 3 showed no transmission of the stimulus across the cut. The extreme difficulty of ascertaining with certainty, even with microscopic observation, that all the water-conducting elements were cut across, and remained severed during the experiment, may justify us in suspending our judgment as to the correct interpretation of this experiment.

Mr. Snow also invites attention to his Experiment 12, in which he observed that exposing a narrow zone of a petiole to steam prevented the passage of a stimulus. In his paper he points out that both Haberlandt and Fitting obtained the opposite result. Furthermore, it is quite probable that substances introduced into, or developed in, the tracheæ by the heat may have prevented rapid motion of fluids in these capillaries.

With some trouble I have succeeded in consulting, at Mr. Snow's advice, Prof. Herbert's paper in the *Philippine Agriculturist*. It has disappointed me. The details of the experimental arrangements are scanty throughout, and until more convincing evidence is produced I could scarcely agree with Mr. Snow's statement—"The xylem of the petiole cannot conduct excitation downward at all, as has been shown by Herbert." In fact the latter emphasises more than once that, if the downward transmission is to be prevented, "a good deal of the wood" must be removed. Further, when "dexylification" was practised by Herbert, he filled the cavity left by the removal of the wood with water. In this, of course, the hormone may have been transmitted, as in Ricca's experiments.

Mr. Snow quotes Bose as having showed that the phloem is the conducting tissue, by evidence derived from electrical changes. Unfortunately the same investigator produces the same evidence in favour of transmission in the parenchyma on the inner side of the xylem, mistaking it for phloem. To this tissue both Snow and Herbert deny the power of transmission. HENRY H. DIXON.

School of Botany,
Trinity College,
Dublin.

Indian Kala Azar Commission.

IN the issue of NATURE dated December 6, 1924, page 840, under a notice of the anniversary meeting of the Royal Society, mention is made of an investigation to be carried out under the auspices of that Society upon kala azar in India. The steady spread of kala azar in India has for long been a most disquieting feature in certain provinces. Recently, as a

result of the action of certain Provincial Governments in providing and encouraging treatment in the villages, the number of cases that have come forward has shown the disease to be prevalent, more particularly in Assam, Bengal, and Behar, to an extent hitherto unsuspected. The number of cases treated has steadily increased as the benefits of treatment have become known, until the total for 1924 in Assam and Bengal alone has exceeded 100,000 treated cases. But this probably represents only a portion of the actual incidence of the disease. There is reason also to believe that even in recent years kala azar has extensively invaded new tracts, *e.g.* whilst in 1910 only a few foci were to be found in Upper Assam, infection in the villages of the southern portion of this area is now almost universal. There is no question, therefore, as to the menace of this disease, which has something of the relation to India that sleeping sickness has to Africa.

It may interest readers of NATURE to know that this state of affairs has received very serious attention in India, both in respect to efforts to cope with the fatal effects of infection by special measures for supplying treatment, and in regard to scientific investigation with the view of discovering the method by which the disease is transmitted. Formerly kala azar was classed as an untreatable and almost necessarily fatal disease. Since the discovery of the effect of tartar emetic in treatment, a large proportion of cases now yield to this drug, and the beneficent action of Governments in providing treatment has had an immense effect in the saving of life, though it has not apparently had any measurable effect in decreasing the incidence of kala azar, as was at one time hoped. The scale on which treatment has been organised will be appreciated from the colossal total of treated cases already given, which represents for the greater part cases of kala azar treated near their own homes in the often remote infected villages, and cases which would otherwise have been unable to avail themselves of treatment even had the benefits of such been known to them. In Assam particularly, where the organisation for kala azar treatment has developed into one of the most remarkable efforts in ameliorative medicine in modern times, legislative measures have been freely taken, including an organisation for survey and notification and compulsory treatment where necessary. The need for the latter, however, has steadily disappeared as the benefits of treatment have become known. In addition, improvements in treatment which have largely originated in India promise in the future still further to rob kala azar of some of its terrors, for by the use of special antimonial compounds, *e.g.* urea stibamine, the percentage of successful treatments can be increased to include all but some 1·0 per cent. of the 10-15 per cent. of cases resistant to the ordinary method of treatment by tartar emetic. By the use of these drugs also the necessary period for treatment is reduced from a tedious period of three months to one of a month or less.

Unfortunately, treatment of what is probably only a percentage of the actual number of cases, however effective to the individual sufferer, appears to hold out very little hope of preventing the continued spread of the disease, and effective preventive action can scarcely be successful until the method in which kala azar is contracted is known. The need for research on these lines has been all along appreciated in India, where, apart from the earlier work of Donovan, Rogers, Patton, Row, and others, there has been for the last ten years almost continuous investigation in the form of a Kala Azar Inquiry that has worked under officers well known as protozoologists and workers on insect-transmitted diseases. In October 1923 it was decided at the annual meeting of Research Workers of India that kala azar should receive attention as a priority research, and a draft constitution for a Kala Azar Commission was drawn up and submitted to Government. The Commission, financed by the Indian Research Fund Association and the different interested Provincial Governments, was constituted early in 1924, and has since been at work chiefly in Assam, where the facilities for the study of the disease are specially great. In connexion with the Commission is an ancillary inquiry at the School of Tropical Medicine, Calcutta, constituted by Major R. Knowles, I.M.S., Dr. L. E. Napier, and Assistant Surgeon R. O. A. Smith. This inquiry, led by their previous epidemiological work to suspect either the sandfly (Phlebotomus), or the minute midges Culicoides, as the transmitters of the disease, were able to show that the parasite of kala azar develops with great certainty and ease in the sandfly *P. argentipes*. The investigation of the relation of these insects to kala azar transmission is now taking first place in the researches of the Commission, who have already confirmed the results of the ancillary inquiry that sandflies of the above species fed on the peripheral blood of kala azar cases, in about 25 per cent. of those fed, develop infections of the mid-gut with the flagellate form of the parasite. These infections by the fifth day after feeding may be so heavy as to be comparable with the condition seen in culture and in natural infections with Herpetomonas.

There remains, however, much to be done before the sandfly can be stated definitely to be the transmitting agent, for the method in which the parasite re-enters man is still unknown, nor has it yet been shown by experimental feeding or otherwise that infection can result in this way. Extensive investigation is also necessary even when the carrier has been demonstrated before practical results can be achieved in prevention. The Commission, though now working in Assam, will undertake researches in turn or simultaneously in other provinces, in order that full advantage may be taken of comparison of the conditions in as many areas as possible. It is understood that the investigation under the Royal Society will in part at least be carried out in collaboration with this Commission, thus greatly strengthening and assisting the action already taken by India for the investigation of kala azar.

S. R. CHRISTOPHERS.

Series Spectra of Two-valence-Electron Systems and of Three-valence-Electron Systems.

WE have recently been able to prove that the following laws first discovered in the X-ray field, namely (1) the Moseley law, (2) the regular-doublet, or Sommerfeld, law, and (3) the irregular-doublet, or Hertz, law, hold also throughout the whole field of optics, provided only the radiating atoms under comparison have the same electronic structure but varying nuclear charge.

We have further been able to obtain in our "hot-spark" spectroscopy long series of such atoms of like electronic structure, such as the seven stripped atoms Na I, Mg II, Al III, Si IV, P V, S VI, and Cl VII, a stripped atom being defined as an atom robbed of all its valence electrons save the one that, by jumping between the series of energy levels characteristic of the atom, gives rise to the observed spectrum (Millikan and Bowen, *Physical Review*, January 1924, September 1924, April 1925).

We have also found the foregoing X-ray laws, especially the irregular doublet law, powerful means for the interpretation of complicated spectra, *i.e.*, for the picking out of the lines due to particular electronic jumps in atoms in various stages of ionisation.

We have thus recently worked out and published the fairly complete spectra of a considerable number of stripped atoms.

In the present note we present the condensed results obtained by the extension of the same method to two more series of atoms of like electronic structure, namely, two-valence-electron systems, such as Mg I, Al II, Si III, P IV, S V and Cl VI, and three-valence-electron systems such as Al I, Si II, P III, S IV, and Cl V. The method of obtaining these results will be presented in detail in forthcoming articles, but the term values divided through in each case by the square of the effective nuclear charge are presented in the following tables, from which, however, Cl V and Cl VI are omitted because not enough lines have been identified to permit of the complete working out of term values.

TABLE I.

COMPARISON OF TERM-VALUES OF A SERIES OF ATOMS CONSTITUTING A TWO-ELECTRON SYSTEM, Mg I, Al II, Si III, P IV, S V.

	N. / R/N².	3. 12192·78.	4. 6858·44.	5. 4389·40.
s	Mg/1	..	20474·5	9799·3
	Al/4	..	15147·3	7942·64
	Si/9	..	12962·5	7096·0
	P/16	..	11730·5	6592·5
	S/25	..	10923·0	..
p_1	Mg/1	39760·5	13820·0	7419·0
	Al/4	28570·3	11598·17	6535·34
	Si/9	24097·7	10522·5	..
	P/16	21622·8	9864·1	..
	S/25	20019·9	9407·7	..
d	Mg/1	13714·7	7479·5	4704·1
	Al/4	14078·41	7595·02	4760·18
	Si/9	14121·4	7604·4	..
	P/16	14074·1	7583·2	..
	S/25	13988·0	..	..
f	Mg/1	..	6994·8	4469·0
	Al/4	..	7109·90	4603·27
g	Al/4	..	..	4419·45

TABLE II.

COMPARISON OF TERM-VALUES OF A SERIES OF ATOMS CONSTITUTING A THREE-ELECTRON SYSTEM, Al I, Si II, P III, S IV.

	N. / R/N².	3. 12192·78.	4. 6858·44.	5. 4389.40.
s	Al/1	..	22933·27	10591·58
	Si/4	..	16580·8	8462·9
	P/9	..	13944·2	7477·0
	S/16	..	12506·8	6908·2
p_1	Al/1	48168·87	15316·48	8003·24
	Si/4	32882·8	12643·0	..
	P/9	26974·7	11313·5	..
	S/16	23787·0	10489·0	..
d_1	Al/1	15844·15	9347·22	6043·31
	Si/4	13119·5	7700·0	..
	P/9	14050·0	7878·3	..
	S/16	14337·5	7884·5	..
f	Al/1	..	6962·6	4451·5
x	Si/4	19124·5	..	..
	P/9	15903·9	..	..
	S/16	16127·3	..	..

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February, 1925.

Losses of Ammonia from Soil by Volatilisation.

THE present communication is a preliminary note on the subject of the loss of volatile constituents from soil, which it is proposed to investigate in detail and on a large scale in the immediate future.

It has, of course, been known for long that while the growth of grasses and tree vegetation on an undisturbed soil produces increases in the nitrogen content of the soil largely owing to the activity of a series of nitrogen fixing organisms, the cultivation of a soil in which the nitrogen equilibrium point had been raised by quiescence invariably results in a loss which was not recoverable in the crop.

In this way there is a leakage of nitrogen which represents a serious economic loss. This occurs not only in Great Britain, but is even more pronounced in those countries where climatic conditions are such as to cause a very complete desiccation and aeration of the surface layer.

It was shown by Hall and Miller (*Journal of Agric. Science*, iv. 56) that when dishes of sulphuric acid were exposed above the soil there was a small absorption of ammonia which was supposed to come from the atmosphere. They observed that very considerable quantities of ammonia were given off from the soil as a result of an application of ammonium salts, and they conclude that "if the soil is palpably giving off ammonia during the months immediately following the ammoniacal manuring it must still be doing so at other times of the year."

It has been shown previously by one of us (Oxford Forest Memoirs, No. 2) that in those soils which contain large quantities of ammoniacal nitrogen there is a considerable portion of this which can be easily removed by solution in water, and further, that when the total amount of ammonia increases during desiccation, as is normally the case, the larger part of this increase is in a form in which it can be removed by water alone.

	Moist.	1st Period.	2nd Period.	3rd Period.
Total ammonia	11 parts per million of dry soil	16	19	22
Water Soluble Ammonia .	10 ,, ,,	13	16	19
Solubility percentage .	90·9 ,, ,,	81·25	84·2	86·38

These figures show an increase in total amount of ammonia, which is largely composed of ammonia so little retained by the soil that upwards of 80 per cent. is removed by solution in water alone. The drying of these soils was carried out slowly and without aeration.

During the desiccation the increase of ammonia did not appear to be due to denitrification, as there was an increase in the nitrate content as well during the time of drying.

	Moist.	1st Period.	2nd Period.	3rd Period.
Nitrate . .	49 parts per million of dry soil	53	69	69
Increase as percentage of initial concentration	. .	8·2	40·8	40·8

These results and others which arose in the course of an investigation into the presence of phenols in the soil, and the observations of Hall and Miller, already quoted, led us to carry out a series of experiments in which attempts were made to aerate the soil under different temperature conditions, and to determine whether any volatilisation of ammonia could be detected.

The results of the first series, carried out with dry air at room temperature, are given below. The dehydration of the soil in these took place slowly.

Soil.	Crop.	Season.	P_H.	Total NH_3.	Soluble NH_3.	Volatile NH_3	Moisture lost during Dehydration as per cent. of Dry Soil.
				p.p.m.			
Forest	Tsuga	Winter	5	5·7	2·1	1·45	30
,,	Corsican Pine	Spring	4	4·95	1·5	·2	35
,,	Oak	Spring	7	2·4	·8	·8	30
,,	Larch	Summer	4	8·8	4·8	·2	41

The second series were carried out with different soils and the aeration was effected by a current of dry air, the temperature of this and of the soil being maintained above 50° C.

Soil.	Crop.	Volatile NH_3, Parts per million of Dry Soil.	Moisture lost during Dehydration as per cent. of Dry Soil.
Egypt .	Cotton	1·1	15
Chalk .	Barley	·5	12
Marlstone	Pasture	·5	31
V. rich Hothouse	. .	1·5	62

These figures again show a considerable amount of ammonia volatilised from the soil.

An apparatus is in the process of construction which will deal with large quantities of soil, and it is hoped, will enable an extended series of observations to be made with soils of different types and at different temperatures.

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Robert Browning as an Exponent of Research.

I HAVE read with delight Mr. Lamplugh's glowing appreciation (NATURE, February 28) of Browning's sympathy with scientific thought, and I agree with every word except that one searches vainly in "Paracelsus" for any clear appreciation of scientific research. For more than forty years I have felt that that poem breathes throughout the very spirit of scientific enthusiasm which is the mainspring of research. Paracelsus first "aspires"

> To contemplate undazzled some one truth,
> Its bearings and effects alone—at once
> What was a speck expands into a star,
> Asking a life to pass exploring thus.

When he "attains" fame in the world he is struck with fear that his ideals may have declined with his lost youth and hopes, and exclaims:

> . . . Would I were sure to win
> Some startling secret in their stead, a tincture
> Of force to flush old age with youth, or breed
> Gold, or imprison moonbeams till they change
> To opal shafts !—only that, hurling it
> Indignant back, I might convince myself
> My aims remained supreme and pure as ever !

In mature age he "aspires" again, looking back over more disappointments than triumphs, and the old passion swells up once more, struggling under the rein of reason.

> And I betake myself to study again
> Till patient searchings after hidden lore
> Half wring some bright truth from its prison ; my frame
> Trembles, my forehead's veins swell out, my hair
> Tingles for triumph. Slow and sure the morn
> Shall break on my pent room and dwindling lamp
> And furnace dead, and scattered earths and ores ;
> When, with a failing heart and throbbing brow,
> I must review my captured truth, sum up
> Its value, trace what ends to what begins,
> Its present power with its eventual bearings,
> Latent affinities, the views it opens,
> And its full length in perfecting my scheme.
> I view it sternly circumscribed, cast down
> From the high place my fond hopes yielded it,
> Proved worthless. . . .

Finally, when he "attains" to wisdom while dying in poverty and neglect, Paracelsus, "the searching and impetuous soul," reviews his career of discovery and traces the course of Nature from the time when

> The centre fire heaves underneath the Earth
> And the Earth changes like a human face,

and onward in a fine description of the origin of land, the advent of plants and animals and their development,

> Suggesting some one creature yet to make,
> Some point where all those scattered rays should meet
> Convergent in the faculties of man.

Surely this is not only appreciative but prescient also of scientific thought, for Browning wrote the poem in 1835 when Darwin was still sailing the seas, an unknown assistant-surgeon on the *Beagle*.

HUGH ROBERT MILL.

February 28.

The Translation of Helmholtz's Physiological Optics.

THE reviewer of Helmholtz's "Physiological Optics" (NATURE, December 20, 1924, p. 887) remarks, "at last a deep reproach has been lifted from the record of English scientific literature."

Nearly quarter of a century ago (on returning from three years' work in a German scientific institution), I proposed to Messrs. Longmans that I should write a translation for them to publish. They agreed, and secured the services of Sir Michael Foster to edit the work, and bring it up-to-date. Sir William Abney and other scientists warmly supported the idea. The German publishers also were quite willing, and agreed to lend their clichés. The scheme fell through because the heirs of von Helmholtz, after long delay, refused to grant the rights of translation, acting on the advice of Prof. Arthur König. I forget the exact terms of König's letter, but it was to the effect that the book dealt with researches which had not been completed, and therefore it would be unfair to the memory of von Helmholtz to allow it to be presented to English readers as representative of his work.

ALICE EVERETT.

Teddington, Middlesex,
February 17.

The Historical Succession of Cultural Impacts upon South Africa.

By Prof. RAYMOND A. DART, University of the Witwatersrand, Johannesburg, South Africa.

SINCE their discovery by the ivory trader Adam Renders (1868) the famous Zimbabwe ruins in Rhodesia have formed the rallying-point around which a fierce and even bitter controversy has raged amongst anthropologists and others. The central point at issue is whether these stately relics owe their existence to an endogenous civilisation, which has since vanished, or to an external and highly advanced culture the impact of which, though powerful, was gradually and ingloriously diminished at a remote historical period.

The conflict which has proceeded about this issue has been valuable in causing suggestive data of considerable magnitude to be placed upon record. It has revealed the existence of a stupendous enterprise in mining of gold, copper, tin, and pigments which involved virtually the whole territory from the Belgian Congo on the north to the Central Transvaal on the south, and from the Kalahari Desert in the west to the Portuguese East African coast in the east. These undertakings were prosecuted with a finesse which never fails to command the respect of modern engineers. Rhodesia, the centre of the mining area, is found at the present time to be pervaded by extensive monumental remains in the form of monoliths, stone circles, and stone buildings, together with vast areas of terraced cultivation. In many instances the buildings reveal a nicety of architecture and a regard for sanitation such as are not characteristic of Southern African natives. Moreover, the ornamentation and objects of phallic worship found in numerous sites have betrayed to many the influence of a people with artistic feeling, and with a complicated theology and religious ritual, who were probably Phœnician, coming from Sabaea in south-eastern Arabia.

Important as the information at our disposal may be, we are far from an exact knowledge in any of the fields involved in this evidence. There has been as yet no systematic anthropological survey of even a portion of the territory involved. In the absence of detailed and precise data, it has been easy for ill-informed argument to accumulate and the significant issues to be overwhelmed in a sea of conjecture.

It is at this juncture that the painstaking and tireless investigations of a Trappist monk of the Marianhill Monastery in Natal appear to provide decisive information such as has been so long searched for. Equipped with the knowledge of an artist skilled in reproducing and retouching medieval works of art in the Cathedrals of Cologne, Bonn, and elsewhere, Brother Otto has been copying with infinite patience for some years the Bushman paintings found in the rock shelters of the Kei River Valley, in the eastern portion of the Cape Province. Copies of certain of these he has forwarded to me with notes for the purposes of this article.

Bro. Otto is not the first investigator who has worked in this region. Stow visited a number of the caves here; and another priest, P. M. A. Schweiger, R.M.M., published (*Anthropos*, 1913) certain of the paintings which Bro. Otto has since studied more minutely. It has remained, however, for Bro. Otto to reveal the historical significance of these works of art.

In the first place, Bro. Otto believes he is able to prove that the art of painting was indigenous to this country, and was not introduced from outside. The works which illustrate the beginnings of the art are crude drawings in charcoal, chiefly of animals, and later of naked human forms revealing the well-known Bushman characteristics. Apparently, by experimenting with pigments mixed with the juices of the Euphorbia flora, works were executed with exceedingly fine brush technique. The pigments, of which a considerable variety was utilised, seem finally to have been rendered impervious to the passage of time and the most rigorous climatic exposures by the discovery of the value of oil as a medium, until latterly the finest works were executed indifferently in the recesses of shelters or on the weather-beaten faces of the rocks outside.

These matters are important enough, but a greater human interest attaches to the discovery that, after their technique had become perfected, the Bushman found subjects for artistic exploitation in voyagers who visited their coasts and inland rivers at a period

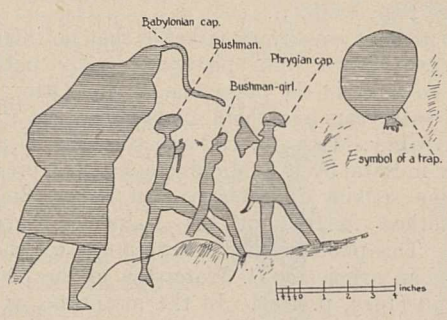


FIG. 1.—Bushman painting in deep red monochrome, in a cave near the confluence of Ngolosa and Kei Rivers. (After Bro. Otto.)

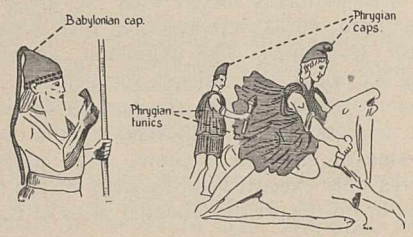
so remote in time that paintings depicting them are sometimes found to be partially covered by an incrustation one-sixteenth of an inch in thickness.

From twenty-eight separate sites over an area twenty miles in length along the Kei River, Bro. Otto has collected more than two hundred and fifty copies of painted groups, and has not omitted, to his knowledge, any detail depicted by these primeval artists within this circuit. From this mine of material he is in a position to provide authoritative information concerning the homeland of these visitant navigators of early times.

A picture from a cave near the confluence of the Ngolosa and Kei Rivers in the Cape Province is represented in Fig. 1. Here we find the figures of two naked Bushmen, and of two foreigners—gigantic in the Bushman's estimation, and wearing ancient Asiatic tunics and headgear. The painting depicts a scene in which a piece of clothing is about to be cast over a nude Bush maiden by a bearded man dressed in a Phrygian tunic and cap, and carrying a weapon (sword ?). Opposition is expressed in the antagonistic attitude of the naked Bushman, who carries a stick in his hand, while the operations are followed closely by the other massive figure, also clad in a tunic, but

wearing a cap of Babylonian design. This figure has no weapon, and is presumably that of a merchant captain. Other pictures of similar alien intruders show them to be usually bearded and armed with bows and arrows, shields, and other weapons—swords and javelins,—whereas the Bushman in these old pictures is generally unarmed or is armed only with a stone or a stick. It seems possible from these facts that the Bushman learned the use of the bow from such visitors.

It is amazing to find that the clothing and headgear



FIGS. 2 and 3.—On the left, figure of Marduk, original in the Berlin Museum. (After Birkner, "Rassen und Völker.") On the right, Mithras slaying a bull, original in the Louvre, Paris. (After Hochland.)

of the people depicted in this painting have their counterpart upon the bas-reliefs of Babylonia and the ancient paintings and sculptures of the Mediterranean area (see Figs. 2 and 3).

It is perhaps equally remarkable that no inferences have been drawn from pictures already published similar to those in the possession of Bro. Otto. More than twenty years ago there appeared in the "Natal Railway Guide" (1903, p. 216) a picture (Fig. 4), photographed in Natal by J. E. Middlebrook, which presented the same striking juxtaposition of naked Bushmen and clothed Asiatics of the Babylonic-Phœnician period. This photograph was reproduced for the purposes of an article by D. Waterston in the *Scientific American* (1915, p. 191). In the meantime, as mentioned already, another priest, Albert Schweiger, had published (*Anthropos*, Bd. VIII., 1913) numerous pictures portraying the presence of clothed foreigners

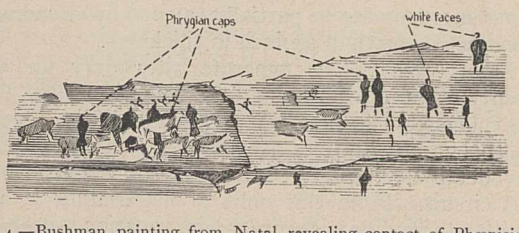


FIG. 4.—Bushman painting from Natal revealing contact of Phœnicians with Bushmen. (After photograph from the "Natal Railway Guide," 1903, and *The Scientific American*.)

which were gathered in the same area as that examined by Bro. Otto. A copy of one of these paintings (Tafel XI.) showing a Babylonian type of cap is shown in Fig. 5.

Pictures showing clothed foreigners are also to be found in the classical work of Miss Helen Tongue ("Bushman Paintings," Oxford, 1909). This author has published many plates of paintings copied in the eastern part of the Orange Free State and Cape Province. Plate XV., No. 102, of her work presents a "procession of men and women dressed in cloaks." The faces of the members of the procession are painted white—a feature of no small significance when it is recalled that Bushmen generally represented themselves and other African natives by means of a black or a scarlet pigment. Bro. Otto's experience agrees with that of Miss Tongue and of J. E. Middlebrook (*vide* Fig. 4) in finding the features of these alien personages depicted usually by means of a white pigment.

We have seen, then, from the independent evidence of at least four people, that foreigners who were clothed in Phœnician and even Babylonian garb were well known to the aboriginal Bushmen of the Eastern Cape Province, Orange Free State, and Natal. But perhaps the most beautiful reproduction of a Phrygian cap was discovered by Father Krauspenhaar a thousand miles north of this region, in Rhodesia, at Rusapi, which is situated on the Beira–Salisbury railway some two hundred miles inland. Fig. 6 is a drawing of Father Krauspenhaar's copy of this picture.

In a portion of the same area (Barkly East) as that examined by Miss Tongue are many pictures of clothed and capped Phœnician foreigners, some of which have been reproduced in Dr. O. Moszeik's "Malereien der Buschmänner" (Berlin, 1910, pp. 61 and 66). Barkly East is situated on a tributary of the Orange River

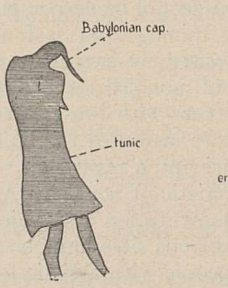


FIG. 5.—Bushman painting from "Nthintshi" near Kei River, Cape Province, depicting a foreigner. (Schweiger.)

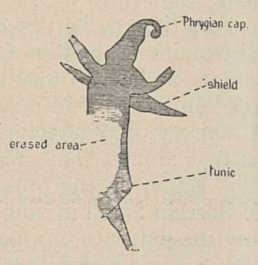


FIG. 6.—Bushman painting in monochrome red from a cave near Rusapi, Rhodesia. (After P. F. Krauspenhaar.)

nearly two hundred miles inland, and consequently we are now in a position to state that the whole of the eastern portion of the African continent for some hundreds of miles inland, which lies between the latitudes of the Zambezi on the north and the Orange and Kei Rivers on the south, was exploited by the *old-colonists*, as Bro. Otto terms them, from South-west Asia in remote ancient times. He calls them *old-colonists* because he believes he is able to prove conclusively from the paintings that these very ancient voyagers not only visited these territories and carried off their denizens, particularly their women, but also intermarried with them and settled down amongst them, bringing to them novel arts and customs (Fig. 7).

The significance of these observations for the unravelling of the Zimbabwe riddle is not far to seek, for they reveal the unsound nature of Randall MacIver's theory of medieval and even Bantu origin of the ruins, mines, and agricultural terraces south of the Zambesi. The pictorial art of the Bushman has preserved through the lapse of centuries unassailable evidence of the impact of ancient civilisations of the Eastern Mediterranean and Mesopotamian areas upon a Bushman South Africa which betrayed in their day no evidence of Bantu contamination.

One of the supposedly crucial pieces of evidence

adduced by MacIver in support of his hypothesis of a medieval Rhodesia, the culture of which was of purely Bantu origin, was the constantly recurring discovery of Chinese porcelain in these ruins. The presence of this ware was rather naturally attributed to Portuguese influence. But the Chinese were navigating the Indian and Pacific oceans in luxurious fashion in the days of Marco Polo, when the Princess Kokáchin went by sea from China to Persia. Nearly three centuries before Marco Polo's time, Alberuni (about A.D. 1030) records that "The reason why in particular Somanâth (in India) has become so famous is that it is a harbour for seafaring people, and a station for those who went to and fro between Sufâla in the country of the Zanj and China" (E. C. Sachau, 1910, vol. 2, p. 104). Indeed, the timid writer of the Periplus found his way south along the African coast so far as Rhapta in the first century of our era, and relates of Arab captains and agents at that period "who are familiar with the natives and intermarry with them, and who know the whole coast." There is every reason for believing that

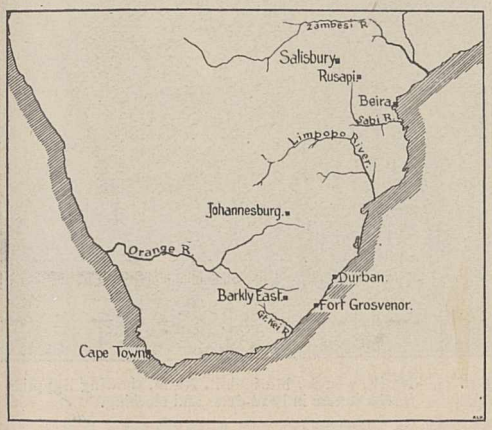


FIG. 7.

in the early centuries of the Christian era, and perhaps prior thereto, when Chinese arms were pushing far westward upon land, Chinese shipping was contesting with Indian and Arabian vessels the trade of the East African coast, which had already fallen from the hands of Egypt and Mesopotamia and those who brought and carried for these countries.

Fig. 8 is a copy of Miss Helen Tongue's Plate XVIII., No. 27, of which she states that "the whole appearance of this painting is ancient." The present interest lies in the fact that it portrays a man of light brown complexion, adorned with two necklaces, arrayed in sumptuous apparel, and carrying on his head a peaked Chinese hat. Bro. Otto has also discovered a number of pictures (*e.g.* Figs. 9 and 10) showing this unexpected type of headpiece. In the light of all these facts it must be recognised that MacIver's hastily drawn conclusions are utterly inadequate to explain the ethnological problems of the southern end of this continent.

That Rhodesia was brought into contact directly with Arabian and Indian agricultural products is shown by the fact that vines, lemons, figs, and cotton, though not indigenous to South-east Africa, are found on the terraced hills of Inyanga in Rhodesia. "Livingstone, Chapman, Burton, Kirk, and all authorities on Zambesia down to the present day have called attention to the great number of plants, fruits, and trees of Indian habitat to be found together on the Rhodesian gold-mines area. These are, of course, not indigenous to this country: the now wild *Tonge manga*, a cotton of Indian origin, not the *Tonge cadja*, which is indigenous; also a bean, *Cajanus Indicus*, known in India as the Dhal Plant; the Indian fig, grown wild; and a tree, *matuvi*, found elsewhere only in India. There is also the *Mahobohobo*, which has its habitat only in Southern India and Malaya. In Rhodesia this tree is only found on the area of the prehistoric rock mines, but the vast extent of the country now covered by its forests demonstrates that it arrived in some exceedingly remote time" ("Guide to Rhodesia," 1924).

Whether Chinese pottery reached Rhodesia by a European or, as is more likely, by a more direct route past India and Arabia, the discovery of it affords us little light upon what was taking place in Southern Africa long before European and even Indian and Chinese contact was possible; and it is precisely here that the evidence accumulated by Bro. Otto is of premier significance, seeing that it demonstrates an extremely ancient cultural impact upon the aboriginal Bushman.

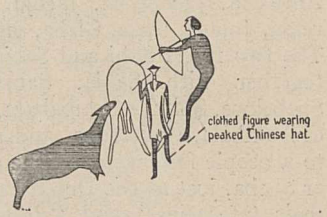


FIG. 8.—Bushman painting in light brown and dark brown, from Magdala, near Barkly East. (After Miss Tongue.)

FIG. 9.—Bushman painting on a stone block, Eliweni, Kei River, depicting a foreigner.

FIG. 10.—Bushman painting in black from cave on the White Kei River, Cape Province, depicting a foreigner.

These remarkable pictures also bring into their proper perspective a series of discoveries of a different but allied nature which have been inadequately appreciated hitherto.

About fifty years ago, Mr. Thomas Cook, who is still living in Durban, discovered twenty-eight coins in a calabash at a depth of about six feet, on the site of a native hut, near the beach at Fort Grosvenor in Eastern Pondoland. Many of these were so worn that their inscriptions were illegible—illustrating that they had been much handled—but some, which were legible, were described by Mr. G. F. Hill, of the British Museum, in the *Classical Review* (of 1897 or 1898). The oldest three coins were of the period of Ptolemy I., II., and IV. respectively (*i.e.* 304–204 B.C.), and the other coins examined were Roman coins issued between the dates A.D. 296 and 313, five of them being struck at Alexandria, two at Antioch in Syria, and one at Cyzicus.

This discovery is not the only one of its kind, for when the monks were building their water reservoir at Marianhill, twenty-six miles from Durban, they found, at a depth of eighteen inches in a recent stratum

of sand and humus on the side of a hill, a Hebraic coin of the reign of Simon Maccabæus (143–136 B.C.), with the inscription "fourth year of the deliverance of Sion" (*Anthropos*, Bd. V., 1909, p. 168).

Now it is conceivable that stray Egyptian, Maccabæan, Syrian, and other coins might percolate even to extreme Southern Africa without any intense cultural movement being afoot; but coins generally signify commerce, and the most cursory examination of any map of Africa south of the Zambezi will show that Palestine and Arabia—those homes of commerce—have left behind very clear evidence of a lengthy contact with this part of the globe. It is by no accident such as might conceivably determine the movement of coins, nor by any philo-Semitic proclivities of the Portuguese, that we find in Portuguese East Africa and the countries adjacent thereto place-names such as Antiocha, Jacobecua, Jacoja, Jacota, Gadsane, Gadzema, Jofane, Gaza, Gizha, Sinoia, Jobo, and the like. The two rivers Sabi and Sabie as well as Lake Sibai, together with Sabia, Sabetsi, Sebaba, Sebakwe, Shebekwe, Shibuto, Shibabara, Chabane, Chiba, Chibi, Chibambala, Chibababa, and so on, owe their names to a people fascinated by the central root Saba, Seba, or Sheba, just as the Dutch have left in South Africa their "fonteins" and "burgs," the English their "Londons" and "Cambridges," and the Scotch their "Dundees" and "Glencoes." So, too, Masibi, Mazibi, Mazibila, Masipe, Mripa, Mriba, and Mareba have an intimate relation with Marib, in the same way as Mocuba, Mokuba, Mkubi, Namoko, Makiki, Muchacha, Machiche, and Machacane recall the Arabian Mocha.

In brief, the themes for the variations provided by hundreds of place-names south of the Zambezi lie in the Asiatic continent, and still await the investigations of specialists in this field. The evidence to be culled from this study will be especially valuable in "dating" and "placing" the different cultural intrusions. Many of the Arabian names are undoubtedly pre-Koranic. In addition to names from Western Asia, there are Indian types such as Ricatla, Mandle, and Kande, and variants of the old name of Japan (Zipangu), namely, Chipanga and Chipinga. I have entered into this matter of place-names in some detail because, rich as the field obviously is, I am not aware of any serious study of this sort made hitherto upon this locality.

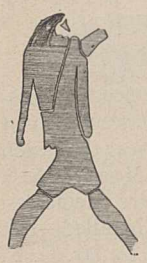


FIG. 11.—Bushman painting from "Ngolosa" (Kei River), revealing Egyptian characters in clothing and head-dress. (After Schweiger.)

We have considered already evidence which indicates that, prior to the coming of the European, not only mediæval Arabian, but also Indian, Chinese, pre-Koranic Arabian (Himyaritic-Sabaean), Palestinian, Phrygian, and even Babylonian influences have played a part in moulding the destinies of the primitive peoples of Southern Africa. There are not lacking evidences that Egypt, too, was in intimate contact with this remote region. There is one picture of Schweiger's from the Kei River Valley (Fig. 11), in which the head-dress, clothing, and artistic feeling is positively Egyptian. However, I would have disregarded this picture if I had not been arrested while in Marianhill by the persistence of the same Egyptian fashions of head-dress amongst the native women at the present day. The photograph reproduced in Fig. 12 reveals Egyptian characters not only in the head-dress

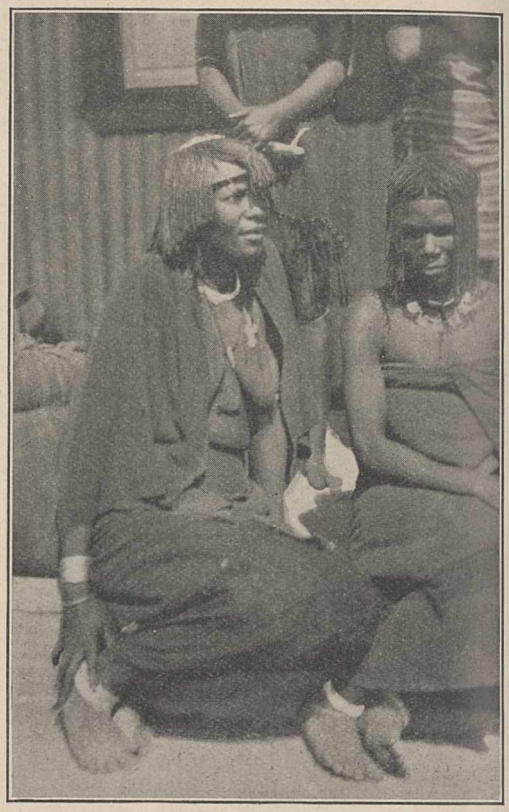


FIG. 12.—Native women, Marianhill, Natal, showing Egyptian characters in head-dress and clothing.

and the head-ring, but also in the clothing (suspension at the waist, fringe at the lower margin), and even in the features of one woman; the other looks Semitic, but neither is frankly Negroid or Bushmanoid. For comparison with Figs. 11 and 12, I have reproduced one of the figures in the procession of servants of the Queen Hatshepsu who visited the Land of Punt (Fig. 13).

FIG. 13.—Figure in procession of Queen Hatshepsu's servants, to illustrate Egyptian head-dress and clothing.

In this connexion, it will be recalled that Dr. Karl Peters discovered (Keane's "Gold of Ophir") in Rhodesia a figurino of an Egyptian courtier—of the period of Thothmes III. (Dynasty XVIII.)—holding in his hands the scourge of a slave-driver. Further, most authorities concur in believing that the steatopygous Queen of Punt and her daughter portrayed in the spoils of the voyage of the sister of Thothmes III., Queen Hatshepsu's (1501–1479 B.C.) servants to the divine South-land, was a Bushwoman or closely related to one. Thus Sir Flinders Petrie ("History of Egypt," vol. 2, 1899) says, "The strange fatness of the queen has been much speculated upon; whether it was a disease such as elephantiasis, or was natural fat, has been debated; but as her daughter shows much the same tendency of

curve in the back, it is probably the effect of extreme fat, which was considered a beauty, as in South Africa at present." Rawlinson (*Ancient Egypt*, 1893) is still more emphatic when he states, "She belonged, more probably, to one of the dwarfish tribes of which Africa has so many, as Dokos, Bosjesmen, and others."

The land of Punt is generally supposed to have been south-eastern Arabia or some point along the southern Somali coast; the spices, resins, and incense products being in favour of the former; the giraffes, ivory, cynocephalous apes, and the like speaking for the latter. Frobenius ("Das unbekannte Afrika," 1923) has shown in a map the distribution of houses on piles such as were seen by these voyagers to Punt. None such are to be found in Arabia or Somaliland, but they are found on the big rivers of Africa southward from Somaliland. Resins and snuffs have the highest of values amongst the Bush people even in modern times. I do not say that the data are conclusive to prove that God's land, Punt, lay in Africa south of the Zambezi, but the facts are highly suggestive. The products of the country—people, animals, gold, resins, pigments, and the like—were such as this country certainly was affording in plenty at that remote period. At the same time, it is a well-recognised fact that for centuries, perhaps millennia, prior to Queen Hatshepsu, ships had been navigating the Red Sea, the open ocean, and the Persian Gulf between Egypt and Mesopotamia. It is not reasonable then to imagine that the Egyptian queen would render herself a laughing-stock before the civilised world by celebrating in the building and decoration of a new temple as extravagant marvels the products of places near by like the coasts of Arabia and Ethiopia. To fit out an expedition for this remote South-land of Punt was always an epochal event, and was carried out only by the greater Pharaohs in times of peace and prosperity, and was even then worthy of record. Such expeditions are recounted in the times of Sankh-ka-ra (Dynasty XI.) under the nobleman Hannu, of Hatshepsu, of Thothmes III.—the Napoleon of Egyptian history—and of Horemheb (all three of Dynasty XVIII.), and of Rameses III. (Dynasty XX.). It is absurd to believe that these proud names in Egyptian history would reckon trips to little beyond the mouth of the Red Sea as worthy of mention when the equipment of voyages three years in duration were commonplaces in the chronicles of the pigmy court of Solomon. Even in the humdrum days of Herodotus, one circumnavigation of Africa had not been entirely forgotten, for he relates how King Necho's Phœnician servants had accomplished this hardy feat.

His Honour the Administrator of the Transvaal (Prof. Jan H. Hofmeyr) has informed me that the remains of what was presumably an ancient galley were discovered during the laying out of the Maitland Cemetery on the Woltemade flats near Cape Town in the 'nineties. At that time the contact of one end of Africa with the other by navigation was undreamt of, and the significance of finding a boat, one hundred and eighty feet in length, buried six feet underground at a distance of three miles from the present coast-line, was lost on the workmen, who utilised it for firewood. The event at least indicates that the followers of Prince Henry were not the first to anchor in Table Bay.

The continuity of the Atlantic and Indian Oceans around the southern extremity of Africa was customarily portrayed by the ancient cartographers of Greece (*e.g.* Globe of Crates), of Arabia (*e.g.* Idrisi), and of Europe from Venice to Anglo-Saxon England (*vide* "Encycl. Britt."). It is difficult to understand how such conceptions could have grown up and persisted in this fashion unless the experiences of ancient voyagers had provided some foundation for them. It is likely that the voyage of Necho's servants was but a repetition of many similar ventures in the storied past. In any case the tale provided by Herodotus is more easily believed when we know that Bushmen from the Zambezi to the south-eastern corner of the continent on the shore-coast and for hundreds of miles inland have recorded in portrait the arrivals and the activities of not merely one but untold numbers of invaders at successive historical epochs.

It is not in the contact of any one people but in the endless procession of emissaries of every great navigating power in the Indian Ocean down this coast that one finds an explanation of the prodigious extent of the early mining industry of Southern Africa. Moreover, it is only in terms of this procession that the physical, anthropological, and ethnological problems of this country can be adequately understood. It is impossible here to do more than direct attention to certain aspects of these intricate but highly fascinating studies. It has already been stated that no exhaustive anthropological survey of the region concerned has been made; but if the urgent necessity for such a survey of the paintings, ruins, terraces and mines, and the nature and richness of its prospective fruits, are indicated, these meagre notes will have been justified.

Biographical Byways.[1]

By Sir ARTHUR SCHUSTER, F.R.S.

12. ESMATT EFFENDI.

I AM not aware that any publication of Esmatt Effendi has ever seen the light of day, but nevertheless my readers, I hope, will agree that his name deserves to be included in this collection of reminiscences. He certainly possessed two essential qualities, enthusiasm and perseverance. I made his acquaintance at Suez, on the evening of May 3, 1882, when, on behalf of the Khedive of Egypt, he received a party sent out under the auspices of the Royal Society to observe the total eclipse of the sun that was to take place on May 17 at Sohag, some way up the Nile. He gave us a very promising account of the local facilities, more especially with regard to bricks and mortar for the foundations on which to place our telescopes; and if his predictions did not come true, and the only brick we saw was that aimed at the head of one of the party by an inhabitant of the village, his intentions were undoubtedly good.

Esmatt Effendi had an ambition to learn something about astronomy, and showed great interest in a

[1] Continued from p. 385.

sextant that I had taken out to check our chronometers. He begged me to teach him its use. After a few lessons, I found him one day trying to find the image of the sun in an artificial horizon, having pushed all dark glasses out of the way. I had warned him against this, and got rather angry with him. He replied, "I am an Egyptian, and I cannot see the sun with the dark glasses. When an Egyptian says he is going to do something he is going to do it, and I am going to see the sun through this sextant even if I lose my eyesight." I had to lock up the sextant.

It was some years before I heard of Esmatt again. Through diplomatic influence, the Naval Observatory at Washington had been persuaded to take him in as a kind of apprentice. They found him, as I had done, persevering and enthusiastic, but incapable of assimilating any knowledge. They tried to persuade him to return home and take up some other occupation, but Esmatt Effendi had made up his mind to stay. The authorities of the Observatory learned afterwards that all the time he was half starved, and had to sell his books and a great part of his clothing to pay for his board and lodging. Matters ultimately reached a crisis and he was told to leave. He finally consented, on condition that the authorities would give him a testimonial which would enable him to find a position at home. They considered the matter, and ultimately resolved that it was worth while to stretch a point, and they sent him the requested testimonial. To their surprise, they found Esmatt again at his desk next morning. He was reminded that they had kept their part of the bargain and that he must keep his. Esmatt stood up, took the testimonial out of his pocket, waved it in front of their faces, and said, "The man who deserves this testimonial deserves to work in the Observatory of Washington." The rest of this story, which I give on the authority of one of the principal astronomers concerned, must be left to the imagination.

Conclusion.

It is with some hesitation that I conclude these reminiscences with the account of an incident that revives painful recollections, and the publication of which I should, for obvious reasons, have preferred to be left over until after my death. It concerns a distinguished personality whose memory is cherished by many friends, but their ranks are now rapidly thinning, and for this reason I feel compelled to disregard personal considerations.

Early on during the War, I was one morning surprised to find paragraphs in the daily press implying that a wireless apparatus had been found and "seized" in my house, with more or less veiled references to the purpose for which the apparatus was likely to have been erected. The complete story may be told some day; at present it is sufficient to say that I do not blame the newspapers.

Though I knew that the implied accusation was not likely to impress my friends, the matter, in view of my position at the time, was serious, and it was with fear and trembling that I entered the Athenæum a few days later and selected a solitary place in the coffee-room. I was leaving again directly after luncheon, and as I was putting on my coat in the hall I suddenly felt some one stepping up behind to help me. Surprised at this politeness, which is somewhat unusual in the Club, I turned round and looked into the kindly face of Lord Roberts, with whom I had no personal acquaintance. The hall was then full of members of the Club, and it was obvious that the action was intended to be, and in fact was, a demonstration. Such incidents are not likely to be forgotten.

Obituary.

Prof. W. A. Haswell, F.R.S.

THROUGH the death of Prof. W. A. Haswell, at the age of seventy-one, zoology has lost one of its foremost exponents, and the University of Sydney a teacher and investigator of world-wide reputation.

William Aitcheson Haswell was born in Edinburgh in 1854, and was educated at the Edinburgh Institution and the University, where he gained the Bell-Baxter Scholarship as the most distinguished natural science graduate of his year. As quite a young man he went out to Australia and, settling down in Sydney, there spent the rest of his life. In 1880 he held the post of curator of the Queensland Museum. Then, returning to Sydney, he delivered public lectures on zoology, and became in 1882 acting curator of the Australian Museum, and published his valuable Catalogue of the Australian sessile- and stalk-eyed Crustacea. In the same year he was appointed lecturer in zoology and comparative anatomy in the University of Sydney, under Prof. W. J. Stephens, who at that time held the chair of natural history. Young and enthusiastic, Haswell threw himself with great energy into the study of the rich fauna of Port Jackson and the adjacent coasts, and in the course of a few years published, in the Proceedings of the Linnean Society of New South Wales, numerous papers, mainly of a systematic character, on the Crustacea, Annelida, and Bryozoa of the Australian seas. In particular we owe to Haswell the first description, in 1882, of the giant Phoronis that occurs in Port Jackson, which he named *Ph. australis*, and in the same year he exhibited drawings of the early stages of its development before the Linnean Society.

During this period, however, Haswell by no means confined himself to invertebrate zoology, but contributed to the Linnean Society valuable papers on vertebrate morphology, on such diverse subjects as the anatomy of birds, the structure of the paired fins of Ceratodus, the skeleton of elasmobranch fishes, and the early stages of the development of the emu (1887). He also described in 1886 in the *Q.J.M.S.* the remarkable striate muscle fibres in the "gizzard" of the polychæte worm Syllis, and in 1889 published a very interesting comparative study of the same fibres. In 1888, also in the *Q.J.M.S.*, he gave the first detailed account of the anatomy of that remarkable ecto-parasitic trematode, Temnocephala, a form which will always be associated with his name.

Such was the reputation Haswell had established for himself as an original investigator and teacher that the Senate of the University of Sydney, when the

Challis professorship of biology was instituted in 1889, appointed him to the chair, without advertisement—at the time a most unusual proceeding—and this he held continuously until his retirement in 1917. All through these years his scientific activity continued unabated.

In 1893 Haswell published, in the Macleay Memorial Volume, his great monograph on the Temnocephaleæ, a group which occupied his attention right up to the end of his working days, for the last paper he wrote is entitled "Critical Notes on the Temnocephaloidea," and was published in the Proc. Linn. Soc. N.S.W. so recently as December 29, 1924. In the volume above mentioned he also described the remarkable new type, Actinodactylella, from the gill-cavities of the Gippsland burrowing crayfish, *Engæus fossor*. In numerous papers, published mainly in the *Q.J.M.S.* and the Proc. Linn. Soc. N.S.W., he contributed largely to our knowledge of the Turbellaria, both fresh-water and marine, and the Cestoda, and by his discovery of the histriobdellid, Stratiodrilus, and his detailed accounts of its anatomy and development, he greatly extended our knowledge of the "Archi-annelida," whilst to him we are indebted for the only available account of the early development of the Port Jackson shark (Heterodontus).

Outside the ranks of professional zoologists, Haswell is perhaps best known to the scientific world as the joint-author, with his staunch friend the late Prof. T. Jeffrey Parker, of the monumental "Text-book of Zoology," which, issued in 1898, is now in its second edition and is accepted as a standard text-book in zoological laboratories all over the English-speaking world.

Amidst all his academic work Haswell found time to take an active interest in the various Australian scientific organisations. He was for long on the Council of the Linnean Society of N.S.W., and acted as its president in 1892–93; he was president of Section D of the Australasian Association for the Advancement of Science in 1891, and he was for many years a trustee of the Australian Museum. In 1916 he edited the Reports of the Australasian Antarctic Expedition.

Haswell was a man of wide knowledge and culture. Shy and somewhat reserved in disposition, he was a loyal, warm-hearted, and ever helpful friend and a kindly and charming host. He was a keen trout-fisher, enjoyed a game of golf, and was an ardent gardener. In 1894 he married Josephine Gorden Rich, a pupil of Jeffrey Parker and joint-author with him of a paper on the myology of Palinurus, and she always took a lively interest in her husband's work. She and an only daughter survive him.

Haswell was elected a fellow of the Royal Society in 1897, and was a member of numerous societies both at home and abroad.

The writer will ever bear his old chief in grateful memory for the forbearance and many kindnesses he showed him during an association of some fourteen years.

J. P. H.

Prof. John Cleland, F.R.S.

Prof. John Cleland, who died on March 5, in his ninetieth year, held the chair of anatomy in Queen's College, Galway, from 1863 until 1877. In the latter year he succeeded Dr. Allen Thomson as occupant of the chair of anatomy in the University of Glasgow, which he held until 1909, retiring at the age of seventy-four to spend the happy evening of his days at Crewkerne, Somerset.

Cleland was a man of imposing appearance who impressed on the generations of students who passed through his class-rooms his love of knowledge, his wide culture, and independence of outlook. He was beloved by his students. All his life long he was fighting a rear-guard action. He was born and bred in pre-Darwinian days and grew up in the school represented by John Goodsir and Richard Owen. He believed in evolution—particularly the brand represented in the "Vestiges of Creation." He could not abide the dogmatic assurance with which Huxley proceeded to sweep the "underlying element of spirit" from all biological processes. For him Darwin's law of "Natural Selection" was true and potent, but in his opinion this law was powerless in the production of purposive adaptations. He was a student of "morphological design" and believed that a "unity of cause" worked through "the ordered sequence to be seen in all biological events." The "morphological beauty of the skull" was almost one of his religious tenets. Those who know the researches and writings of John Goodsir will realise how strong was the influence which the master exerted on John Cleland seventy years ago. With him goes the last representative of the transcendental and philosophical anatomists of the nineteenth century.

Cleland was born in Perth in 1835, the son of a medical man. He was turned from the Church to medicine by his mother, and began his studies in the University of Edinburgh in 1852. Goodsir, then a man of thirty-eight, was at the height of his fame and immersed in researches of the most diverse kinds, but was particularly enamoured of Owen's speculations regarding the "original design" which was supposed to underlie the head and body segments of vertebrate animals. When Cleland became junior demonstrator to John Goodsir in 1857—Sir William Turner was then senior demonstrator—he applied himself chiefly to the morphological problems of the vertebræ and of the skull. He published many dissections made on rarer animals, but the work he will be best remembered by is that done on the human skull. Unfortunately, in 1857, Goodsir's great gifts were already being sapped by the disorder which carried him off ten years later; it is vain to speculate now as to the course events would have followed if Goodsir had retained his full powers of mind; his disease certainly fanned his tendency towards transcendentalism, and it was this side of his mind which had the strongest influence on his junior demonstrator.

In 1861 Cleland left Edinburgh to demonstrate anatomy under Prof. Allen Thomson of the University of Glasgow, one who was a master of scientific method. In 1863 he was appointed to his first chair, in Queen's College, Galway. His best known research was done while he was there, and was published in the Philosophical Transactions (1870, vol. 160, p. 117), on "An Enquiry into the Variations of the Human Skull, particularly in the Antero-posterior Direction." This inquiry has not received the attention it deserves, for in

it Cleland directed attention to the remarkable changes in shape which the human skull passes through at various stages of growth of the child and at later phases of life. Even in adult years head form is not fixed; significant changes may occur in the later decades of life. Between 1855 and 1906 he published more than fifty separate papers and covered a variety of subjects. He was a poet and published a book of verse, "Scala Naturae" (1887); a volume of essays, "Evolution, Expression, and Sensation" (1881); he was one of the editors of the seventh edition of Quain's "Anatomy" (1867); with his former pupil, now Principal J. Yule Mackay of University College, Dundee, he wrote a text-book on "Anatomy (Human Anatomy, General and Descriptive)," 1896, and a "Directory for the Dissection of the Human Body" (1877). A. K.

Dr. A. de Watteville.

Dr. de Watteville, whose death, at the age of seventy-eight, occurred in Switzerland on February 24 last, was a prominent member of the medical profession in London between twenty and thirty years ago. A Swiss by birth, scion of one of the oldest families of Switzerland, he was an Englishman by education, and qualified for the medical profession. He specialised in neurology, and more particularly in electro-therapeutics, which he did much to establish on a scientific basis. His work on "Medical Electricity," which ran through two editions—the second in 1884—established his reputation as the chief authority on the subject in Great Britain. He specially insisted on measurements of current strength as the essential condition of a rational application of electricity, and led to the milliampere being adopted as the electro-therapeutic unit by the International Congress of Electricians.

It was, however, as editor of *Brain* that Dr. de Watteville found his chief interest and occupation. In 1883 he became associated as co-editor with the original founders and editors of this important journal—the late Sir J. C. Bucknill, Dr. Hughlings Jackson, Sir J. Crichton-Browne, and Sir David Ferrier—and in 1886 was appointed sole editor, when *Brain* became the official journal of the newly founded Neurological Society. This post he held until 1900. On his resignation the council of the Neurological Society by unanimous resolution paid him the following well-merited tribute:

The Council accepts with great regret Dr. de Watteville's resignation of the Editorship of *Brain*, and desires to take this opportunity of recording the deep debt of gratitude that the Society owes him for the way in which he has conducted the Journal for the past twenty years. The Council feels that parting with Dr. de Watteville is an event of great moment to the Society, for he has not only brought *Brain* to a high standard of perfection and secured for it a great European reputation, but even the existence of the Journal at the present time is due to his energetic action at a critical juncture in 1880. Moreover, the Council is mindful that the Society itself took origin on Dr. de Watteville's initiative at a meeting held at his house on November 14, 1885.

Soon after resigning the editorship of *Brain*, Dr. de Watteville left London and went to reside in Switzerland, and spent the remainder of his life in quiet study and contemplation among the beautiful surroundings of his native land. Dr. de Watteville was a man of wide culture and great force of character, charitable and self-sacrificing almost to a fault, and the outspoken foe of quackery and pretence of every description. D. F.

We regret to announce the following deaths:

Dr. W. F. Hillebrand, chief chemist of the U.S. Bureau of Standards, who was distinguished for his work on rock and mineral analysis, on February 7, aged seventy-one.

Prof. A. von Wassermann, emeritus professor of experimental therapy and immunology in the University of Berlin and director of the Kaiser Wilhelm Institute for Experimental Therapy in Berlin-Dahlem, on March 16, aged fifty-nine.

Current Topics and Events.

Elsewhere in this issue is an article by Prof. Raymond Dart dealing with certain evidence which, on his view, reveals a long history of cultural contact between South Africa and the outside world from an early date. It is scarcely necessary to emphasise the importance of Prof. Dart's views in relation to the "diffusionist" theories which have been put forward by Prof. Elliot Smith and his colleagues. Perhaps the most striking piece of evidence with which Prof. Dart deals is the parallel drawn between the head-dress and clothing of certain figures in the Bushmen paintings of the Kei River Valley and of figures in the art of Babylonia and Western Asia. Bushmen paintings are thought by some, for good reason, to be relatively modern; the evidence of the incrustation of which Prof. Dart speaks is of little value without further information as to its character and rate of deposit. If the identification of the Babylonian cap were accepted, it would suggest the eighth century B.C. as a probable date, but without a strong corroborative evidence the identification is precarious, especially as this type of cap is of extreme rarity in Babylonian art. Prof. Dart is on surer ground when he points to the problem presented by the extensive traces of early mining activity in Rhodesia. It may be that the researches of the Committee of the British Association which is investigating the composition of early bronzes may point to South Africa as one of the possible sources of supply and thus afford some clue to the date of some of these workings. It is, however, beyond question that the discovery by Dr. Randall-MacIver in the ruined structures of Rhodesia of Nankin china which could not be dated at the earliest much before the fourteenth century, is a great stumbling-block in the way of those who seek to prove an early date for the Zimbabwe culture.

With the past two or three weeks reports have reached Great Britain of a new experiment carried

out by Prof. Michelson and Dr. Silberstein in the United States, on the principle of the Michelson-Morley experiment, to test the drift of the ether in relation to matter in motion. No authenticated account of the experiment is yet available, but references have been made to it in letters from the United States, and the *Morning Post* of March 2 and 7 published articles stating that evidence of relative motion of ether had been obtained. It is stated that a triangle of three water conduit pipes was used, and that the velocity of light travelling round the triangle was found to be different in two opposite directions. Sir Oliver Lodge, in reply to an inquiry as to whether he had received any details of the experiment and the result, has been good enough to favour us with the following comments upon the subject: "In response to your inquiry, and judging solely from the newspaper accounts, the experiment mentioned as having been conducted by Prof. Michelson and Dr. Silberstein appears to be a repetition of the Fizean moving-water experiment, in which the water is this time kept stationary with respect to the earth, and only shares the earth's rotation. If the rest of the apparatus did not share the earth's rotation, no one would doubt a perfectly calculable positive result. The difficulty and interest arise from the obvious fact that the rest of the apparatus must have shared in the earth's rotation; so that an effect was (presumably) observed which did not involve relative motion of matter. But, assuming all this true, the obvious way out is that 'rotation' has always been regarded as exceptional; and the observation, however interesting and important, need be no more perturbing than Newton's bucket or the shape of the earth."

AN important discovery by the Harvard-Boston Expedition to Egypt, which is working among the Giza pyramids, is announced. According to a *communiqué* issued by the Egyptian Ministry of Public Works which appeared in the *Times* of March 10, a tomb has been found of which the burial chamber is at the bottom of a 150 ft. shaft. Although no detailed examination had then been possible owing to the unsafe condition of the shaft, a rectangular alabaster coffin was visible with a number of poles, the tops of which were covered with gold foil. Among inscriptions on a plank by the side of the coffin was the cartouche of Seneferu, first king of the Fourth Dynasty, which would suggest that it is the burial-place of a member of his family. The unusual depth of the shaft, however, and the fact that it is filled with concrete and cement instead of rubble as in other tombs in this area, have been taken to support the view that this is the tomb not merely of a personage of importance—a high official or a member of the Royal Family—but possibly of King Seneferu himself, although he is usually supposed to have been buried at Medum, where he built a pyramid. Dr. Reisner, however, who is in the United States, has cabled since the announcement of the discovery that the tomb is that of the Princess Medti-Seneferu. Presumably he has definite evidence to this effect. The floor of the tomb is covered by a quantity of objects, including alabaster bowls, a copper basin or ewer, and remains of heavily gilded chairs. If it should appear eventually that this is the tomb of the King himself, it would constitute a discovery of great historical importance; but scarcely of less moment to the archæologist is the evidence which the tomb will afford in regard to the art and technique of the smaller objects mentioned, of which at this period little is known.

THE sixth of Sir Oliver Lodge's series of "talks" on "Ether and Reality," broadcasted from the London station (2LO) of the British Broadcasting Company on Tuesday March 17, dealt with matter as one of the forms of energy. Sir Oliver said that one of the functions of the ether is the constitution of matter itself. Atoms are built of electrons and protons, and electrons are evidently composed of ether, because whatever mass they have is represented by the energy of their electric field; though we cannot yet, with any certainty, make a similar statement about a proton. We know, however, that both are more massive when moving than when they are at rest. Their mass and energy increase together, the extra mass behaving like additional matter, but not like permanent matter. When an electron is stopped, the additional matter disappears: it is changed into radiation and travels out as a quantum with the speed of light. There is a curious kind of discontinuity in the immediate neighbourhood of a material nucleus: the satellites can occupy certain positions and no others. But they can drop from one of these positions to another, and they then emit energy in the form of radiation, which depends on how far they have dropped and where they drop to. The process is a reversible one; and when radiation is absorbed, the electron is jerked up again. How far it is jerked up depends on the kind of radiation. The important thing is that matter is turning out to be one of the forms of energy. This has been proved for temporary matter, and is probably true for permanent matter also, a conversion of which is believed to account for stellar radiation. Whether the process is reciprocal—whether radiation can ever generate not only temporary matter but so-called permanent matter—still remains to be discovered.

A SCHOOLBOY once replied to the question "What is an egg?" by stating that an egg is "an oval-shaped article of diet." The Concise Oxford Dictionary says that it is a "spheroidal body produced by female of birds, etc., especially of domestic fowl, containing germ of a new individual." Neither of these definitions can be regarded as entirely satisfactory from the scientific point of view, but the latter has the advantage of grasping to some extent the fundamental point and of restricting the application of the term to bodies of a similar nature. A more precise definition is usually given by biologists of the Latin word "ovum," used as a technical term; an ovum, or egg-cell, is a nucleated cell capable of developing (usually after union with a spermatozoon) into a new individual; a conception, of course, that was as unfamiliar to Latin writers as it still is to dealers in eggs. An embryo, on the other hand, is an individual in an

early stage of its development from the ovum. Unfortunately even men of science still use these terms in a very unscientific manner. Human embryologists not infrequently apply the term "ovum" to quite advanced embryos, thus counteracting the efforts of those biologists who wish to emphasise the fundamental fact that every typical animal starts life as a single nucleated cell—to which alone the term "ovum" should be applied.

IN their interesting and beautifully illustrated paper on "The Early Development of the Cat" (*Quarterly Journal of Microscopical Science*, vol. 68, Part IV.), Prof. J. P. Hill and Dr. Margaret Tribe use the word "egg" in much the same way, but what justification can there be for this usage? It fulfils the requirements neither of popular language nor of scientific terminology. It is perhaps less objectionable than the illegitimate use of the word "ovum," which is evidently intended as a technical term and therefore ought to be used only with scientific precision. But in what possible sense of the word are these early embryos of the cat eggs? They are not articles of diet, and they are in no way comparable to the egg of a fowl, but only to something which may, in certain circumstances, be found in the egg of a fowl. We call this something an embryo—why should not the same term be used for the early stages in the development of the cat? It is in no mere carping spirit that we venture to make these criticisms, but with the view of directing attention to the necessity for a more rational system of terminology in embryological writings, and nothing that we have said must be regarded as indicating any want of appreciation of a most careful and accurate piece of work, a notable contribution to embryological science.

A TIDE predictor has been presented to the Tidal Institute at Liverpool and has been installed at Bidston Observatory. The machine has 10 semi-diurnal components, 6 diurnal, 3 third-diurnal, 4 quarter-diurnal, and 3 sixth-diurnal components, 26 in all; provision has been made for the addition of other components, if desired. Long-period components have been omitted, as such constituents are easily allowed for, if of importance. Very great care has been given to matters of design and workmanship, and the machine has been constructed in an admirably efficient manner by Messrs. Kelvin, Bottomley and Baird, of Glasgow. The accuracy of performance of the machine is very great, and it is capable of being used even for research work. A noteworthy feature of the machine is the provision of apparatus for recording electrically the time at which the tide reaches a definite height. The electrical contact is made by a roller on the edge of a wheel, which is attached by a flexible wire to the pen, and the electrical circuit is completed through a dotting apparatus which registers on a revolving drum. The dots are arranged on a spiral line. This chronograph can be used for registering the exact time of high (or low) water by setting on the machine the desired harmonic constants representing the rate of rise and fall of tide. The donors of the machine are Messrs. Alfred Holt, the Booth, Cunard and Orient S.S. Cos., Mr. Harrison Hughes, Mr. C. Livingston, and the Local Committee for the Liverpool meeting (1923) of the British Association.

THE *Welsh Journal of Agriculture*, of which the first number has recently been issued, is intended to fill a definite need by providing a channel whereby farmers and others in the Principality can be kept informed of the progress of agricultural education and research in Wales. The published articles are to be based on scientific investigations, and will convey scientific and technical information set out in plain language to render it of the greatest possible value to the agricultural community. The first number appropriately leads off with an outline of the history of agriculture in Wales, by C. Bryner Jones, followed by an article on the human side of the farming business by A. W. Ashby. Other articles of a general character, but all having a bearing on agricultural development, are given, dealing with genetics and the stock breeder, modern tendencies in soil research, and with various aspects of research in such fundamental matters as animal breeding, dairying, horticulture, and fruit culture. The rest of the volume is occupied by a number of short papers on various Welsh investigations and by an important article by Prof. Stapledon on "Seeds Mixtures for Temporary Grass." This outlines the results of investigations carried out in Denmark and Sweden in comparison with observations on similar trials now in progress at Aberystwyth, and is of much value as a contribution to the perennial problem which confronts the farmer who desires to put down leys of long or short duration. A useful list of recently published agricultural books is included, together with a section of abstracts, reviews, and bibliographical notes.

SIR E. JOHN RUSSELL, Director of the Rothamsted Experimental Station, Harpenden, Herts., has been elected a corresponding member of the Paris Academy of Sciences, in the Section of Rural Economy, in succession to Prof. Winogradsky, who has been elected a foreign associate.

THE Summer Time Bill was read a second time in the House of Commons on March 13. By it the dates between which legal or clock time is to be one hour in advance of Greenwich Mean Time are from the Sunday following the first Saturday in April to the Sunday following the first Saturday in October. If the measure is passed, summer time will begin this year on April 5 and end on October 4. The period during which legal time is thus to be advanced has been decided upon in agreement with France and Belgium, and is to be the same every year instead of being determined year by year, as has been the case since summer time was first introduced in 1916.

ON Tuesday next, March 24, at 5.15, Prof. A. S. Eddington will begin a course of two lectures at the Royal Institution on the internal constitution of the stars; on Thursday, March 26, at the same hour, Mr. T. Thorne Baker will deliver the first of two lectures on the chemical and physical effects of light:

(i.) "Reproduction of Light Images by Photography," (ii.) "Transmission of Light Images by Electricity"; and on Saturday, March 28, at 3 o'clock, Prof. J. H. Ashworth commences a course of two lectures on the nervous system and some reactions. The Friday evening discourse on March 27 will be delivered by Sir Ernest Rutherford on "Studies of Atomic Nuclei," and on April 3 by Sir Daniel Hall on "The Productivity of English Land."

THREE research assistants are required at the Building Research Station of the Department of Scientific and Industrial Research. Candidates must be honours graduates in chemistry or have an equivalent qualification, with some experience in research. One post requires a special theoretical knowledge of paints and varnishes, another of physical chemistry, and another of inorganic chemistry, a good knowledge of metallography, and ability to read French and German. Applications, upon a special form, must be received by, at latest, March 28 by the Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1.

AT the annual general meeting of the Ray Society on March 12, the following officers were re-elected: *President*, Prof. W. C. M'Intosh; *Treasurer*, Sir Sidney F. Harmer; *Secretary*, Dr. W. T. Calman. Lord Rothschild was elected a vice-president, and Prof. A. E. Boycott and Mr. R. T. Gunther were elected new members of council. It was announced that the first volume of "British Hydracarina," by Mr. C. D. Soar and Mr. W. Williamson, would shortly be published, and that the issue for 1925 would be the "Life of Wilhelm Hofmeister," by K. v. Goebel, translated by Prof. F. O. Bower. The Society published in 1862 a translation of Hofmeister's work on "The Higher Cryptogamia," and it seems fitting that the life of the author should now be included in the same series. The Council has also undertaken to publish a monograph on "British Sea Anemones," by Mr. T. A. Stephenson, which will be illustrated with coloured plates from drawings by the author. It is intended that the first volume shall form the issue for 1927.

WE learn from *Science* that it has been decided to establish a National Hall of Fame for Engineers, Inventors, and Industrialists in the proposed National Museum of Engineering and Industry to be erected in Washington. Records of the achievements of the outstanding leaders in invention and engineering, now scattered throughout the country, are to be assembled, and all original models, so far as recoverable, are to be obtained for the museum. In addition to the central museum, it is hoped to form a chain of local museums of industry in the industrial centres of the country. Among those who probably will be represented in marble or in bronze in the Hall of Fame will be Charles P. Steinmetz, Alexander Graham Bell, Thomas A. Edison, Orville and Wilbur Wright, Eli Whitney, Captain John Erikson, Mergenthaler, and Robert Fulton.

THE report of the Department of Agriculture of the Tanganyika Territory for the year ending March 31, 1924, gives an account of attempts to improve and extend crop production in that region of Africa. Among the most important features of these experiments was the introduction of ploughing among native cultivators. The sub-district of Shinyanga was selected for the experiment as having certain advantages in a closely settled population and extensive areas of cultivable soil in open country free from the tsetse fly. The attempt was facilitated by the growing interest of the natives in cotton production, while the tribal organisation lent itself readily to a system of cultivation by communities. A station for the training of oxen was established, where the natives were instructed in ploughing. Twenty-five ploughs were then issued to native villages, with the result that 500 acres of land were put under cotton, and requests have been made for a supply of 320 additional ploughs for use during next cotton season. A further development of the work which is even more striking consists in the extension of ploughing into areas at present covered by bush and infested by tsetse fly. This not merely increases the area available for cultivation but also causes the recession of the fly-stricken bush, which was advancing into open country and restricting cattle-grazing grounds.

THE Botanical Society and Exchange Club of the British Isles issues with its report for 1923 a plate illustrating the little sedge *Carex microglochin* Wahl, the discovery of which at Glen Lyon, Perthshire, by Lady Davy and Miss Gertrude Bacon, is described by Dr. G. Claridge Druce, the secretary of the Club, as the great botanical event of the year. In addition to the usual notes upon rare finds during the year, or references to interesting work upon British species and new county records, the report contains several papers of distinct interest to systematists, such as the paper upon British forms of Thymus by K. Ronniger, Vienna, notes on British mints by J. Fraser, on violets by E. S. Gregory, upon *Orchis maculata* L. and *O. Fuchsii* Druce, by G. Claridge Druce. Descriptive accounts of special areas of vegetation include that upon the vegetation of Beinn Laoigh (Perthshire) by Donald Patton, and of the Culbin Sands by E. J. A. Stewart and Donald Patton. The report closes with a very interesting illustrated account of the foundation of the Oxford Botanic Garden and its tercentenary by Dr. Druce. No one is better qualified than this writer to evoke in a few brief pages memories of the many botanists officially connected with this historic botanic garden.

IN his article on "Early Activities of the Royal Society," in NATURE of January 31, Mr. T. E. James referred to the election of Pepys and his undertaking in 1674/5 to provide a lecture for the Society. Mr. James was unable to find any record of Pepys having kept the promise or paid the fine in default, and he remarked that there was "no reference to this lapse in the well-known Diary." Mr. C. Macnamara writes from Arnprior, Ontario, to point out that the last date in the Diary is May 31, 1669, that is, several years before Pepys made the promise mentioned in the article.

THE efficient equipment of observatories calls for the services of the engineer as well as the scientific-instrument maker and the optician. The firm of Messrs. Cooke, Troughton and Simms, Ltd., Buckingham Works, York, are fortunate in having at their command facilities for the production of all the apparatus and equipment required for astronomical observation. Several well-known observatories have been built and equipped by the firm, and this branch of their production is now being further developed. A recently issued catalogue, No. 570, contains a full list of astronomical instruments and apparatus manufactured by them, including domes from 10 to 40 feet in diameter, telescopes with objectives up to 20 inches in aperature, a full range of eyepieces, photographic and spectroscopic accessories and position micrometers. Portable equatorial and alt-azimuth stands, semi-portable and fixed equatorial telescope mountings and transit instruments, of various types, are described and illustrated, as well as mechanical and electrical accessories. The articles included in the catalogue are all standard apparatus and instruments, for which prices are quoted; but the firm undertakes also the design and construction of instruments for special purposes.

Two important catalogues of second-hand books of science have just been issued by Messrs Wheldon and Wesley, Ltd., 2 Arthur Street, W.C.2, viz. No. 15, Zoology, Part 2—Vertebrate Faunas, containing nearly 1500 titles, and No. 16, Lepidoptera, with some 262 titles. A number of scarce works are offered for sale, and the catalogues should appeal to many readers of NATURE.

Our Astronomical Column.

MIRA CETI.—There have been three interesting discoveries made concerning this famous variable in recent months. The finding of the faint companion, that is responsible for the bright lines seen in the spectrum at minimum, has already been reported in this column. The next step was the investigation of its heat radiation by the thermocouple by Messrs. Nicholson and Pettit at Mt. Wilson; this was described by Prof. Eddington at the February meeting of the Royal Astronomical Society (see *Observatory* for March, p. 58). While the visual magnitude varies from the third to the ninth, a 200-fold range, the "heat magnitude" varies only from 1·5 mag. to 3 mag., a 4-fold range. This shows that the loss of light is almost wholly in the short wave-lengths.

The third discovery, reported in the *Times* of March 12, is that Dr. F. Pease has successfully applied the 20-ft. interferometer on the 100-inch reflector at Mt. Wilson to the measurement of the angular diameter of Mira, obtaining the value of 0·06″, which is the largest yet found for any star, though its linear diameter would be about equal to that of Betelgeuse, each being about 250 million miles, assuming that their adopted parallaxes are correct.

It is evident that the surface brightness of Mira must be very low, since in spite of its greater angular diameter it is some two magnitudes fainter than Betelgeuse even when at its maximum light. It will probably be followed for as long a portion of the light curve as the interferometer method permits, in order to see whether the diameter varies periodically. Such a variation was strongly suspected in the case of Betelgeuse, itself a variable but with a much smaller range.

Mira is probably the nearest to us of the long-period variables, and anything found about it may be applicable to the whole class. They were formerly thought to be expiring suns, but are now considered to be at an early stage of star-life.

A NEW APPLICATION OF THE SPECTROHELIOGRAPH.—Mr. Royds, Director of the Kodaikanal Observatory, described at the meeting on March 13 of the Royal Astronomical Society, a new method of using this instrument. Instead of placing the second slit wholly on the H_α line of hydrogen, it was made to project on to the light spectrum; the character of the image was then found to be entirely different. Instead of measuring the amount of light from glowing hydrogen in different regions, it now measures the varying pressure of the gas by the varying width of the line, and consequent reduction of light where it is broadest and the pressure greatest.

Each sunspot is found to be surrounded by a narrow bright ring; outside this there is a large dusky region, showing a good deal of structure. The general mottling of the whole disc is very clearly brought out, and seems to have more regularity than in ordinary pictures. The method is quite a hopeful one for bringing out some new points concerning the distribution of gases over the sun's surface.

THE SYSTEM OF β-LYRÆ.—Prof. H. H. Turner, at the meeting on March 13 of the Royal Astronomical Society, announced an interesting result which Miss Blagg has obtained. She finds that there is a small subsidiary variation of light, the amplitude of which is about 0·1 magnitude, and period 6·595 days, very little in excess of the 6·454 days which is the half period of the main variation. It is this approach to synchronism that has prevented the new term from being detected earlier. It shows itself not as a separate curve, but as a slow alteration in the amplitude of the principal curve. No suggestion was made of the explanation of this new term. As the two stars are supposed to be almost in contact, there would not seem to be room for a third orb in their immediate vicinity.

THE DISTANCE OF THE ANDROMEDA NEBULA.—Prof. H. N. Russell gives some further details in *Scientific American* for March of Prof. Hubble's investigation of the distance of this nebula by photographing the Cepheid variables in it. He mentions the possibility that was alluded to in NATURE of March 7, p. 349, that absorption by the nebula might diminish the stars' light and so give too large an apparent distance. But he says that several stars in different parts of the nebula agreed in giving the same distance, thus showing that the absorption effect must be very small, since otherwise it could scarcely be the same for all the stars. Prof. Russell also notes that stars that are individually visible in the nebula must be a thousand times as luminous as the sun; hence only the extreme giants are separately visible, and the great mass of the stars in it are only seen as a general glow. There is still something of a puzzle about the very rapid diminution of light as we pass away from the centre that was found by Mr. Reynolds's photometric measurements. This seems to indicate a different structure from that in our sidereal system.

Research Items.

PALÆOLITHIC MAN IN CENTRAL EUROPE.—L'Abbé Breuil continues his account of his "voyage paléolithique" in Central Europe in *L'Anthropologie*, t. 34, No. 6. He now deals with finds in the loess of Moravia and Bohemia, which are to be described in two sections, the first, which is the present instalment, covering open-air shelters, and the second the caves. Three stations in Moravia are described: Premost, Ondraditz, and Brno (Brünn). As regards the human remains found at Premost, L'Abbé Breuil is of the opinion that the view of Dr. Hrdlička and Dr. Matiegka, that Premost man represents a cross between Neanderthal man and the Aurignacian races, cannot be maintained. The prominent supraorbital ridges cannot be regarded as a decisive criterion against the absence of characters such as the remarkable platycephaly, the development and specialised character of the face, of the nose and orbits, and the receding chin of Neanderthal man—characters which are far more significant than the prominence of the supraorbital ridges. The same applies to the Brno man. Both must be regarded as Aurignacian, differing from Aurignacian man in Western Europe, it is true, but also exemplifying the highly diversified character of the Cro-Magnon race, which was probably already a mixed race when it penetrated Europe.

ANTHROPOLOGY OF THE CHINESE.—Mr. W. W. Cadbury, of the Canton Christian College, contributes to the *Philippine Journal of Science* for December a study of the height, weight, and chest measurements of Mongolian peoples, with special reference to the Southern Chinese. He has made a valuable digest of the literature dealing with these points and has added to it the results of his own observations on the students of the Canton Christian College. The general conclusions at which he arrives are that the Chinese people average 165 cm. in height, the people south of the Yangtze being generally taller than those to the north of the river. Cantonese students of 20 years or more average 163·6 cm. The average weight for the Chinese is 56·9 kgm. in the north, 52·6 kgm. in the south, Cantonese students 51·9 kgm. The weight-for-height index varies from 313 in the south to 384 in soldiers of the north. Cantonese students average 317. Chest circumference is relatively small, varying from 77·4 to 86·9 cm. Cantonese students have an average circumference during rest of 78·9 cm. with a play of about 6 cm.

CANCER AND GOITRE.—In a recent number of *Biometrika* (vol. 16, 1924, p. 364), Dr. Percy Stocks concludes, from a statistical examination of the data of several countries, that there is a distinct positive correlation between the rate of mortality from cancer of the stomach and œsophagus and indices of the prevalence of goitre. An analysis of post-mortem records also leads to the conclusion that enlargements and other anomalies of the thyroid, the anomalies being usually of the type associated with depressed functioning, are more frequent in cases of cancer than in other cases. On the other hand, there is some evidence of a negative correlation between the incidence of cancer and of Graves' disease. Dr. Stocks thinks that these findings "seem to indicate that defective functioning of the thyroid gland is favourable to the incidence of cancer of the stomach, and possibly of other organs also."

SOUND PRODUCTION BY INSECTS.—An interesting critical paper on this subject by Mr. Frank E. Lutz is to be found in the Bulletin of the American Museum of Natural History, vol. 50, 1924, pp. 333-372, and the conclusions arrived at by this observer may be briefly mentioned. He remarks that, leaving out of account the Orthoptera and the cicadas, there are few or none of the sound-making insects that have well-authenticated organs of hearing, or the sound-producing organs of which may not quite conceivably produce the sounds by pure accident and without any purpose or profit. Until we have proof that insects in general purposely make sounds, or that they profit by sounds which they make without intention, there is nothing in our present knowledge of the biology of insects that furnishes good ground for believing that the few cases in which we hear insect-sounds are really exceptions to a rule that insects do not communicate by that means. In the cases of Orthoptera and cicadas, the presence of extreme specialisations, wonderfully efficient in producing sound and apparently not used for any other purpose, gives us a reason for thinking that there is a purpose. The presence of what seems to be a definite ear in the stridulating Orthoptera is an additional reason. However, when we see that the termites, which are not known to stridulate, have the same sort of an ear as crickets and long-horned grasshoppers, and that the cicadas, which produce a loud (to us) sound, probably have no ear (unless it be connected in a deafening way with the sound-producing structure), this latter reason loses some of its force. If these structures have not arisen for the purpose of making sounds, why have they arisen, and how? There is at present no certain answer to this question. In a former paper (Lutz, Annals N.Y. Academy of Sciences, 39, pp. 181-282) an attempt was made to show that complicated and definite structures, including details of wing-venation, had arisen by mutation or through the action of developmental factors without any "purpose" or favouring action of natural selection. The author does not say that this is true of the cricket's wing and the cicada's drum, but he does not deny the possibility.

CHROMOSOMES OF *PARIS QUADRIFOLIA*.—Mr. Bolles Lee contributes another paper (*Quart. Journ. Micro. Sci.*, vol. 69, part 1) on the structure and division of chromosomes. In a study of *Paris quadrifolia*, he finds that the chromosomes contain a spiral periaxial filament and are surrounded by a sheath. Various observers have described such a spiral, others have interpreted it as a row of alveoli. The small sizes of these structures renders their interpretation one of great difficulty. The most surprising conclusion drawn is that the chromosomes always divide transversely in the telophase of mitosis, and never longitudinally at all. We can only say that much more convincing evidence would be required before such a view could be regarded as at all probable. Practically all of these results have been controverted by Martens (*C.R. Paris Acad. Sci.* t. 179, p. 1280) in a preliminary paper in which it is also claimed that a reticulum of delicate threads can be demonstrated in the living "resting" nucleus and is therefore not created by fixation methods.

SOME NEW GREGARINES.—B. L. Bhatia and S. Setna (*Parasitology*, vol. 16, p. 279, 1924) record the occurrence of a cephaline gregarine, probably a species of Leidyana, in the alimentary canal of a carpenter bee, *Xylocopa æstuans*—the first gregarine to be described from a hymenopteran host. The parasite occurs in large numbers throughout the length of the alimentary canal in every carpenter bee examined, but although the investigation extended

over several months, neither cysts nor spores were met with. The authors suggest that these stages probably occur within the larvæ of Xylocopa. They also record the occurrence of a species of Leidyana in the parenchyma of the polyclad Leptoplana.

COPEPODA OF THE CHILKA LAKE.—Major R. B. Seymour Sewell records (Mem. Ind. Mus., vol. 5, pp. 771-851, 16 plates, 1924) the results of his examination of the copepod Crustacea of the Chilka Lake. Of the fifty-seven species present in the collection twelve are regarded as new, and five new varieties are also described. The author gives an account of the changes in the copepod fauna correlated with the varying conditions of the water, *e.g.* the influx of sea-water during the winter months causes a disappearance of the purely fresh-water species which had been carried into the lake during the monsoon. He remarks upon the number of species, hitherto regarded as being typical inhabitants of north temperate or even arctic seas, present in tropical waters. The breeding seasons of many of the species are noted.

HYDRA CHIMÆRAS.—Mr. V. Issayer describes an extended series of experiments (*Journ. Genetics*, vol. 14, No. 3) in producing animal chimæras by grafting together in various ways two species of Hydra, a stalked form of brown colour (*Pelmatohydra oligactis*) and a red variety of *Hydra vulgaris* found near Leningrad the cells of which contain carotinoid and lycopinoid pigments. The former species also has longer tentacles. By pinning together two specimens which had been opened out flat, by inserting an individual of one species into the cavity of another, and by other methods, chimæras were obtained the components of which could be followed by their colour. Mosaics were also obtained by cutting up Hydras into fine pieces and moulding the fragments together. Parts of some chimæras were intermediate in character and were called cytomictical. (It may be pointed out that the term cytomyxis is already in use in cytology in another sense.) Such individuals frequently reverted in buds to *oligactis* but never to *vulgaris*. The bearing of these results on problems of individuality, divisibility, regulation, somatic mutation, and other topics is discussed. A cytological study of these forms is being made which will throw more light on their nature.

SOUTH AMERICAN FUNGI.—Under the title "Fungi Paraguayenses," Carlos Spegazzini describes in the Anales del Museo Nacional de Historia Natural de Buenos Aires, vol. 31, some 267 species and forms of fungi collected by him during a visit to Asuncion in 1920. Many new species are described and figured, spore sizes and figure as well as other microscopic data being supplied.

POISONOUS PLANTS AND LIVE-STOCK.—In the *Kew Bulletin* (No. 1, 1925), J. Burtt Davy has an interesting note underlining the value of scientific investigation of the causes of losses to live-stock as the result of local peculiarities in the quality of the grazing grounds. He uses as a text the important reports upon "Gauwziekte Veld," by Sir Arnold Theiler and Dr. Pole Evans, which have recently been published by the Department of Agriculture, South Africa. The nature of the injury to stock thus produced may be estimated by the fact that one farmer lost 1047 sheep (59 per cent. of his flock) after grazing them for less than twenty-four hours on gauwziekte veld. After prolonged inquiries lasting over ten years and feeding tests with 98 species of plants, these investigators definitely proved that the cause of the losses of stock was *Vangueria pygmæa* (Rubiaceæ). This plant appears to contain a toxic principle, acting directly on the heart, though the toxin has not yet been isolated. Other cases of toxic species in grazing grounds are referred to by the author, who is thus able to make out a strong case for the work of a Government Department of Agriculture by which alone long and extensive investigations, involving the co-ordination of the work of specialists in different fields, can be both promoted and maintained until success is reached.

SYMBIOSIS OF SEEDS AND BACTERIA.—Gilbert J. Fowler and Miss R. K. Christie raise this question on very general lines in their paper in the Journal of the Indian Institute of Science, vol. 7, part xiii. They say that every seed they have examined so far has proved to be associated with specific bacteria either within the seed (poppy), within the husk (rice) attached to the seed by the mucilage coat (*Cassia tora*), or on the testa (indigo-seed). These bacteria are not essential to the germination, but do appear to be helpful in the growth of the seedling. Little difficulty appears to be raised by the authors' conclusion that these bacteria can break down protein reserves, but it is not clear how this property could be utilised by the germinating seedling. An interesting point is raised by the suggestion that the growth of these bacteria is associated with the specific seed extractive, apparently of basic or glucosidic nature, and removable by water or other suitable solvent, which every seed examined appeared to contain. This extractive did not prove on examination to be invariably antiseptic, but it is suggested that, on dilution during germination, it may stimulate the growth of the bacteria associated with the seed whilst holding them in check so long as it is concentrated, as in the resting seed.

CLIMATIC CONDITIONS FOR COTTON GROWING.—Mr. E. E. Canney has carried out a useful piece of work in analysing the climatic conditions required for the growth of cotton without irrigation (Journal of the Textile Institute, vol. 15, p. 1533). He finds that three conditions are essential: freedom from frost during the growing season, adequate but not excessive rainfall, and abundant sunshine. The cloudy, humid climate of large areas of the tropics is fatal to the economic production of cotton of good quality. The mean annual temperature should be above 60° F., the rainfall between 20 and 60 inches per annum, and the mean cloudiness less than five-tenths. On this basis he has prepared maps showing the areas where climatic conditions are favourable for cotton growing, and he finds that there are large parts of the British Empire, awaiting development, with suitable climates for growing as much cotton as is likely to be required for a long time. In the text, and still more strongly in an accompanying letter, Mr. Canney points out the urgent need for trustworthy meteorological observations from many more stations than at present exist in tropical regions. The lack of information as to climate retards development, and may lead to expensive failures owing to attempts to grow crops in regions which are climatically unsuitable.

ATOMIC WEIGHT OF BROMINE.—The January number of the Journal of the Chemical Society contains a paper by H. V. A. Briscoe and P. L. Robinson on the atomic weight of bromine. Ammonium bromide was subjected to 2700 fractional crystallisations from water, the object being to test Richards and Hall's conclusion that isotopes are inseparable by fractional crystallisation. No evidence of separation

was obtained. From the ratio Ag/AgBr, the atomic weight of bromine was found to be 79·914±0·01.

CHLOROPHYLL SPECTRA.—Jan Wlodek has an ingenious suggestion to account for the differences observed between the spectra of chlorophyll in the living leaf and in various solvents. By combining the absorption spectra given by Willstätter and Stoll for chlorophylls *a* and *b*, he obtains a spectrum with absorption bands very closely coinciding with those of the living leaf, far more so than does the absorption spectrum of the alcoholic solution of the mixed pigments. He suggests therefore that in the living leaf the two chlorophylls are present in separate solvents, and that the changes in the absorption spectrum of the leaf under insolation are due either to the proportion of the two pigments changing, a fact that Willstätter and Stoll failed to establish by their classical analyses of the pigments, or that new spectra are developed as the result of temporary combination with carbon dioxide. The paper is published in English in the Bulletin de l'Académie Polonaise des Sciences et des Lettres, Séries B, Science Naturelles, pp. 407-423, 1924, as a contribution from the Jagellonian University of Cracow.

ABSORPTION OF RADIATION BY THE EMITTING ATOM.—In the *C.R. Acad. Sci. Paris* of January 19 M. de Broglie and J. Thibaut describe measurements of the intensities of the corpuscular lines, due to the conversion of the *K* radiation of tungsten (doublet α) in an element, and of the *K* fluorescence lines of the element itself. The relative intensity of the second, with respect to the first, increases regularly with the atomic number for copper, silver, iodine, and barium. Bragg's law, combined with that of Moseley, would indicate a variation in the opposite direction. In the case of radioactive transformations giving β- and γ-rays simultaneously, the β-ray spectrum being due to a photoelectric action of the γ-rays on the electronic shells of the disintegrating atoms, it is found that when the γ-radiation is converted into secondary photoelectrons in an isotope of the disintegrating substance, producing an identical β-spectrum, the intensities of the lines are much less than in the original spectrum of the radioactive substance. Using mesothorium and lead, the ratio of the intensities was found to be very roughly 1 : 10, indicating a much more intense absorption of mesothorium γ-rays in mesothorium than in lead. Ellis has come to a somewhat similar conclusion on this subject, though he considers that in a γ-radiator the γ-rays are absorbed most strongly in the actual atom from which they are emitted, a point to which the authors have not directly given attention in their paper.

THERMOPILES IN THE LARGE SCALE MANUFACTURE OF GASES.—In the manufacture of hydrogen by the electrolytic process, it is very important to know at every stage the percentage of oxygen in the gas, and highly desirable to have an arrangement for sounding an alarm signal when the proportion of this impurity becomes too large. Dr. P. Gmelin, in the F. Paschen *Festschrift* number (January) of the *Annalen der Physik*, describes apparatus in which a small quantity of the gas is passed constantly through pressure regulators, half of the stream being sent through a tube of hard glass containing eight alternate thermal junctions of copper and constantan, and half through a similar tube, parallel to the first, which contains the remaining junctions. The two tubes are surrounded by an electric furnace, and in one of them pure platinum is deposited in the neighbourhood of the thermal junctions, to act as a catalyser for the combustion $O_2 + 2H_2 = 2H_2O$, the heat of the reaction being given up to the junctions. When no oxygen is present the registering millivoltmeter, to which the thermopile is connected, is not affected, and when the amount of this gas reaches 2 per cent. the deflexion is sufficient to make an electric contact and ring an alarm bell. It is arranged that this bell shall also ring when the current through the electric furnace is too low and when the gas stream is interrupted. The apparatus can be adapted to show the presence of 0·1 to 2 per cent. of oxygen in nitrogen manufactured by the Linde process. Enough hydrogen is added to the test stream to combine with the oxygen and leave a small excess. Instead of the single pair of tubes described, as many as twenty-four pairs have been employed, to register from 0·01 to 0·5 per cent. of oxygen in mixtures of nitrogen and hydrogen.

THE PHYSICS OF SPRAY FLUIDS.—Rowland Marcus Woodman has two further papers upon this subject in the *Journal of Pomology*, vol. 4, No. 2, January 1925. In the first paper is studied the influence of various substances in maintaining a suspension of lead arsenate, that is, in preventing its sedimentation, and it is pointed out that this is by no means the same property as that of lowering the surface tension of the liquid air surface so that the spray fluid readily wets the surface of the plants upon which it is discharged. As the results of experiment, gelatine and calcium caseinate were found the most effective substances in promoting both these desirable ends; by fine grinding lead arsenate could be got into permanent suspension in water alone, but calcium caseinate, gelatine, or some other substance would still be necessary, in this case, to promote spreading. In the second paper the advantages of the method of intermittent shaking for the preparation of emulsions of oil in water are studied and elucidated. Gelatine and potash soaps prove to be much better emulsifiers than sodium soaps.

A NOVEL T-SQUARE.—A new T-square and drawing-board made by Axene Ltd., Maxwell House, Arundel Street, W.C., has been brought to our notice. The object of the invention is to "free the hands of" the draughtsman by providing a T-square which will retain its position on the board without any complication of cords or pulleys. This is accomplished by the use of a magnet as the stock of the square, running on a steel strip in the edge of the board. The principle is not new, and previous inventions on these lines have not come into general use. The distinction of this square lies in the utilisation of the new magnetic cobalt alloy said to retain its magnetism almost indefinitely, and the whole of the stock is composed of this alloy. An examination of one of these boards suggests that, provided the length of the stock be proportioned to the length of the T in a ratio not less than found in ordinary squares, the T-square retains its position unaided, and assuming the retention of its magnetic properties, should be of considerable value to draughtsmen. These T-squares can be made with movable heads, but the leverage on the fixing screw on a long square is so great that a fixed head is usually preferred, at least for work which is mostly rectangular, and we did not observe any notable improvement in this respect in the square under discussion. Another useful feature of "The Axene" is the bevelling of the under side of the back edge of the square, enabling it to slide over drawing-pins. The drawing-board can be made with a steel strip on the bottom as well as on the left-hand edge, enabling the T-square to be used vertically and set squares to be dispensed with for work in which this position of the T-square is more convenient.

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World Wheat Production.

DURING the past ten years it has been realised that all the countries in the world have a common bond in the international trade in wheat. Various adjustments in relationships have perforce been necessary, but the six years which have elapsed since the War have given wheat-growing countries time to stabilise their positions and in some degree to accommodate themselves, on one hand, to the cessation of export from Russia, and, on the other hand, to the discontinuance of the artificially enhanced production prevalent during the War years. For this reason the agricultural statistics for 1923 [1] published by the International Institute of Agriculture at Rome, with their comparisons with pre-War years, are of special interest, since they do at this stage indicate the trend which agriculture in general and wheat production in particular is taking throughout the world.

The situation as revealed by the year-book is, on the whole, reassuring. Except in Europe, both area and production in wheat show an increase over the corresponding figures for the period 1909–1913. In North America the increases in area and production are approximately 40 per cent. The year 1923 was admittedly a favourable one for wheat growing, but an examination of the annual returns shows that this increase is not an isolated instance. Europe is still 7·3 per cent. below its pre-War average in production of wheat, and 9·5 per cent. below its average area in that crop over the same period; but the area has increased steadily since 1920, and the production, notwithstanding fluctuations, has never fallen lower than it was then.

Russia is omitted from these returns, but the decrease in wheat production in that country during 1922, when famine conditions were at their worst, is now authoritatively stated as fifty-five and a half million quarters, or 65 per cent. of the pre-War average. In 1923 Russia had a small export trade. It will be remembered that, before the War, Russia was one of the chief sources of the world's wheat supply.

A good deal of attention has recently been directed towards the wheat production and crop balance-sheets of Canada and the United States. No appreciable decrease in area under cultivation in either country is

[1] International Year-book of Agricultural Statistics for 1923. Rome: Imprimerie de l'Institut International d'Agriculture, pp. xcv+471.

recorded in the data published, but wheat production in both is less in 1923 than in 1922. Almost the whole of this loss can be apportioned to the United States, where increases in the more important crops of cotton and maize more than counterbalance it. Four million acres went out of wheat in 1923 and 5·4 million were added to the maize and cotton crops. Further, the excess of exports over imports of wheat has fallen from 32 million quarters in 1921 to 9·6 millions in 1923. Taken together, these figures would seem to afford a striking confirmation of the forecast made by the Bureau of Agricultural Economics in the U.S. Department of Agriculture Year-book for 1921. In a paper on "Wheat Production and Marketing," O. E. Baker says, "Wheat production, however, has been increasing less rapidly than population in this country, and it is very probable that this will continue to be true, at least until we reach the point where we consume practically all we produce." Such a state of affairs is obviously of very serious import.

The International Year-book has grown during its brief career, and this issue gives many more details than its predecessors. It is to be regretted that in so doing it has been thought necessary to discontinue some of the summary tables. That relating to the percentage of each crop, based on total area under cultivation in each country, is a noticeable omission. The book contains sections dealing with crops, live-stock, trade returns, prices, freight charges, fertiliser consumption, and rates of exchange, and will repay perusal not only by the agriculturist and economist but also by the interested layman.

Critical Ionisation Potentials.

THE publications in the Bulletin of the National Research Council of the Washington Academy of Sciences have included many numbers which are excellent reports on the state of knowledge at the time of publication in special branches of modern science. The monograph under review [1] is stated to be the first of a series which, when complete, will form the report of the National Research Council Committee on Ionization Potentials and Related Subjects. The monograph is in two parts, the first of which, by Prof. K. T. Compton of Princeton University, deals with the methods by which critical potentials for the excitation and ionisation of atoms and molecules by electron impacts have been measured. The author gives a very clear account of the principles of the various experimental methods of determining the critical potentials of gases and metallic vapours, and of investigating their significance. There is also a brief section on the critical potentials for the production of soft X-rays from solids. The text is well illustrated by diagrams of apparatus and experimental curves, which will be particularly appreciated by the general reader.

The second part of the work deals with the interpretation to be placed on the critical potentials which have been measured, that is to say, it is a discussion of the nature of the particular disturbance produced within the atom or molecule at each critical stage. It is written in a clear and concise manner by Dr. F. L. Mohler, of the United States Bureau of Standards. The relation between lower critical potentials and arc spectra is first given. Multiple excitation phenomena and the higher critical potentials of gases are then dealt with, and the interpretation of the latter class of data is further considered in connexion with the results for soft X-rays from solids. A final section deals with the results which have been obtained from experiments on polyatomic gases, and their relation to thermochemical data. The whole is illustrated by clearly drawn energy diagrams and Moseley curves.

The bibliography which is appended to the monograph is a very comprehensive one and will be of value to research workers in this field. Altogether the book forms the most complete summarised account we have seen of the work which has been done in the important branch of modern physics with which it deals, and the authors are to be congratulated on their excellent production.

[1] "Critical Potentials," by K. T. Compton and F. L. Mohler, Bulletin of the National Research Council, Vol. 9, Part 1, No. 48. Pp. 135. (Washington, D.C.: National Academy of Sciences, 1924.) 1.60 dollars.

University and Educational Intelligence

BRISTOL.—A lecturer in physiology will shortly be appointed, with duties to begin on October 1. Particulars of the post may be obtained from the registrar. The latest date for the receipt of applications for the lectureship is April 20.

CAMBRIDGE.—The Adams Prize for an essay on "The Physical State of Matter at High Temperature" has been awarded to Mr. R. H. Fowler, Trinity College. A Smith's Prize has been awarded to T. G. Room, St. John's College, for an essay on "Varieties generated by Collinear Stars in Hyperspace." F. C. Phillips, Corpus Christi College, has been elected to the Amy Mary Preston Read Scholarship.

The subject for the Adams Prize for 1925–6 is "The Constitution of the Interior of the Earth and the Propagation of Waves through the Interior and over the Surface of the Earth." The adjudicators say that "the facts as to the propagation of earthquake waves may now be considered fairly well established, and a discussion is asked as to the deductions which can properly be drawn as to the constitution of the interior of the earth. Such questions may suitably be treated as the reflection, refraction and dissipation of waves at surfaces of discontinuity, if any, inside the earth; also the interior arrangements which would best account for the ordinary P, S seismological tables. A discussion might also be given as to how far the various suspected periodicities of earthquake phenomena, if real, must be attributed to a periodicity of external agents, and how far, if at all, they represent periodicities of free vibrations of the earth itself." The Prize, which is of the value of 240*l*., is open to competition of all persons who have at any time been admitted to a degree in the University.

Grants have been made from the Worts Fund to Mr. T. R. Parsons, Sidney Sussex College, towards expenses incurred in studying with Prof. Orbelli of Leningrad the operative procedure used in research by the physiologists of the Pavlov School, and to Mr. K. de B. Codrington, Corpus Christi College, towards the expenses of a visit to India for the purpose of carrying out archæological research at Elura, Hyderabad State, and at Badami, Bombay Presidency, and of making moulds of the sculpture.

It is proposed to erect the new Pathological Laboratory on the Downing site near the Biochemical Laboratory and the Molteno Institute of Parasitology.

Emmanuel College is offering to a research student commencing residence at the University in October 1925, a studentship of the annual value of 150*l*., which will be tenable for two years. Applications must reach the Master of Emmanuel (The Master's Lodge, Emmanuel College, Cambridge, England) not later than July 31. The award will be made on the evidence submitted by the candidates, which must include a brief statement of the proposed course of research and evidence of general ability and of special fitness for the proposed course of research.

GLASGOW.—The late Dr. John Hall, a graduate of Glasgow, of St. John's Wood, London, who died in 1909, left the reversion of one-half of his estate to the University, for the foundation of tutorial fellowships in medicine, surgery, and obstetrics, for the better equipment of the practical classes in these subjects, etc. Through the death of his sister, who has added half her own estate to that of her brother, the large endowment has now accrued, and may amount to some 50,000*l.* when the estates are realised. The benefaction will be of great use to the University's large school of medicine, which now exceeds in numbers and in clinical resources any other in the kingdom.

Dr. J. S. Haldane, fellow of New College, Oxford, has been appointed Gifford Lecturer at Glasgow for the years 1926, 1927.

MELBOURNE.—Applications are invited for the professorship of agriculture and the post of research physicist. Conditions of the appointments may be obtained from the Agent-General for Victoria, Victoria House, Melbourne Place, Strand, W.C.2. The latest date for the receipt of applications is May 31.

APPLICATIONS are invited, until April 18, for the professorship of philosophy at the University College of Swansea. Particulars of the post may be obtained from the College Registrar, Singleton Park, Swansea.

AN election to Beit fellowships for scientific research at the Imperial College of Science and Technology, South Kensington, will take place in July next. Applications must be received on or before April 18. Forms of application and all information can be had by letter addressed to the Rector of the College.

VISCOUNT BURNHAM will deliver an address on "Technical Education as it affects Employers of Labour" on Friday, March 27, at 8 P.M., at the Battersea Polytechnic, London, S.W.11. The Governing Body of the Polytechnic has extended an invitation to the London County Council Joint Standing Conference of Evening Institutes in the district to hold at the Polytechnic an Exhibition of Work done by students on Friday evening and Saturday afternoon and evening, March 27 and 28, while the laboratories, workshops, kitchens and demonstration rooms of the Polytechnic will also be open for inspection.

SOME of the inner working of a preparatory school on modern lines is shown in a pamphlet entitled "St. Piran's Year Book for 1924," recently received. Few people realise how fundamentally wrong is the system of so-called education in a great many preparatory schools where the only object seems to be to cram in a knowledge of a few subjects—principally Latin and Greek—to meet the requirements of the Common Entrance Examination. How this can be expected to encourage latent ability, even for languages, much less to reveal a boy's true bent, passes comprehension. Every schoolmaster admits what Mr. Secretary Cecil said to Roger Ascham, very wisely and most truly, when the great plague was at London in 1563: "Many young wits be driven to hate learning before they know what learning is." The headmaster of St. Piran's, Maidenhead, has shown in a very practical way how scholarships can be won and examinations passed without serious detriment to education in the true sense of the word. Natural science, for example, is taught to the boys at St. Piran's although the Common Entrance Examination does not require it. An engineering shop, various societies—literary, natural history, wireless, photographic, gardening—and lectures on subjects of current interest provide stimuli calculated to reveal latent ability. This is, or should be, the true aim of all education. To the impartial mind it appears that this out-of-date Common Entrance Examination condemns the boys in most preparatory schools to do merely school work in school, while the education, if any, they may have the luck to acquire is most likely to be picked up in out-of-school hours.

THE Battersea Polytechnic's report for 1923–24 shows 2735 as the total number of students, 447 being full-time and 2288 evening and other part-time students. The full-time courses were chiefly in the Training College of Domestic Science, and in engineering. Of the entries for part-time work about a third were for mechanical engineering and building and electrical engineering, a third for physics, chemistry, and mathematics, and the rest for women's subjects, music, hygiene and physiology, matriculation classes, physical training, and art. The figures are large, but a comparison with the figures for previous years is disquieting. The Principal points out that there is a steady decrease in numbers, and says it is largely due to the increased fee for out-county students (to cover the difference between the ordinary fee and the cost to the L.C.C. of the student's education) and the cessation of work under the Government scheme for the higher education of ex-service students. The decrease in the number of full-time students is fully accounted for by these reasons, but there remains a large decrease, nearly 600, in the number of evening students (comparing 1919–20 with 1923–24), attributable in part it may be supposed to the slump in the engineering trades. An interesting development in the Department of Hygiene and Public Health is the institution of a course in practical home dietetics (gas-ring or oil-stove cooking) for bachelor men and women. The enrolments in this department show a substantial increase.

THE international interchange of university students and university teachers has attracted much notice since the War. Many post-War organisations—the League of Nations' Committee on Intellectual Co-operation, the International Confederation of Students and its affiliated national unions, and many others, as well as older associations, such as the League of the Empire and Victoria League, make the fostering of such interchange one of their chief objects. The Universities Bureau of the British Empire has an Interchange Committee, consisting mainly of the Interchange Correspondents of the Bureau in the home universities, and has for several years printed and circulated annually a list of students from other countries in the universities and university colleges of Great Britain and Ireland. To the list for the current academic year is appended a list of university professors and lecturers of these universities who in 1923–24 visited universities in other countries and vice versa. No official sources of information exist regarding the visits of university teachers, since many of them are arranged without the official cognisance of the registrars of the home universities: indeed, the list is so scanty as to suggest that the visits of these "merchants of light," as they have been called, resemble, in being few and far between, if in no other respect, the visits of angels. Nevertheless the list is interesting as a pioneer attempt which should be repeated with more success. When one considers the expenditure incurred in the world of finance and commerce in recording and publishing statistics of imports and exports of material commodities, one wonders that the learned world has not long ago insisted on receiving systematic intelligence of the interchange of savants.

Early Science at Oxford.

March 23, 1685–6. An abstract of Mr. Bent's travailes in France, was communicated by Mr. Welsteed, and read.—Mr. Walker delivered in papers on an empiricall way of curing ye Cramp by a piece of ye root of fflag, and on Second-sighted men in Scotland, concerning whom Dr. Garden was desired to give his opinion.

March 24, 1684–5. Mr. Dalgarno advocated the bringing of a Philosophicall Language into practice. He also presented a compendium of a book, not long since printed by him, entitled *Didascolcophus*, which among other things undertakes to prove, that the Eye & Hand are more useful organs of knowledge, than the Tongue and Ear. This gave occasion to some discourse concerning the Vigour and improvement of some one Sense, upon the Defect, or non-employment of one or more of the others; upon which subject Mr. President was pleased to informe us, that Mr. Whaly (the deaf gentleman, whom he taught to speak) could, when within doors, distinguish a coach from a cart in ye street by the motion, it made; when those, who were in company with him, could not discern whether it were the one, or the other, by the noise, it made.

March 26, 1684–5. Ye Rt. Honorable the Lord Visct. Weymouth, in answer to Dr. Plot's queries, concerning ye splitting of Trees by ye late Frost, wrote that great damages in this kind have befallen ye timber trees in most of ye northward midland counteys, but very little or none in ye western counteys of England.

Ordered that ye thankes of this Society should be returned to Mr. Molineux of Dublin for his ingenious discourse concerning ye Petrifications of Loughneagh: in which it having been affirmed, that these petrifications are sometimes found in ye earth near ye Lough, it was queried, whether ye earth, in which these petrifications are sometimes found, may be supposed to have been thrown up from ye Lough? It was then proposed by Dr. Beeston, that ye Petrifying Springs in, and near Oxon, should be strictly examin'd, particularly as to their chymicall principles; and that enquiry should be made into ye severall steps, and progress, of their respective petrifications.—Mr. Packer, Physitian of Reading, gave an account of some observations he made lately in ye dissection of a Bear; particularly that there was no *Cæcum*, & that ye æsophagus consisted of so narrow a channell; and ye stomac, and entrails, are so well fixed in ye abdomen, that it was altogether impossible, they could at any time fall into ye mouth, as it was formerly supposed it might be in some postures of this animall. It was ordered, that thankes should be returned to Mr. Packer, and that he be desired to continue a correspondence with us.

March 27, 1688. Dr. Plot gave the Society the sight of a Paper written for his Majesty's use, about felling Timber in Staffordshire, where they bark their trees in the spring and cutt them down in winter, which hardens the timber, soe that the outside is as hard as the heart of the tree. For felling wood in winter he brings the authority of the antients, Pliny, Theophrastus, Cato, &c. for the advantage of it. He shewed how the barking of it in the summer farthers the hardening by closing the pores in the evaporation of the juice by the heat of the sun. There is no objection against it but that t'will be more troublesome to fell the Timber so hardened, and to bark it standing, and so dearer, but the goodness will sufficiently answer the price.

Societies and Academies.

LONDON.

Royal Society, March 12.—Sir Charles **Sherrington**: Remarks on some aspects of reflex inhibition. Attempt is made to schematise in a diagram certain features of the interaction of central inhibition and excitation. Assumption is made of an inhibitory agent liberated centrally which neutralises chemically an excitatory agent when this latter is present, but the liberation of which is not dependent on pre-existence of the excitatory agent. Tetanic inhibition is dealt with as due to iterate production of the inhibitory agent, with exhibition of temporal summation and "recruitment." Central after-action, both inhibitory and excitatory, is attributed to temporary persistence of a residuum of the liberated inhibitory or excitatory agent. The schema is designed to meet in particular the experimental data furnished by the knee-extensor under crossed excitation and ipsilateral exhibition. It does not attempt to deal with late successive effects such as successive induction and rebound.—E. G. T. **Liddell** and Sir Charles **Sherrington**: Recruitment and some other features of reflex inhibition. Under mere prolongation of an otherwise unaltered stimulus of the inhibitory afferent nerve, the central inhibitory process recruits more motoneurones as it proceeds. The "stimulation-plateau" of the reflex contraction is more easily inhibited than the "after-discharge plateau." Experiments suggest that a reflex maintains maximal response of the individual "motor-unit" by a degree of central excitation which is commonly "supramaximal," *i.e.* of intensity above the lower limit required for evoking the unit's maximal response. In the excitatory reflex a mechanism proximal to the motoneurone axon seems to react in an "all-or-none" manner when exposed to inhibition.—D. T. **Harris**: Studies on the biological action of light. Ultra-violet radiations exert a stimulant action on the gaseous metabolism of small animals, and on the movements of the frog's isolated stomach. This action is completely annulled by the presence of visible radiations, an action which seems to be physiological antagonism rather than physical interference. Exposure of an animal to mixed radiations of a powerful source of light depresses its heat production to an extent greater in pigmented animals than in albinos for the same rise of temperature in the surrounding medium. Thermo-electric measurements indicate that pigment, nevertheless, possesses high absorptive properties. Pigment appears to protect an animal against the lethal action of certain photo-dynamic substances.—H. **Hartridge** and F. J. W. **Roughton**: The kinetics of hæmoglobin. III. Velocity with which oxygen combines with reduced hæmoglobin. The reaction between oxygen and reduced hæmoglobin is very rapid, the time required for half-completion being 0·01 to 0·001 sec. The velocity-constants obtained at P_H 7 and P_H 10, with different concentrations of hæmoglobin and oxygen, agreed in showing that the reaction is bimolecular. The dissociation curve for dilute hæmoglobin solutions is approximately hyperbolic. The quotient of the two velocity-constants, oxidation and reduction, is practically equal to the equilibrium constant. The presence of hæmoglobin aggregates would not be expected to affect the velocity of oxidation, so long as the part of the molecule with which the oxygen combines is sharply localised and far removed from the aggregate-forming portion. This affords an explanation of the low-temperature coefficient obtained.—S. B. **Schryver**, H. W. **Buston** and D. H. **Mukherjee**: The isolation of a product of hydrolysis of the proteins hitherto undescribed. By

means of the "carbamate" method, a base $C_6H_{14}O_3N_2$ has been isolated from isinglass. It differs from the other basic products of hydrolysis of the proteins in that it yields a barium carbamate insoluble in water. It gives a tri-benzoyl derivative $C_6H_{11}O_3N_2(C_6H_5CO)_3$ m.p. 68-69°, and it is assigned the formula $CH_2 . (NH_2) . CH_2 . CH_2 . CH(OH)CH_2 . (NH_2) . CO_2H$. It has been found after hydrolysis of fish gelatin, isinglass and three vegetable proteins of very diverse origin. It is absent from, or present only in very small traces in, the hydrolysis products of gelatin of mammalian origin, of casein, fibrin, and egg-white.—D. **Keilin**: On cytochrome: a respiratory pigment common to animals and yeast. Under names myohæmatin and cytohæmatin, McMunn described a respiratory pigment, here named cytochrome. Cytochrome, in reduced form, shows a very characteristic spectrum, with four bands (*a*, *b*, *c*, *d*), with positions of maximum intensity: *a*, 603; *b*, 565; *c*, 550; *d*, 523. In the oxidised form no absorption bands can be seen. In different concentrations cytochrome exists in tissues of all animals, *e.g.*, worms, molluscs, arthropods and vertebrates. It is also present in cells of ordinary baker's yeast, a thin layer of which shows well the above four bands. The highest concentration of cytochrome is found in thoracic wing-muscles of insects, striated muscles of mammals, and yeast-cells. It yields various derivatives similar to hæmochromogen and its oxy- and CO-compounds, and porphyrin. Cytochrome may co-exist with other respiratory pigments, and may be considered an intracellular respiratory pigment, generally distributed, forming part of a complicated system of respiratory catalysts.

Royal Microscopical Society (Industrial Applications Section), January 28.—R. Stenhouse **Williams**: The microscope of fundamental importance to the dairying industry.—Norman **Wright**: The structure of the udder, normal and abnormal. The solids-not-fat (lactose, protein, and ash of milk) are secreted in very constant concentration, owing probably to their osmotic properties; the fat bears no relation to the other constituents, since, owing to its insolubility, it has no osmotic pressure. The control of rate of fat secretion is dependent upon the rate of formation in the gland (probably constant), and the fact that the cell membrane must be penetrated in order to liberate the fat globules. The importance of correlation between the constituents of blood and of milk is emphasised.—A. T. R. **Mattick**: The enumeration and differentiation of the various cellular elements of milk, by means of the microscope. On account of the enormous differences in numbers of cells found in the milk of different cows and even in different quarters of the same cow, no such standard can justly be adopted. The method of differentiating between the various types of cells by the use of stains such as Jenners, and finding by means of the microscope the relative frequency of occurrence of the different types, is more promising. Whilst the differential method of Varrier-Jones seems to offer considerable promise, more work on the varieties of cells found in different breeds and under different conditions must be done.—L. J. **Meanwell**: The application of the microscope to the detection of tuberculous infection. Great care must be exercised before assuming that acid-fast bacilli in market milk are of tubercular origin. By the use of the usual routine method of microscopical examination, 20 per cent. of infected milks are detected. As this method is not satisfactory, animal inoculation must be performed before a report can be given. The disadvantages of the animal inoculation method of examination are said to be: (1) Expense, (2) the lapse of time necessary before a report can be given, and (3) the difficulty in tracing the source of infection. 25 per cent. of milking cows are affected with tuberculosis, and in certain districts 4 per cent. of the milking cows show, on post-mortem examination, tuberculous lesions of the mammary gland.—J. **Golding**: Fat globules. "Adsorption films" of the nature of "gels" seem to explain the observations made on milk globules as well as on other emulsions. Observations on the differences in time of churning of the milk of individual cows support the conclusion of other workers that "individuality" may play at least as important a part as "breed" in this respect. The expense and difficulty of accurate estimations of size of fat globules do not encourage the use of the microscope in this direction. The microscopical examination of butter under polarised light yields more definite results in the comparison of butter and margarine.—Miss E. R. **Hiscox**: The separation and identification of the micro-organisms causing faults in milk products. In the first method (moist chamber) a well-isolated cell is kept under observation under the microscope until the resultant colony is large enough to be transferred to a tube of culture medium. In the second (Barber's method) small drops of an emulsion of the cells are blown on the lower surface of a coverslip by means of a micro-pipette. Drops containing a single cell are transferred to tubes of the culture medium. Although physiological reactions are of primary importance in the identification of micro-organisms, microscopical observation of the size and shape (bacteria), form of budding and spore formation (yeasts), form of branching and type of fructification (moulds), may also be of great value.

Physical Society, February 13.—F. E. **Smith**: A system of electrical measurements. The study of the absolute measurement of electrical quantities, though usually regarded as difficult, is not beyond the comprehension of junior students if suitably presented. The electrical units as theoretically defined and the practical standards by which they are represented differ, but an incorrect standard can be brought into more precise accordance with its theoretical unit without inconvenience to industry. The increased refinement of measurements calls for a redefinition of the practical standards, and this could be effected without inconvenience, since the most probable values of the standards lie within the limits prescribed by the errors permissible in industrial measurements.

PARIS.

Academy of Sciences, February 2.—Maurice **Hamy**: The determination of the radial velocities of stars. The application of the Doppler principle to the determination of the radial velocities of stars is now known to require certain corrections. The alteration of the wave-length by pressure has been proved, and the Einstein gravitation effect must also be taken into account. A. Michelson has also pointed out the necessity for another correction due to the fact that most radiations are not simple. An international agreement relating to the comparison lines to be used in the determination of radial velocities is much to be desired.—G. **Bigourdan**: The perturbations of the Hertzian waves during transmission to great distances. A table is given showing monthly, quarterly and annual means; the general mean of the annual values is 0·013 sec.—André **Blondel**: A new method for the harmonic analysis of the curves of electromotive force of alternators. Two methods are described and discussed, one making use of a thermionic amplifier, the other working with a condenser.—Pierre **Weiss**:

The magnetic equation of state and variation of the atomic moment.—M. Eugène Fichot was elected a member of the section of geography and navigation in succession to the late E. Bertin.—A. **Kolmogoroff**: The possibility of the general definition of the differential, the integral, and the summation of divergent series.—J. **Haag**: Euclidian action at a distance.—P. **Fatou**: The movement of a material point submitted to the attraction of a flattened spheroid.—A. **Barbaud** and R. Le **Petit**: The measurement of the wind in an aeroplane and its effects on the route followed.—J. **Cathala**: A recording apparatus for the control of the insulation of enamelled wires. Enamel has been used in late years to an increasing extent as an insulating material for wires, but the wire thus covered always has a certain number of microscopic cracks, where the insulation is nil. In the apparatus described and figured the wire is rapidly drawn through a mercury bath and the weak spots detected.—Léon **Guillet** and Albert **Portevin**: The influence of tempering on the mechanical properties of steel after reheating. Whenever the nature of the metal permits the production of different constitutions by tempering, the results of mechanical tests obey the following rule: for equal final hardness after reheating, the resilience is better for the completely tempered states, that is to say, those formed of pure martensite. Inversely, for equality of resilience after reheating, the final hardness is always higher as the temper hardness is higher.—V. **Auger** and Mlles. L. **Lafontaine** and Ch. **Caspar**: Some salts of cupferron. Details of the properties of 21 metallic compounds of cupferron.—O. **Gaubert**: The modification of the facies of crystals as the result of their syncrystallisation with a foreign material dissolved in the mother liquor.—Albert Michel **Levy**: The birth of biotite in the crushed granites and rhyolites of Morvan.—E. **Tabesse**: Magnetic measurements in Normandy and Brittany.—H. **Hérissey** and J. **Cheymol**: The extraction and properties of geïne, a glucoside giving rise to eugenol, contained in *Geum urbanum*. This glucoside was extracted from the fresh underground parts of herb-bennet, in the proportion of about 0·1 per cent. On hydrolysis, it gives eugenol, *d*-glucose and *l*-arabinose in equimolecular proportions.—M. **Bridel** and C. **Charaux**: The process of blackening of Orobanche in the course of drying.—L. **Blaringhem**: New observations on Xenia in wheat.—Ad. Davy de **Virville**: The biological relations between a liver-wort (*Lophocolea bibentata*) and various Muscineæ.—N. **Kleitmann** and H. **Piéron**: The velocity of establishment of the light sensation and the magnitude of the undulation of pre-equilibrium for monochromatic stimulations of variable intensity.—E. **Fauré-Fremiet**: The quiescent state and active state in the amibocytes of Arenicola.—C. **Hosselet**: The œnocytes of *Culex annulatus* and their chondriome in the course of secretion.—C. **Levaditi** and A. **Girard**: The mode of action of bismuth in syphilis. A quantitative method has been developed capable of detecting 0·001 milligram of bismuth, and this has been applied to the estimation of bismuth in various organs of the rabbit after treatment with trepol (alkaline tartro-bismuthate). Infinitesimal traces of bismuth (0·002 mgm.) are sufficient to destroy the parasite.

Official Publications Received.

Department of the Interior: Bureau of Education. Bulletin, 1924, No. 10: Statistics of Teachers Colleges and Normal Schools, 1921–22. Prepared under the Direction of Frank M. Phillips. Pp. 76. 10 cents. Bulletin, 1924, No. 22: Technique of Procedure in Collegiate Registration. By Prof. George T. Avery. Pp. 26. 5 cents. Bulletin, 1924, No. 24: Organization and Administration of the Duplicate School in Philadelphia, Pa. By Edwin Y. Montanye. Pp. 16. 5 cents. Bulletin, 1924, No. 25: A Platoon School in Kansas City, Missouri. By G. W. Diemer. Pp. iii+25. 5 cents. (Washington: Government Printing Office.)

United States Department of Agriculture: Department Bulletin No. 1313: Fumigation against Grain Weevils with various Volatile Organic Compounds. By Ira E. Neifert, F. C. Cook, R. C. Roark, W. H. Tonkin, E. A. Back and R. T. Cotton. Pp. 40. (Washington: Government Printing Office.) 10 cents.

Contributions from the Princeton University Observatory, No. 7. Photometric Researches: The Eclipsing Variables, TV Cassiopeiæ, TW Cassiopeiæ, TX Cassiopeiæ, T Leonis minoris, SS Camelopardalis. By Richard John McDiarmid. Pp. 64. (Princeton, N.J.)

Bulletin of the National Research Council. Vol. 8, Part 2, No. 44: The Continental Shelf off the Coast of California. By Andrew C. Lawson. Pp. 23. 25 cents. Vol. 8, Part 4, No. 46: The Geological Implications of the Doctrine of Isostasy. By Andrew C. Lawson. Pp. 22. 40 cents. (Washington: National Academy of Sciences.)

Cornell University Agricultural Experiment Station. Memoir 68: The Lepidoptera of New York and neighboring States. Primitive Forms, Microlepidoptera, Pyraloids, Bombyces. By William T. M. Forbes. Pp. 729. (Ithaca, N.Y.)

Library of Congress. Report of the Librarian of Congress for the Fiscal Year ending June 30, 1924. Pp. vi+290. (Washington: Government Printing Office.) 60 cents.

International Geodetic and Geophysical Union (Union Géodésique et Géophysique Internationale): Section of Terrestrial Magnetism and Electricity. Bulletin No. 4: Terrestrial Magnetism and Electricity at the Madrid Meeting, October 1924; General Report. By Louis A. Bauer. Pp. 10. (Baltimore, Md.: Johns Hopkins Press.) 25 cents.

Department of the Interior, Canada. Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 3, No. 1: The Absolute Magnitudes and Parallaxes of 1105 Stars. By R. K. Young and W. E. Harper. Pp. 143+4 plates. (Ottawa: F. A. Acland.)

Journal and Proceedings of the Royal Society of Western Australia. Vol. 10, 1923–1924. Pp. xxvii+129+11 plates. (Perth.)

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 275: Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Md., in 1921 and 1922. By Daniel L. Hazard. Pp. 96+5 plates. (Washington: Government Printing Office.) 10 cents.

Legislative Assembly: New South Wales. Report of the Director-General of Public Health, New South Wales, for the year 1923. Pp. v+157+19 graphs. (Sydney: Alfred James Kent.) 7*s*. 3*d*.

Ministry of Finance, Egypt: Coastguards and Fisheries Service. Report on the Fisheries of Egypt for the year 1923. By G. W. Paget. Pp. v+43. (Cairo: Government Publications Office.) 5 P.T.

Instituts Scientifiques de Buitenzorg "'s Lands Plantentuin." Treubia: Recueil de travaux zoologiques, hydrobiologiques et océanographiques. Rédigé par Dr. W. M. Docters van Leeuwen, Dr. K. W. Dammerman et Dr. H. C. Delsman. Vol. 5: Supplément, Septembre 1924. Pp. 142+5 Tafeln. (Batavia: Landsdrukkerij).

Department of Agriculture, Ceylon. Bulletin No. 70: Guide to the Central Experiment Station, Peradeniya. By T. H. Holland and H. A. Deutrom. Pp. 112+6 plans. Bulletin No. 71: Entomogenous Fungi and their Use in Controlling Insect Pests. By. T. Petch. Pp. 40+2 plates. (Colombo.) 40 cents each.

Union of South Africa: Department of Agriculture. Science Bulletin No. 34: Kemp Fibres in the Merino Sheep. By Prof. J. E. Duerden and Miss M. Ritchie. Pp. ii+18. (Cape Town: *Cape Times*, Ltd.) 3*d*.

South Australia: Department of Mines. Mining Review for the Half-year ended June 30th, 1924. (No. 40.) Pp. 66+5 plates. (Adelaide: R. E. E. Rogers.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 53: The Effect of Irrigation upon Soil Temperatures. By Dr. E. McKenzie Taylor. Pp. 18+7 plates. Bulletin No. 51: A Statistical Note on the Cotton Variety Tests at Sakha, 1916–1920. By Trevor Trought. Pp. 16. (Cairo: Government Publications Office.) 5 P.T. each.

Torquay Natural History Society. Transactions and Proceedings for the Year 1923–24. Edited by the Rev. James A. Balleine and H. L. Earl. Vol. 4, Part 2. Pp. 101-198. (Torquay.)

The Carnegie United Kingdom Trust. Eleventh Annual Report (for the Year ending 31st December 1924) submitted by the Executive Committee to the Trustees on Friday, 27th February 1925. Pp. ii+89. (East Port, Dunfermline.)

Smoke Abatement League of Great Britain. Report of the Smoke Abatement Conference held at the Town Hall, Manchester, November 4th, 5th and 6th, 1924. Pp. xi+308. (Manchester: Hon. Secretary, 33 Blackfriars Street.) 5*s*. 6*d*.

Diary of Societies.

SATURDAY, MARCH 21.

BRITISH MYCOLOGICAL SOCIETY (in Botany Department, University College), at 11 A.M.—Miss E. Green: The Development of Zygorhynchus.—W. F. Hanna: Sex in the Genus Coprinus.—J. Ramsbottom: Fragmenta Mycologica III.—Dr. M. C. Rayner: Sectoring in Cultures of *Phoma radicis-Callunæ*.—Miss A. Lorrain Smith: (I.) Notes on Myxobacteriaceæ; (II.) Templeton's Drawings of Fungi and Lichens.

PHYSIOLOGICAL SOCIETY (Annual General Meeting) (at University College), at 3.—E. H. J. Schuster: Adjustable Pump for Artificial Respiration or Perfusion.—A. C. Downing: (*a*) Magnet Systems for Sensitive Galvanometers; (*b*) Some Recent Muscle Thermopiles; (*c*) A Sensitive Compton Electrometer.—N. Kubo and Prof. A. V. Hill: The Effect of Length on the Heat-production of Muscle.—Phyllis M. Kerridge: Modified Glass Electrodes.—J. Wyman: The Viscous-elastic Properties of Tortoise's Muscle.—W. Shaw: The Relation of the Corpus Luteum to the Pre-menstrual Changes of the Endometrium.—J. R. Pereira: The Patellometer: Measurement of the Threshold Stimulus and Recording of the Knee-jerk.—D. T. Harris: Action of Light on the Affinity of Hæmoglobin for Oxygen.—W. K. Slater: A Micro-respiration Apparatus.—H. A. Ellis: A Rapid Colorimetric Method of Measuring the C_H of Blood.—Dr. C. Da Fano: Modification of the Hewer Method for Staining in Bulk with Hæmatoxylin and Eosin.—H. I. Coombs and T. S. Hele: The

Effect of Phenols on the Sulphur Metabolism of the Dog.—Prof. J. S. Macdonald: Rectal Temperatures observed in Cycling Experiments.—W. Smith and L. B. Winter: Insulin and Micro-organisms.—L. N. Katz and C. N. H. Long: A Comparison of the Lactic Acid Content of Heart and Skeletal Muscle after Stimulation and in Rigor Mortis.—Prof. T. H. Milroy: Carbohydrate and Phosphate Metabolism in Muscles during Hyperglycæmia.—J. Hoet: The Action of Atropine on the Gut.—F. Aveling, R. J. S. McDowall, and H. Wells: The Physiology of the so-called "Psychogalvanic Reflex."—A. St. G. Huggett and Prof. J. Mellanby: The Action of Adrenalin, Ergotamine, and Curare on Muscle Tonus and Decerebrate Rigidity.—Dr. G. V. Anrep: Observations on Pulmonary Circulation.—H. N. Segall: The Isometric Contraction and Relaxation of the Frog's Heart.—Dr. G. V. Anrep and H. N. Segall: The Bainbridge Reflex.—H. E. Kinnersley, R. A. Peters, and J. T. Squires: Animal Quinoidine.—G. S. Adair: The Equilibrium of Oxygen and Hæmoglobin.

BRITISH PSYCHOLOGICAL SOCIETY (at Bedford College, Regent's Park), at 3.—R. H. Thouless: The Physics of the Psychogalvanic Reflex Phenomenon.—Rev. R. C. McCarthy: The "Determining Tendency" and Conation.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: The Counting of the Atoms (IV.).

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch: Junior Section) (at Manchester College of Technology), at 7.—H. Stead: Plate Moulding and the Patternmaker.

HULL ASSOCIATION OF ENGINEERS (at Hull Technical College), at 7.15.—Elce: Steam Turbines.

IPSWICH AND DISTRICT NATURAL HISTORY SOCIETY (at Ipswich).—Dr. H. M. Cade: The Germ Theory of Disease (Pathogenic Bacteria).

MONDAY, MARCH 23.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Dr. A. Balfour: Reflections on Malaria.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—W. J. Bryan: Man and the Divine Image.

ROYAL SOCIETY OF MEDICINE, at 5.30.—Dr. W. Hunter, Dr. R. Hutchinson, and others: Special Discussion (continued from February 16) on Non-specific Disturbances of Health due to Vitamin Deficiency.

INSTITUTE OF CHEMISTRY (Leeds Section) (at Leeds University), at 7.—R. B. Pilcher: Alchemists and Chemists in Art and Literature.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—R. Grierson and others: Discussion on Panel Heating.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Mining Institute, Newcastle-on-Tyne), at 7.15.—Col. T. F. Purves: The Post Office and Automatic Telephones.

ROYAL SCOTTISH SOCIETY OF ARTS (at 117 George Street, Edinburgh), at 8.—Prof. W. Peddie: The Construction of Solid Materials.

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—G. J. Harborow: A Dental Cyst in Connexion with a Deciduous Tooth.—A. Livingston: The Permeability of Enamel.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—F. G. Binney: Across North-East Land.

MEDICAL SOCIETY OF LONDON, at 8.30.—L. B. Rawling, Sir William Willcox, and others: Discussion on Oxaluria.

TUESDAY, MARCH 24.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. J. A. Ryle: The Study of Gastric Function in Health and Disease (Goulstonian Lectures) (III.).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. A. S. Eddington: The Internal Constitution of the Stars (I.).

INSTITUTION OF CIVIL ENGINEERS, at 6.—P. W. Robson: The Large Water-tube Boiler.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at University College, Nottingham), at 6.45.—Major E. I. David: Electricity in Mines.

INSTITUTION OF AUTOMOBILE ENGINEERS (Informal Meeting) (at 83 Pall Mall), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—H. W. Clothier: The Design of Electrical Plant, Control Gear, and Connexions for Protection against Shock, Fire, and Faults.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. F. Young: Perspective.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates' Meeting) (at Broadgate Café, Coventry), at 7.15.—C. Walker: Automobile Steels and Irons.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—Discussion on Internal Combustion Turbines, Prof. W. J. Goudie, and The Manufacture of Brass Condenser Tubes, with some Notes on an Alternative Alloy, G. H. Whiteman and A. Spittle.

ROYAL SOCIETY OF MEDICINE (Surgery, Medicine, and Pathology Sections), at 8.—Sir Thomas Horder (Medicine), R. P. Rowlands (Surgery), and others: The Treatment of Septicæmia.

ROYAL ANTHROPOLOGICAL INSTITUTE (at 52 Upper Bedford Place, W.C.1), at 8.15.—Sir Aurel Stein: Innermost Asia: its Geography as a Factor in History.

WEDNESDAY, MARCH 25.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—C. Barrington Brown and R. A. Baldry: The Clay Pebble-Bed of Ancon (Ecuador).—J. I. Platt: The Pre-Cambrian Volcanic Rocks of the Malvern Inlier.

INSTITUTION OF CIVIL ENGINEERS (jointly with Institution of Mechanical Engineers, Institution of Electrical Engineers, Institution of Naval Architects, Institute of Marine Engineers, North-East Coast Institution of Engineers and Shipbuilders, Institution of Engineers and Shipbuilders in Scotland, Institute of Chemistry of Great Britain and Ireland, Institution of Gas Engineers, British Electrical and Allied Manufacturers' Association, British Engineers' Association), at 6.—W. H. Patchell: A Standard Code for Tabulating the Results of a Steam-Generating Plant Trial.

INSTITUTION OF AUTOMOBILE ENGINEERS (North of England Centre) (at 244 Deansgate, Manchester), at 6.30.—A. F. Burstall: Experiments on a High-speed Gas Engine.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Newcastle and Middlesbrough Graduate Sections) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—Calderwood: The Possible Influence of Recent Research on Propeller Design.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College), at 7.30.—F. H. Walker: The Sampling of Coal.

ROYAL MICROSCOPICAL SOCIETY (Industrial Applications Section), at 7.30.—Dr. J. A. Murray: The Making of Microscopical Preparations: (II.) Imbedding and Section-cutting.—Prof. P. Groom: The Microscopical Investigation of Fungal Attacks on Wood.—A. P. H. Trevelli and R. P. Loveland: The Application of Microscopy to the Photographic Industry.

ROYAL SOCIETY OF ARTS, at 8.—H. G. Dowling: Wall-papers.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Royal Society of Medicine), at 8.—Dr. J. A. Hadfield, Dr. J. Glover, and A. F. Shand: Discussion on The Conception of Sexuality.

THURSDAY, MARCH 26.

ROYAL SOCIETY, at 4.30.—Prof. O. W. Richardson and T. Tanaka: Regularities in the Secondary Spectrum of Hydrogen.—Prof. S. Chapman: The Lunar Diurnal Magnetic Variation at Greenwich and other Observatories.—H. T. Flint: A General Vector Analysis with Applications to Electrodynamical Theory.—Miss M. O. Saltmarsh: The Spectra of Doubly- and Trebly-Ionised Phosphorus (P III and P IV).—*To be read in title only*:—Dr. D. M. Wrinch and Dr. J. W. Nicholson: Laplace's Equation and the Inversion of Surfaces of Revolution.—Prof. T. R. Merton and J. G. Pilley: Experiments relating to the Spectrum of Nitrogen.—Prof. T. H. Havelock: Studies in Wave Resistance: the Effect of Parallel Middle Body.—T. Tanaka: Wave-lengths of Additional Lines in the Many-lined Spectrum of Hydrogen.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. H. Cameron: Some Forms of Vomiting in Infancy (Lumleian Lectures) (I.).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—T. Thorne Baker: Chemical and Physical Effects of Light (I.).

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Dr. Eckener: Modern Zeppelin Airships.

INSTITUTE OF CHEMISTRY (Belfast Section) (at Queen's University, Belfast), at 7.30.—Dr. W. H. Gibson: The Union of Chemical Societies.

INSTITUTION OF AUTOMOBILE ENGINEERS (Luton Graduates' Meeting) (at Luton), at 7.30.—Gibson: Maximum Performance and Balance of a Four-cylinder Engine.

FRIDAY, MARCH 27.

ROYAL SANITARY INSTITUTE (at Town Hall, Leicester), at 3.30.—Dr. Helen Dent, Mrs. C. J. Bond, and others: Discussion on Maternity and Child Welfare Work.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimen illustrating the Commoner Congenital Malformations of the Lower Limb.

ROYAL SANITARY INSTITUTE (at Town Hall, Leicester), at 5.30.—Discussion on Smoke Abatement.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—Annual Meeting.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section) (at 36 George Street, Manchester), at 7.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—Discussion on The Cutting of Heavy Steel Sections.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. Felton: The Thames (Lecture).

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. P. Morris: Irrigation Engineering in Burma.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Literary and Philosophical Society, Newcastle-upon-Tyne), at 7.30.—Eng. Lieut. Comdr. L. J. Le Mesurier: Conversion of the s.s. *Bintang*.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—S. Stansfield: Investigations of Stresses in the Rotating Parts of Steam and Internal Combustion Engines.

ROYAL SANITARY INSTITUTE (at Town Hall, Leicester), at 8.—Prof. H. R. Kenwood: Healthy Living—Facts and Fads (Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Ernest Rutherford: Studies of Atomic Nuclei.

SATURDAY, MARCH 28.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. J. H. Ashworth: The Nervous System and Some Reactions (I.): Of Ciliate Protozoa and Sea Anemones.

PUBLIC LECTURES.

SATURDAY, MARCH 21.

UNIVERSITY COLLEGE, at 3.—Dr. F. M. Feldman: Post-Natal Child Physiology and Hygiene (Chadwick Lecture).

HORNIMAN MUSEUM (Forest Hill), at 3.30.—S. Hazzledine Warren: Who were the First Men?

WEDNESDAY, MARCH 25.

UNIVERSITY COLLEGE, at 5.30.—Prof. T. B. Wood: The Nutrition of the Young Animal (III.).

THURSDAY, MARCH 26.

SOUTH PLACE INSTITUTE (South Place, Moorgate, E.C.), at 7.—Sir Arthur Keith: The Religion of a Darwinist (Moncure Conway Memorial Lecture).

SATURDAY, MARCH 28.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: Living Animals of the Sea Shore.