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AN "ENERGETIC" VIEW OF EXISTENCE.

Vorlesungen über Naturphilosophie. By Wilhelm Ostwald. Pp. 457. (Veit and Co., 1902.)

LEIBNITZ once remarked that if we could imagine a human brain so magnified, without disturbing the relations of its parts, that we could move about in it as "in a mill," and could learn and understand all the mechanism of brain-atoms, we should see merely atoms in motion and should learn nothing of the thoughts which correspond with these motions. Du Bois-Reymond, in an address on the limits of our knowledge of nature, expresses a similar thought. Imagining that we could acquire knowledge of the processes occurring in the brain similar to that which we possess of the heavenly bodies, he says:—"As regards the actual mental processes, it is evident that even with such an astronomical knowledge of the organ of thought (Seeles-organ) they would elude our comprehension, just as they do now. In possession of such knowledge, we should still stand before them as before something completely intangible. An astronomical knowledge of the brain, the highest we can ever attain to, reveals to us nothing but matter in motion. By no conceivable arrangement or motion of material particles can a bridge be constructed which will lead us into the region of consciousness."

"I know of no more convincing proof of the philosophic value of the application of the doctrine of energy to our method of viewing the external world," continues Ostwald, after quoting the above paragraphs, "than that in the light of that doctrine, this ancient problem loses all its terror. For the difficulties are owing to the fact that Leibnitz and Du Bois-Reymond, following Descartes, make the assumption that the physical world is constituted entirely of matter in motion. In such a world there is no place for thought. We, who regard energy as the ultimate reality, perceive nothing of such impossibilities. We have seen that the effects of nerve-conduction can be referred without contradictory ideas to energetic precursors; and we have seen, too, that nerve-processes involving consciousness are continuously connected with those in which consciousness plays no part. I have tried my best to find anything absurd or unthinkable in the assumption that certain kinds of energy involve consciousness; but I have been unable to discover anything of the kind. We shall shortly be convinced, by an investigation of the most important phenomena of consciousness, that they are conditioned by transfer of energy; and it is no more difficult for me to think that one of the conditions of kinetic energy is motion than that the energy of the central nervous system must be accompanied by consciousness."

This quotation will give the reader a glimpse into the nature of the material considered by Prof. Ostwald in these lectures. In the present review I do not intend to offer critical remarks, but merely to present to the readers of NATURE a sketch of the system of philosophy which appears to Ostwald to be the outcome of the present position of our knowledge of physical phenomena. It would be ungracious, however, not to congratulate the author on the great interest which his book awakens, and on the exceedingly clear and lucid style in which he presents his ideas, in spite of the somewhat involved constructions which the nature of the language in which it is written necessitates. In his preface Prof. Ostwald, after asking the indulgence of his readers for many imperfections and omissions, expresses the hope that in the new journal, the *Annals of the Philosophy of Nature*, the false may be corrected, the imperfect completed, and the ideas of doubtful interpretation discussed.

The earlier portions of the work deal with a critique of the older philosophical methods which attempted to forecast and explain phenomena by thinking; Ostwald sets out with the aim of controlling and regulating thought by constantly keeping phenomena in view. Yet in order to convey our thoughts to others we must make use of words and conform to certain laws of thought. In fact, we employ our intellectual apparatus to fathom the depths and investigate the working of precisely that intellectual apparatus, a problem similar to the one solved by Baron Münchausen when he extricated himself from the bog into which he had sunk by pulling himself out by his own pigtail. The ordinary methods of science, however, are here applicable; we can examine various assumptions and accept that which appears best to fulfil its purpose. We can never attain certainty, or a knowledge of the absolute, in philosophy, nor can we, indeed, in any natural science; but we may arrive at conclusions which possess a high degree of probability. And in philosophy, as in science, we must be content with a gradual approach to truth, rejecting, in many cases, conceptions found to be at variance with experience. Philosophy, like science, is empirical; but as it progresses, the region of empiricism is narrowed, although it will never ultimately disappear.

The signification of certain terms is next expounded; experience, memory, comparison, conception, thing, object; and the nature of language and the danger of mistaking words for things. A plea is here entered for the adoption of an artificial language to be used only for science and business, avoiding ambiguities and attaching definite meanings to all its words. Some words of such a language have already been adopted, as, for example, meter and gram; our musical notation and our system of ciphering are universal, and to devise a universal language would be a distinct gain for the human race. A short account of the principal parts of speech and of the changes in meaning of words concludes the chapter. The part played by our senses in receiving impressions from without is next considered, and here the particular views adopted by the author first become prominent. In every affection of the senses a *transfer of energy* has occurred. It is in receiving impressions through the tactile sense that this is most obvious, and here, too, we are impressed by the existence of a *will*. The question whether the "external world" is not to be regarded as a mere phase of consciousness or as reality is solved thus: "We have not to ask, Is there an external world? but, What phenomena must we class under the name *external world?*" "Those which are independent of my will" is the answer; or again, "Those in which my organs of sense take part."

The formation of conceptions (Begriffe) requires five operations—receiving an impression, distinguishing it from others, connecting it with others, comparing it with others and, finally, reaching a conclusion. A

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"thing" is an experience (erlebniss), generally external to ourselves, which we regard as separable or distinguishable from other experiences. But "things" are related to each other, and a collection of things forms a "manifold" or multiplicity (Mannigfaltigkeit). Ostwald illustrates the meaning of a "manifold" by the analogy of the contents of a boy's pocket; the articles have no other relation to each other than that they happen to be there. The laws of the manifolds of our experiences are represented by time and space. Time is characterised by continuity and by its being a "simple manifold," that is, from one point of time to another, there is only one path; and this implies that in time there are no points of intersection, there is only an earlier and a later, and these cannot be interchanged. Space, on the contrary, is a complex manifold, inasmuch as there is an infinite number of ways from any one point to any other, and it is "isotropic," or free from direction.

Manifolds (or collections of things in some way related) can be divided in an affinity of ways; their parts can be placed in order, and, in fact, all real manifolds must be ordered. A consideration of such order brings into operation our faculty of comparison. An instance is to be found in "ordinal" numbers, which form a manifold limited on one side, but unlimited on the other, uniform and ordered. The cardinal numbers, on the other hand, define merely the extent of a manifold, without reference to distinguishing between individuals. But ordinal numbers may be made unlimited in both directions by use of a negative sign.

The conception of magnitude next claims attention. The conceptions of identity and equality, and the impossibility of reaching certainty as regards the latter, the conditions of equality in time, the notion of continuity, and the law of interpolation lead up to the consideration of two kinds of magnitude—those which may be termed intensities or "strengths" (Stärken), and those for which the English word "capacity" or "quantity" appears the best translation (Grössen). While capacities may be subdivided into similar portions, these portions may be recombined in any proportion to reproduce a capacity of equal kind. On the other hand, intensities cannot be divided into similar portions, for each portion retains the characteristic property due to its position in the original intensity, even after subdivision. Capacities can be measured by use of cardinal numbers; thus, five litres of water remain five litres, whether they be contained in one or in a hundred vessels, whereas intensities require ordinal numbers to denote them, the first second of time is not the same as the tenth second, although it is equal to it; it is impossible to substitute the one for the other.

The restrictions of human thought by the conditions of time and space depend on the fact that while it is impossible to predict certainly what will be the consequence of any events, it is nevertheless possible to predicate what consequences are necessarily excluded. And no events in the external world are possible unless they happen in time and space. Given these conditions, however, there is an infinite possibility of events occurring. Kant's contention that space and time are "forms of thought" is considered by Ostwald to be due to our having inherited countless experiences in which these conditions of thought regarding external phenomena are essential.

And now, after 146 pages of preliminaries, we come to the features of this work which give it its definite character. Relying on the fact that in all our impressions from without the repetition of a certain individual impression at different times and seasons conveys to our minds a conviction of permanence, inasmuch as the mountains and the sea, our neighbours and ourselves, preserve identity, while exhibiting continual change, Aristotle summed up the conclusions formed by innumerable generations of his predecessors in attributing to each thing an unchangeable *substance*, its changes being ascribed to *accidental* variations. Ostwald now proceeds to inquire, What is the universal *substance?* And in what way are diverse things differentiated from each other? What is the most general *accidence* or condition of modifying substance? To this question the answer is, energy; it is the most general substance (the word being used in the signification of that which underlies all external things), for it is present in time and space, and it is also the most general accidence, for it can be differentiated in time and space. The substance of physicists and chemists is termed *matter*; but a definition of matter is avoided in most treatises on chemistry and physics. It is customary, however, to use the word "mass" in the sense of "quantity of matter." The seventy or eighty different kinds of matter are called elements. Extension, form and impenetrability are ascribed to matter, and it is regarded as indestructible. Among other properties imputed to it are inertia, weight, divisibility and porosity, but, as a rule, little emphasis is laid on the question as to which of these properties is essential and which adventitious. To the old conception of matter has been added in recent years that of ether; not, according to Ostwald, because its assumption leads to a satisfactory presentation of facts, but because people have been unable to devise any better assumption. Indestructibility, or permanence, too, has been ascribed to matter, but ponderable substances are not the only ones which possess permanence; that quality, for example, may likewise be predicated of momentum. Again, a quantity of electricity is permanent, regard being paid to positive and negative signs. Energy also possesses the quality of permanence, and it has the supreme advantage that all natural phenomena can be grouped in an orderly fashion by means of the conception of energy as an entity, and it embraces, not only the conception of substance, but also that of causality. The definition chosen for energy is "work, and all that arises from, or can be converted into, work." If the amounts of energy which result when one kind is completely converted into any other kind be termed equal, then Julius Robert Mayer's law that "during any change the total amount of the energies present remain unchanged" holds. The object of the book under review is to construct a scheme of the world by the exclusive use of the concept of energy, instead of the concept of matter.

The next chapter treats of the various forms of energy in a manner which will be familiar to those who have read Ostwald's "Allgemeine Chemie." There are here some thoughts which appear to me new. For example, the question is asked, How comes it that all things which we know on this earth possess at once elastic energy as well as weight? The answer is, that it is conceivable that by a process of elimination all things which have no weight have left our universe; for the slightest impulse would send them on a road into space, never to return. A similar suggestion is put forward to account for the coexistence and the proportionality of mass and weight, and matter is defined in terms of energy as a portion of space in which a number of kinds of energy coexist. In reply to the question, Why do they coexist? it is answered that if they did not coexist we should be without knowledge of that portion of space; they *may be* there singly, but if so they elude our senses or methods of detection.

Ostwald claims for this method of regarding Nature that it is free from hypothesis; that each conception necessary for it has a demonstrable and measurable capacity and intensity; and that nothing is stated which cannot be tested by experiment and measurement.

It is impossible, in the limits of a review like this, to follow the author in his contest with the "mechanical explanation" of natural phenomena. An idea may be gained of his method by the quotation,

"Had our researches dealt originally with heat instead of with mechanics, we might be reading books with such titles as 'Motion Regarded as a Mode of Heat'; and there is as much justification for this title as for the ordinary version."

Indeed, the phenomena of radiation begin to be regarded as rapid alternations of conversion of electric and magnetic energies into each other, and in this the pictorial or mechanical idea is almost, though not completely, abandoned and replaced by an energetic interpretation. "Explanations," in the sense of pictorial analogies, are bound in the long run to be fallacious, and only those elements actually present in the phenomena should appear in its representation. As an illustration, it may be said that, in spite of our knowing much about the relations of bodies towards one another from an electrical standpoint, we are nevertheless ignorant of the "nature of electricity." To this it is answered that when we are acquainted with all such relations we shall know as much of the "nature of electricity" as is possible.

Among the laws of energy are to be found the following:—Every equalisation of energy requires time for its accomplishment; no equalisation (Ausgleich) can ever be complete. Only such energies can maintain themselves as distinct phenomena in space which, when coupled with others, maintain a compound equilibrium in which an increase of intensity of the one form is compensated by an equivalent increase of intensity of the other. In order that anything may take place, uncompensated differences of intensity must be present; the uncompensated excess will act as if it alone were present; the weight hung from the spring will fall, unless it is completely compensated by the tension of the spring; the spring will shorten, if the weight is not heavy enough to keep it in equilibrium.

While the happening of an *occurrence* is the resultant of differences of intensity, what we term "matter" is closely connected with capacities. The reason of this is that chemically equivalent quantities or, in other words, chemical capacities are either equal to or bear some simple relation to other capacities.

In treating of causality, Ostwald accepts Schopenhauer's view that the mind is conditioned by the necessity of ascribing a cause to all occurrences, as it must regard them as existing in time and space; but as with time and space, he regards this condition as inherited. From the point of view of energy, one form of energy is to be regarded as the cause of another kind, into which it is transformed, and it is to be noted that in such a transformation energy of higher intensity is always converted into energy of lower intensity. In the case of compensated energies, as, for instance, with a coiled spring, the cause may be regarded as the small amount of energy necessary to release or discharge it, that is, the removal of the compensation of energies at one place. Another group may be referred to a state in which the velocity of change is insignificantly small; an accelerator may be introduced, thus acting as a discharging agent. Changing his point of view, Ostwald suggests that the law of causality is nothing more than another aspect of the process of forming a concept. For this implies placing together things which display agreement in properties, and this "synthesis" may result either in the invention of a name or in the statement of a law of nature; the applicability of this concept in new cases depends only on our skill in originally forming the concept. Passing to the discussion of "necessities of thought" and applying them to the laws of logic, the question is not, Are such laws inherently necessary? but, Are our concepts in general, and among them the laws of logic, fitted to represent the sum of our experiences?

The phenomena of life next come under review. Ostwald regards as the special characteristic of living organisms self-preservation, that is, the preservation of a "stationary" form of existence; the organism must preserve its normal state by maintaining uncompensated differences of intensity by continuous expenditure of energy, and it does this by making use by its own act of previously stored supplies of energy. Reproduction is regarded as a special case of self-preservation. The stores of energy, thus utilised, are mainly chemical, and it is incidentally remarked how much more easily chemical energy can be stored than any other form. The rate of change is regulated by three methods—first, by control of temperature; second, by introducing reagents only where they are required; and third, by the use of "catalysers," that is, of substances which have the power of accelerating or of retarding chemical change. Inasmuch as time is not a factor in chemical energy, the retarding or accelerating action of catalysers requires no "explanation." It is perfectly natural to suppose that the presence of foreign bodies may exert influence as regards the rate of the conversion of chemical energy; on the other hand, if the atomic hypothesis be accepted, it is by no means evident why the motion of the atoms should suffer change by the introduction of a substance which, as it remains unchanged during the conversion of chemical energy, brings no "force" to bear capable of accelerating or retarding the supposed atomic motion.

In the chapter on the "Purpose and Means of Life" the Darwinian theory is alluded to, and the word "fitness" (Zweckmässigkeit) is defined, with regard to life, as that which increases its duration. And "fitness" consists in the organism being provided with means for spreading, by multiplication, over a wide area, and in its possessing a large store of energy. These conditions are fully discussed in a most suggestive manner. Passing on to the nerves and their functions, it is noticed that the transfer of energy through a nerve is not dependent on the nature of the stimulus which is applied; thus a mechanical, electrical or chemical stimulus, that is, the expenditure of any one of these varieties of energy, is equally effective in causing a flow of energy through a nerve. Ostwald therefore throws out the suggestion that a special form of energy must be associated with all nerve-processes, which he terms "nerve-energy." He regards it as probable that the passage of energy in a nerve is due to the presence of catalysers, which are brought into action by the nerve-energy; these are partly destroyed by their action, so that the nerve fails to respond after it has undergone excess of stimulation. But with rest the catalysers are replaced in even greater amount than originally, and the nerve gains power by use. Organisms, in general, store energy in a chemical form, and their chief function is the conversion of this chemical energy into other forms. As a means of effecting this change they employ catalysers in order to accelerate useful changes and to retard those which are baneful. Closely connected with this idea is memory, which, according to E. Hering, may be defined as that property of living substance by means of which processes which take place in them leave effects which are favourable to the repetition of such processes. Without insisting on the justice of his suggestions, Ostwald adduces a number of chemical processes in which repetition renders the chemical change easier and more rapid.

Passing next to the consideration of the life of the soul or intellect (das geistige Leben), Ostwald takes the view that in all intellectual processes another kind of energy takes part, which he terms "spiritual" (geistige) energy. He is disposed to regard this as identical with nerve-energy, and consciousness is a property of this form of energy when its seat is the brain. Again he illustrates by an analogy; extension in space is a sign of mechanical energy and duration in time of energy of motion. Indeed, he surmises that as the processes of consciousness are themselves associated with a special kind of energy, our views of external nature are therefore legitimately energetic. One is reminded, however, of Dr. Johnson's dictum, "Who drives fat oxen must himself be fat"; at all events the idea is an ingenious one. Consciousness need not always, however, be associated with the occurrence of a process involving nerve-energy; while we have conscious impressions, conscious thoughts and conscious acts, these may also occur unconsciously. It must be admitted that some explanation is required of unconscious thought; anyhow, the author makes out a fair case for the belief.

To follow the author in his discussion of personality, of will and its freedom, of pleasure and pain, of art, of music and of goodness would occupy much space. I hope that even the very imperfect sketch which has been attempted will prove sufficient to induce students both of science and of philosophy to read for themselves this interesting work, and to examine, without prejudice, Ostwald's interpretation of the facts of Nature.

W. R.

THE CIVILISATIONS OF THE OLD AND NEW WORLDS.

The Fundamental Principles of the Old and New World Civilisations. By Zelia Nuttall. Being the second volume of the *Archaeological and Ethnological Papers of the Peabody Museum.* Pp. i+602. (Cambridge, Mass.; London: Quaritch; Leipzig: Hiersemann, 1901.)

THE interesting volume before us is, we believe, the first which any writer has devoted to a careful study of the common principles which underlie the civilisations of Egypt, Babylonia, Mexico and Europe, and as such it merits much consideration at the hands of ethnographers and anthropologists, and of students of religion in general. Much is known about European civilisation, both in its early and middle forms, and something is known of the great civilisations of Babylonia (Sumerian) and of Egypt, but Mrs. Nuttall, in bringing together the results obtained from the study of these subjects during recent years, and in putting them into line with a new group of results obtained from an examination of the Mexican inscriptions at first hand, has done a piece of good and useful work which will be appreciated by all serious students of the beliefs of primitive man. The books which have appeared in Europe and America on early symbolism and cognate subjects are many, but in most of them the writers have confounded what ought to have been kept apart, and owing to a want of groundwork of facts have been led to make nebulous theories which have earned for their authors the ridicule of the trained investigator of such subjects. There is no study more fascinating than that which results in the bringing together of the facts which are common to all great civilisations from China to Mexico, and there is probably none in which so many men have gone astray; every earnest worker knows why this has happened and deplores the publication of books and articles by faddists and others which will obscure the true light.

Mrs. Nuttall's work may be conveniently divided into three sections, which deal with the civilisations of America, Asia and Europe respectively, and these are followed by a fourth section, which treats of civilisations in general; the remainder of the book contains three appendices and an index. As was to be expected, nearly one-half of the volume is devoted to the description of American civilisation, and it is this section in which the archæologist will probably be most interested. Originally the author intended to produce a short monograph of forty-one pages, which treated of the origin of the native swastika or cross symbols, but having actually written the monograph she arrived at the conclusion that the cosmical conceptions of the ancient Mexicans were identical with those of the Zuñis. It was next clear to her that the same fundamental ideas were to be found in Yucatan, Central America and Peru, and the natural result of her investigations into them was that Mrs. Nuttall's monograph of forty pages grew into one of 284 pages, and that then she found a course of comparative studies would be necessary if the best use was to be made of her previous labours. Unfortunately, Mrs. Nuttall began to print before she realised the magnitude of the task which she had undertaken, and it was impossible, therefore, for her to avail herself of the results of the study of symbols, &c., given by the late Mr. John O'Neil in his "Night of the Gods," by Mr. Elworthy in his work on the "Evil Eye," and by Mr. Frazer in his "Golden Bough." There is, however, little cause to regret this, for by works of this kind Mrs. Nuttall would certainly, though unconsciously, have been influenced, and it is probable that she might have been tempted to modify some of her views as the result; but as it is we have her unbiased opinions placed before us, and this is what is wanted at this stage of the study of primitive beliefs and symbolism. Many years must elapse before the final work can be written on these subjects, for all the materials upon which it must be based have not yet been collected, and until this is done it is futile to attempt to deduce the "conclusion of the matter."

Starting with the discovery that the great Mexican god Tezcatlipoca was identical with Mictlantecuhtli, and that having been overthrown by Huitzilopochtli he arose and transformed himself into the constellation of Ursa Major, Mrs. Nuttall goes on to show by a series of cuts that the constellation of Ursa Major furnished the archetype of the different forms of the swastika and cross symbols. The next point to determine was at what epoch the swastika was used as a symbol, and this Mrs. Nuttall decides could not have been before Ursa Major became circumpolar, *i.e.* about B.C. 4000.

"At that period, when Draconis was the Pole-star, the circle described about it by Ursa Major was considerably closer than it is at present" (p. 21).

At a very early period, Mrs. Nuttall thinks, Polaris came to be regarded as an immutable centre of axial energy, and in process of time as the symbol of the Creator of the universe. The rotary motion of Ursa Major was next observed carefully, and eventually the different positions of the constellation became associated with the seasons, and the swastika was commonly employed as the sign for year, or for a cycle of time.

But besides the swastika another calendar sign is known, *i.e.*, that which is a representation of the night of the winter solstice, the well-known triskelion; examples of the swastika are common among the ancient Mexicans, while of the triskelion there are none. The constellations of Ursa Major and Ursa Minor each contain seven stars, and this mystical number appears in the seven tribes of the ancient Mexicans who traced their origin to seven caves situated in the north, and in the seven parts into which Cosmos was divided. The first of Cosmos, or fixed centre, was Polaris, creative, generative and ruling power of the universe; its Four Quarters were associated with the elements and were ruled by the central force, and the ideas of Above and Below, which are found in Egyptian and other ancient languages, were suggested by the rising and setting of celestial bodies.

The Mexican religion being of a character so decidedly astronomical, it follows that everything connected with the worship of the great god would partake of the same nature; pyramids and temples were just as much astronomical observatories as houses of God, and their construction was planned accordingly. The people who held the views described above believed that they were descended from star deities, and they had a legend that the goddess "Starry Skirt," having been united to "Shining Star," gave birth to a flint knife, called Tecpatl. Their other children were startled at this, and, seizing the flint knife, hurled it to the earth, when it broke into pieces at the "Seven Caves" and produced 1600 gods and goddesses. It is worthy of note in connection with this that the flint knife was called the son of Cihuacoatl, the earth-mother. As befitted a religion which was based upon the cult of the night sky, at least one-half of the ceremonies were performed during the night; the sacred fire burnt by day and by night, and was only allowed to go out once every fifty-two years. But it was rekindled at midnight precisely.

We regret that we cannot follow Mrs. Nuttall step by step through her deductions from the Mexican picture signs and her description of primitive customs and beliefs as illustrated by them, for to do so would require the space allowed for several articles; the reader must do this for himself, and we are justified in saying that he will be rewarded for his pains if he does so. The astronomical origin of nearly every habit and custom of the ancient Mexican is clearly traced, and the relative position of the sexes in the State, as well as the classification of the people for administrative purposes, are well delineated; in short, what Mrs. Nuttall has given us is a detailed history of the ancient Mexican and his civilisation. The references to inscriptions throughout the work prove that she is familiar with what is known of the meaning of Mexican picture signs, and many of her facts are based upon the results given by Mr. Alfred Maudslay, but we are glad to see that whilst Mr. Le Plongeon is quoted at times, Mrs. Nuttall does not in any way identify herself with his wild views about the Maya language.

Passing from American to Chinese civilisation, Mrs. Nuttall has collected a large number of notes and passages from which it is seen that the Chinese held views about Ursa Major, the Four Quarters of Heaven, the Above and the Below, &c., very like those which were held by the ancient Mexicans, and it is remarkable how close is the similarity between the habits and customs and religion of the two peoples in certain respects. The really interesting point in connection with such similarity is to account for its existence; at present it is impossible to do this, and we do not see that the difficulty is in any way lightened by the theory which makes the Chinese to come originally from Babylonia, which country the emigrants are said to have abandoned when Kutir-Nakhkhunte conquered Babylon, B.C. 2295. The identity of Chinese and Akkadian has not been demonstrated to the satisfaction either of Chinese or Akkadian scholars in general, although it was fashionable some few years ago to declare that the two languages were one and the same tongue; the theory was not entertained by any except Chinese scholars who knew no Akkadian, or by men who knew a little Akkadian but had no knowledge of Chinese. The remarks on the entrance of Buddhism into China in the first century of our era are to the point, and the extracts from the famous bilingual Syriac and Chinese inscription (p. 304) at Singanfu which Mrs. Nuttall quotes contain interesting confirmation of her views of the Christian cross being originally related to the swastika. The Chinese, taking this view, naturally called the Christians "Cross-worshippers." In Japan and India Mrs. Nuttall has found many parallels, and in Mesopotamia to this day the men of Saba appear to worship the Pole-star. The religious literature of ancient Babylonia and Assyria contains many passages which prove that the Semites who employed the cuneiform character held many views in common with the Mexicans; while an elaborate examination of Egyptian works has provided Mrs. Nuttall with a large number of proofs that in Mexico, China, and Egypt the views held in respect of certain astronomical phenomena were identical.

One of the most interesting sections of the book before us is that which treats of civilisations in general, and which contains Mrs. Nuttall's general summary and conclusions about the meaning of the facts which she has so diligently compiled. To detail these would greatly lengthen an article which is already inordinately long, and the reader will, no doubt, prefer to peruse these for himself; but we may briefly point out that the central idea of the work is that the swastika, which was first employed as a year sign, became later the symbol of the Four Quarters, of quadruplicate division, and of a stable central power, whose rule extended in four directions and controlled the entire Heaven. Human society was divided into four groups, and territorial organisations were formed in four parts. Early civilisations were founded on astronomical principles, on which also rested the worship of the gods. In the case of America, certain elements of culture are assumed to be due to "Mediterranean seafarers" and to transported refugees and would-be colonists; the basis, however, of both foreign and native civilisations was the recognition of immutable laws governing the universe, "attained, by both races, by long-continued observation of Polaris and the 'northern' constellations." The use of Mrs. Nuttall's volume is much facilitated by the excellent index, which fills thirty-four pages of matter printed in double columns in small type, and which merits great praise. We could have wished that a bibliography had been added and more references to the public literature of early symbolism; to say this is not to detract from the commendation which the book justly deserves, for a classified list of authorities could be compiled from Mrs. Nuttall's notes, and it would be useful to everybody interested in the subject.

GEOMETRY—NOT IN EUCLID'S ORDER.

Primer of Geometry, comprising the Subject-Matter of Euclid I.-IV., treated by the Methods of Pure Geometry. By H. W. Croome Smith, B.A. Pp. xvi + 100. (London: Macmillan and Co., Ltd., 1901.) Price 2*s*.

THIS little book is another attack on Euclid, and its main object is to exhibit an elementary course of geometry in a system of natural sequence—Euclid's order and method being, of course, ignored. Although in the preface the author adopts a severely logical style and successfully maintains a strong case against our conservative Euclidians, it seems to us that in one respect he is in error. His work is divided into three chapters, headed "Straight Lines and Rectilineal Figures," "The Circle," and "Areas." In the first chapter no mention of a circle occurs, and the author taxes Euclid with an illogical mode of procedure in the following words:—

"It is at least questionable logic to make use of the circle in the early stages, and subsequently to use the properties thus demonstrated of lines, angles, &c., in demonstrating the properties of the circle."

Justice to Euclid compels us to maintain that this charge is substantially unjust, because the only use made by him of the circle in the early stages (Book I. of Euclid) relies on the facts that the radius is a line of constant length, and (in prop. xii. of Book I.) that if a circle cuts a right line once, it will cut it again. No one can quarrel justly with these assumptions, or can seriously describe them as involving "properties" of the circle which require antecedent demonstration. When criticising Euclid, we must remember that geometry is not wholly a system of pure or formal logic—it implies the sense of sight, sensuous intuition in space.

One disadvantage of ignoring the circle wholly in the early stages, as is done by Mr. Croome Smith, is that we get into serious difficulties with regard to the conception and measurement of *angles*. He identifies an angle with "change in direction"—"this *change in direction*, which has nothing to do with the length of the line, is what we mean by *angular magnitude*" (p. 6); "the angle is *measured* by the amount of revolution of a straight line when turned about the vertex in the plane of the lines from the one to the other." True; but how are we to get a quantitative meaning of the word "revolution" itself? It is, without the aid of the conception of a divided circle, or of a system of superposition, just as vague and undefined as Euclid's own term "inclination." It appears to us that Mr. Croome Smith wrestles vainly with a definition of a right angle on p. 7. He imagines a right line OA to revolve round O into the position OB, which is OA reversed, and he says,

"in the position OC, midway between OA and OB in the course of its revolution, the turning line makes with OA or OB an angle which is half the preceding angle: such an angle therefore is also an angle of *constant* magnitude, and is called a right angle."

In this definition there is one little word—"midway"—the precise meaning of which we should wish to know. We fear that it is hopelessly vague without the notion of a circular protractor, or something more than the author is willing to give us. Hence we think that his definition of an angle and his method of measuring angular magnitude are not successful.

Nevertheless, criticism of this kind must not condemn a book which has several merits. A judicious teacher will always be able to supplement imperfect definitions. There is, perhaps, far too much straining after completeness of definition and verbal exactness in writers on geometry; for some of the most simple notions in the subject are things which cannot be defined with absolute accuracy, and the writer as well as the teacher must take it for granted that the pupil has already an adequate notion of the thing described—*e.g.*, a point, a right line, a plane surface.

Mr. Croome Smith rightly discards Euclid's limitation that we must make no use of the bisector of an angle or of a line until we have shown how to draw the bisector. Fancy anyone laying down the law for Clerk Maxwell that he must make no investigation of the electromagnetic theory of light until he has demonstrated the reality of the ether! By ignoring the restriction, Mr. Croome Smith is enabled to replace the usual proof of the Asses' Bridge proposition by one much simpler.

All the *problems* of Euclid (to bisect an angle, to draw a perpendicular to a line from a point without it, to draw a tangent to a circle, &c.) are kept by themselves in a section at the end of the book. The author's proofs leave nothing to be desired on the score of simplicity, and his little book will be of much value to any committee that may be formed by the Universities or the British Association for the purpose of providing an easy and natural course of geometry for use in our schools.

We cannot refrain from calling the author's attention to the *form* of such a statement as (p. 31): "A rhombus, and therefore a square, are equilateral." This is followed by one of similar arrangement; and in line 12 from the end of p. viii, "is implied" should be "are implied."

OUR BOOK SHELF.

The Small Farm and its Management. By James Long. Pp. xvii + 281. (London: Smith, Elder and Co., 1901.) Price 6*s*.

MR. LONG starts with the idea that it is very desirable for the purpose of maintaining a vigorous rural population that the number of small farms cultivated by their owners should be considerably increased. Nearly everyone will probably agree to this proposition. When, however, we learn the conditions needed for the success of the small farmer, and which are plainly set forth by the skilful writer of the present book, we become more and more convinced that the extent to which successful farming of this kind can be developed under present conditions is very limited.

Mr. Long tells us that for a successful twenty-acre farm, third-class land must be refused at any price; that second-class land should only be occupied by highly skilled men with sufficient capital; and that first-class land should, if possible, always be selected for such a holding. The land must, further, be situated near a railway, with easy access to a large consuming population. Such land, Mr. Long frankly tells us, will generally be found already occupied, and could not be purchased save at a high price. His ideal farm is, further, to have one-half of its area in permanent grass, and to possess an acre of orchard. It must, of course, have a dwelling house and farm buildings, with a suitable access to a road. How can all these special conditions be provided except at a prohibitory cost?

When we pass to the details of the management which is to result in a handsome profit to the owner, we discover that he is supposed to be no mere agricultural labourer, but to excel both in knowledge and judgment the average farmers of the country. His farm of twenty acres is to carry one horse, four cows, a breeding flock of ten ewes, two sows and their offspring, eighty hens and forty turkeys, and is to produce for sale twenty-four quarters of oats, twelve tons of potatoes, and the fruit from an acre of orchard. His four cows are to be chosen and managed with such judgment and skill that they will yield 3000 gallons of milk every year, a quantity far above the average. His hens are to lay twice the number of eggs usual in poultry yards. Everything on the farm is assumed to be first rate and thoroughly successful. The result of this splendid management is to be a profit of 120*l*. per annum. Years of drought, or other agricultural disasters, are apparently not supposed to occur. It will naturally be asked, if a profit of 120*l*. can be made on twenty acres, why should not an annual profit of 1200*l*. be made on a farm of 200 acres worked on the same lines? And if such is the value of the land to the occupier, at what price can it be purchased?

Whatever opinions we may form as to the possibility of creating a system of small farms, or as to the prospects of their profitable cultivation, we can form but one opinion about Mr. Long's book. It is well done, and supplies a large amount of information on a great variety of subjects which cannot fail to be of value to all who are seeking to make a profit out of a small holding.

R. W.

L'Huître Perlière, Nacre et Perles. Par L. G. Seurat. ("Encyclop. Scient. des Aide-Mémoire"). Pp. 194. (Paris: Masson et Cie.) Price 2 fr. 50 c.

THIS is a useful little book of close on 200 pages and a few illustrations, in which the author—whose name was already known in connection with pearl oysters—has brought together the leading facts in regard to the molluscs, of both sea and fresh waters, producing pearl and mother-of-pearl. The introduction shows that the book has been written mainly in the interests of the French nacre industries, which the author regards as of great national importance. Although London is at present the great market for pearl shell, we are told that "La France possède, en effet, les plus vastes bancs d'huîtres perlières et nacrières qui soient au Monde, dans ses colonies d'Océanie," and the author evidently desires to stimulate the exploitation and cultivation of the French pearl industries at Tahiti and other Pacific stations. But still, the descriptions of animals and fisheries have been drawn from all parts of the world, and, in fact, most attention is given to the oyster (*Meleagrina fucata*) of Ceylon and British India on the well-known banks of the Gulf of Manaar.

M. Seurat points out on more than one page the gaps in our knowledge of the nacre-forming molluscs, and wisely insists upon the necessity of a thorough examination of the structure, life-history and habits of the Meleagrinas before it is possible to establish a rational regulation of the fisheries. The scope of the work may be gauged by the following summary of the contents of the chapters: Anatomy and biology of the pearl oyster and of other molluscs that produce pearls or nacre; the pearls, their position, structure, chemical composition and experiments as to their production artificially; the fisheries both in the sea and also in the rivers of Europe and America; commerce and industries; and, finally, pearl-oyster cultivation. In his conclusion our author sums up that "l'ostréiculture perlière est une chose possible, qui est susceptible de donner des résultats pratiques," and draws a rosy picture of the prosperity that would attend the lagoons of Tahiti under a rational exploitation of this new industry. So may it be.

Voices of Nature and Lessons from Science. By Caroline A. Martineau. Pp. 160. (London: Sunday School Association, 1901). Price 1*s*. net.

MISS MARTINEAU describes clearly a number of simple scientific facts, mainly concerning natural history subjects. She thus assists the extension of a knowledge of nature among those who are greatly in need of it. The prominence given to Darwin's teachings—a large part of the book being taken up with the elementary principles of evolution—is a very commendable characteristic. The spiritual lessons to be learnt from natural phenomena may be "skipped" by readers who prefer to deal with ethics apart from natural science.

LETTERS TO THE EDITOR.

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

The Quadrantid Meteors, 1902.

ON the night of January 3 some fine meteors were observed here. It is doubtful, however, if any of them were directly connected with the radiant that has given this early January shower its name. Possibly the first meteor observed shortly before ten o'clock may have issued from the neighbourhood of Boötes, as it shot upwards from the direction of the Great Bear with a brilliancy sufficient to attract attention in a lighted thoroughfare, from where, however, its starting point could not be clearly ascertained. During a watch kept under more favourable conditions for observation, between 10.30 and 11.30 G.M.T., four or five shooting stars were observed, the brightest of which scarcely equalled a second magnitude star, its path extending from Gemini to the east of Ursa Major. The others were seen flashing to the east of the latter constellation with no well-defined centre of radiation. It should have been stated that in a ten minutes' watch between 10 and 10.30 a stationary meteor more brilliant than a first magnitude star appeared for about half a second midway between the Quadrantid radiant and Ursa Major. This was the only meteor seen that may perhaps be regarded as comformable to the radiant proper, though almost exclusive attention was given to that part of the sky. Though occasionally a look out was kept from 12 to 1 a.m., no shooting stars were seen, but in an unbroken watch from 1.15 to 1.45 a.m. a brilliant bolide was observed at 1.40 gliding down evidently from the neighbourhood of Gemini towards the Great Bear, and throwing off several fragments near the end of its path. It was the brightest meteor seen during the night. The night of the 3rd was very fine here, though a few clouds interfered somewhat with observation between 10 and 10.30.

Similar atmospheric conditions obtained in the first half of the night of the 4th, and an early watch for Quadrantids was maintained between 10 o'clock and midnight. Six or seven meteors were observed during this period. The first seen at 10 p.m. shot down through Orion at a great rate from some point considerably higher up, the exact whereabouts of which could not be known, as the meteor was only accidentally glimpsed. It must have been of a magnitude equal to Sirius. Another meteor (second magnitude) passed from a little below Gemini to Ursa Major at 10.45, and yet another from the same radiant centre to Leo at 11.45, the latter being of more than first magnitude brightness. This upper radiant must have been at the least fairly active, as the above meteors were only accidentally seen, persistent observation being maintained towards Boötes, which, however, as yet met with scant success, only a few meteors having been noticed, all below the second magnitude with the exception of one in the form of a brilliant flash, which shot straight from the direction of Boötes, but made its first appearance considerably to the east of that constellation, its course being parallel to the horizon. No definite centre of divergence could be assigned to the rest.

During a subsequent watch held between 12.45 and 1.15 there seemed to be a period of meteoric quiescence, but when the outlook was resumed at 1.30 a distinct change had evidently taken place in the interval. Bright meteors were shooting steadily from the last two stars in the tail of Ursa Major. The radiant seemed very accurately defined there at a point midway between the stars in question and very slightly to the east. From 1.30 to 1.45 five meteors issued from this centre ranging between the second and third magnitudes. During the same time also three second magnitude shooting stars came down towards Ursa Major, evidently from the upper radiant, whose activity had drawn attention to it earlier in the night, and which was now in active cooperation with the radiant centre lower down. Further observations, however, could not be obtained as regards the progress of the display, as light clouds at 1.45 a.m. began to obscure the sky, obliterating all but the brightest stars, which continued to shine dimly for a while, during which an occasional flash of a meteor was seen ; but eventually the heavens became a starless blank, and the watch had to be abandoned. Whether, therefore, the radiant proper of this shower developed any symptoms of activity as the night wore on and the time of the expected maximum drew near could not be ascertained here. In view, however, of the sudden appearance of the radiant in the tail stars of Ursa Major, this may not have been improbable, the more especially as there are reasons for believing that the maximum of the shower may have occurred one or two hours later than that fixed at 3.30.

It may be observed that the multiple character of the radiant of the meteors of January 2 was particularly noticeable in 1872 (British Association Report, "Luminous Meteors," 1872), when radiant centres roughly corresponding with those on the present occasion furnished more than 50 per cent. of the meteoric shower observed in that year. JOHN R. HENRY.

Dublin.

Sir Walter Raleigh and Evolution.

I HAVE recently come across a passage in Sir Walter Raleigh's "History of the World" which seems to me sufficiently remarkable for the author to deserve a notable place among those early naturalists who anticipated in some measure the modern views on evolution. In the historical sketch at the beginning of the "Origin of Species" Darwin quotes Buffon, who was born a century and a half later than Raleigh, as "the first author who in modern times has treated the subject in a scientific spirit" ; but although, scientifically, Raleigh cannot be compared with Buffon, the fact of his having penned at such an early date the words I am about to quote possesses some interest. The passage I refer to is to be found in the 1621 edition (part i., book i., chap vii., § 9, p. 94). Speaking of the days of the Flood, he says : "But it is manifest, and undoubtedly true, that many of the *Species*, which now seeme differing, and of severall kindes, were not then *in rerum natura.* For those Beasts which are of mixt natures, eyther they were not in that age, or else it was not needfull to preserve them, seeing they might be generated againe by others : as the Mules, the *Hyæna's*, and the like ; the one begotten by Asses and Mares, the other by Foxes and Wolves. And whereas by discovering of strange Lands, wherein there are found divers Beasts and Birds differing in colour or stature from those of these Northerne parts ; it may be supposed by a superficiall consideration, that all those which weare red and pyed Skinnes, or Feathers, are differing from those that are lesse painted, and were plaine russet or blacke ; they are much mistaken that so thinke. And for my owne opinion, I find no difference, but onely in magnitude, betweene the Cat of *Europe*, and the Ownce of *India* ; and even those Dogges which are become wilde in *Hispagniola*, with which the *Spaniards* used to devoure the naked *Indians*, are now changed to Wolves, and begin to destroy the breed of their Cattell, and doe also oftentimes teare asunder their owne Children. The common Crow and Rooke of *India* is full of red feathers in the drown'd and low Islands of *Caribana* ; and the Black-bird and Thrush hath his feathers mixt with blacke and carnation, in the North parts of *Virginia.* The Dog-fish of *England* is the Sharke of the South Ocean : For if colour or magnitude made a difference of *Species*, then were the *Negro's*, which wee call the Blacke Mores, *non animalia rationalia*, not Men, but some kind of strange Beasts : and so the Giants of the South *America* should be of another kind, than the people of this part of the World. We also see it dayly, that the natures of Fruits are changed by transplantation, some to better, some to worse, especially with the change of Clymate. Crabs may be made good Fruit by often grafting, and the best Melons will change in a yeere or two to common Cowcummers, by being set in a barren Soyle." AGNES ROBERTSON.

The Old Hall, Newnham College, Cambridge, January 13.

The Teaching of Mathematics.

PROBABLY every experienced teacher of mathematics qualified by a sufficiently thorough acquaintance with the relations of his subject to the physical sciences and practices will have some sympathy with the document which appeared under this heading in your last issue (p. 258). I do not desire to discuss the changes it suggests, I merely wish to describe as a contrast to that or any other rational scheme the work that year by year the public purse pays some of us to attempt. Protests against South Kensington teaching and the South Kensington scheme of work are frequent, but I do not remember seeing any detailed criticism of any part of the course. Here is the work that I and hundreds more teach yearly in what is known as the second stage of mathematics.

In geometry; the second, third and fourth books of Euclid. In algebra; quadratic equations, or indeed any equation, surd or rational, for one or two unknown quantities, except such as ultimately demand the solution of a non-factorial cubic or biquadratic; the simplification of surd quantities and expressions and problems in ratio and proportion.

Trigonometry has to be taught from the beginning through the equations of identity between functions of the ratios and the values of the ratios of the simple angles to the logarithmic solution of oblique triangles, with proofs of the requisite formulæ. A sufficient knowledge of logarithms is demanded from the student to prove the ordinary logarithmic laws—no reference is made in the entire syllabus to the theory of indices—and to prove the numerical laws of characteristic and mantissa belonging to the decimal system of logarithms. He must also be able to adapt and use—for any possible logarithmic computation—a few seven-figure logarithms given at the end of his examination paper, and obtain by means of proportional differences a result corrected to six significant figures.

All this work is to be taught between September and May to pupils who, throughout the country, are generally accorded two hours a week for the subject, and who, as evening students otherwise employed through the day, are seldom able to give much time to study.

In some parts of the course—for instance, the equations set for solution—a pedant's ingenuity is used to find novelty and—for the beginner—difficulty. In other parts—as, for example, the surds and logarithms—the monotony of treatment year by year is one of the mainstays of the examination-teacher.

I have not exhausted the possible complaints against the course. Its first four stages are almost equally bad throughout, though the second is certainly the worst. But I have, I hope, said enough to convince any experienced teacher of the subject under other conditions of the urgent need we feel for changes.

I wish to guard myself against one possible personal imputation. I am not complaining because I have failed; I have been, I believe, at least averagely successful in obtaining the examination-product that South Kensington demands, and I have, I hope, also taught some mathematics. But I protest that my efforts towards the one end should be so severely handicapped by the necessity of attaining the other.

Plymouth Technical School. C. J. FORTH.

Birds Capturing Butterflies in Flight.

MR. MCKAY's letter in NATURE of January 16 (p. 247) is of interest in pointing out that some butterflies are normally exposed in flight to danger from certain birds. Nevertheless, I believe this to be exceptional so far as this country is concerned. At the present moment I have in my possession a specimen of the day-flying moth *Orgyia antiqua*, which my friend Mr. D. F. Taylor saw seized when on the wing by a house-martin, which relinquished its hold in consequence of a luckily aimed stick from my informant. The left fore-wing shows plainly the mark of the bird's beak, which, however, did not tear the wing, but merely left a triangular area denuded of scales. So far as I am aware, house-martins do not, as a rule, feed on Lepidoptera, and this instance is probably to be regarded as a mistake on the part of the bird. It is possible that other isolated examples of similar mistakes may have been noticed, but their bearing on the general question of the coloration and markings of butterflies must be very slight. OSWALD H. LATTER.

Charterhouse, Godalming, January 17.

An Unusual Rainbow.

ON June 16 last I was at Lucerne, and at about 4 p.m. there was a remarkably brilliant rainbow over the lake. It was, however, unlike any previous rainbow ever seen by me, inasmuch as in addition to the ordinary bow of seven colours there was a second band of orange colour and a second band of purple, added to the other seven colours on the underside, but distinctly part of the same unbroken and continuous band of colour; in other words, it was a bright broad rainbow composed of nine instead of seven bands of colour. I have, since my return, met with no person able to explain this phenomenon. I was quite alone at the time. The rainbow lasted several minutes. It has been suggested to me that possibly some scientific reader of your paper could explain this very unusual appearance; or, at any rate, some other traveller at Lucerne on the day referred to may be able to confirm my description of what appeared to me so very unusual that I should almost have hesitated to accept any other person's description of it. THOMAS FULLER.

Bristol, January 17.

Change of Pitch of Sound with Distance.

IN Mr. West's letter in NATURE of December 12, 1901, he suggests that a lowering of pitch with distance may have been noticed, although his experience has been the reverse. My grandfather, the late Mr. Henry Knaüff, who, during his lifetime, was an organist and organ builder in Philadelphia, mentioned having noticed this lowering of pitch on several occasions. In long churches, with the organ over the front doorway, he claimed that the voice of the celebrant at the altar sounded distinctly flat to a listener at the organ, but on advancing to the altar this flatness disappeared. I have never noticed this myself, but I have not his ear for small differences of pitch.

PAUL R. HEYL.

Boys' High School, Reading, Penna., U.S.A.

TO THE MOUNTAINS OF THE MOON.[1]

MR. J. E. S. MOORE has undoubtedly written an interesting and original book on the lake region of Central Africa, a book which in many respects deserves to rank with that remarkable pamphlet (it was little more in volume) by the late Prof. Drummond on Nyasaland (miscalled in this instance "Central" Africa). Prof. Drummond's journeys up and down the Zambezi-Shire and the length of Lake Nyasa, with a climb on to the Nyasa-Tanganyika plateau superadded, were wholly unremarkable as a work of exploration, but Drummond contrived to see and put into pithy sentences what a legion of African explorers had seen but never expressed before. Drummond's little book should long remain a classic, and many of his expressions are quoted by the more modern African travellers with force, but without acknowledgment. Mr. Moore avows his indebtedness to Drummond on more than one occasion, but his own work is quite as original in its way, though perhaps dashed with a spitefulness which was absent from Drummond's writings. Mr. Moore's book is a true account of what he has seen, but a partial one, that is to say, he has told no untruth, but he has left untold at least a third of the whole account. In order to be original, in order to counteract the rather wearisome optimism of most works of African travel written during the last ten years, he has been careful to insist on all the faults which a white man may legitimately find with the climate, soil and insalubrity of Central Africa. He deliberately ignores much that might be permanently attractive to the European settler, much that is profitable to European commerce, and much of the good that has been done by European pioneers, whether Government officials, missionaries or traders. It is a pity in some respects that Mr. Moore's work is not complete, that he should have striven so much after originality as to refrain from writing a perfectly balanced book conveying an impartial verdict. It is, perhaps, best and fairest to regard Mr. Moore's work as a "two-thirds" book, a description giving two-thirds of the whole truth and leaving the reader to supply the missing third from the many other publications describing East-Central Africa between the White Nile and the Zambezi which have appeared since 1890. There is no doubt that Mr. Moore is eminently readable; he is so interesting that his occasional descents into sheer flippancy and his carelessness in the spelling of names may easily be forgiven, except, perhaps, by those whose names are incorrectly spelt! By a curious fatality there is scarcely a single European surname or a native place-name of any importance in the whole book which is not incorrectly spelt.

1 "To the Mountains of the Moon." By J. E. S. Moore. Pp. xvi+350 (London: Hurst and Blackett, Ltd., 1901.)

The illustrations supplied to the work consist of photographs and drawings, the latter singularly vivid if occasionally crude. Mr. Moore succeeds almost better than any other African traveller whom we know, able to use pen and brush, in giving an idea of the wonderful cloud effects to be seen in these African skies. We have stigmatised his black and white drawings as crude—as such they must appear to the ordinary European—yet in extenuation of their hard light and shade must be quoted the undeniable fact that there is something about the African atmosphere which gives these violent effects. A vivid (and the reviewer is able to say a truthful) picture is that facing p. 76—"Storm-clouds, Mountains and Bananas on the East Coast of Tanganyika."

Rift Valley occurred through the uprising of the Mfumbiro volcanoes, is probably correct. It is certainly original. The lacustrine fauna of Kivu is apparently similar to that of Albert Edward, and quite distinct from the remarkable marine fauna of Tanganyika.

With regard to Mr. Moore's attempted ascent of the Ruwenzori range, furnished with guides by Mr. Bagge, the Government official at Fort Portal (a place which Mr. Moore persists in calling Fort Jerry), he attacked the mountain by the Mubuko Valley. According to his own account he probably reached a total altitude of 14,900 feet. Sir Harry Johnston, who ascended the mountain some months later, tells us that he, following the same route, could get no higher than 14,800 feet. Subsequently

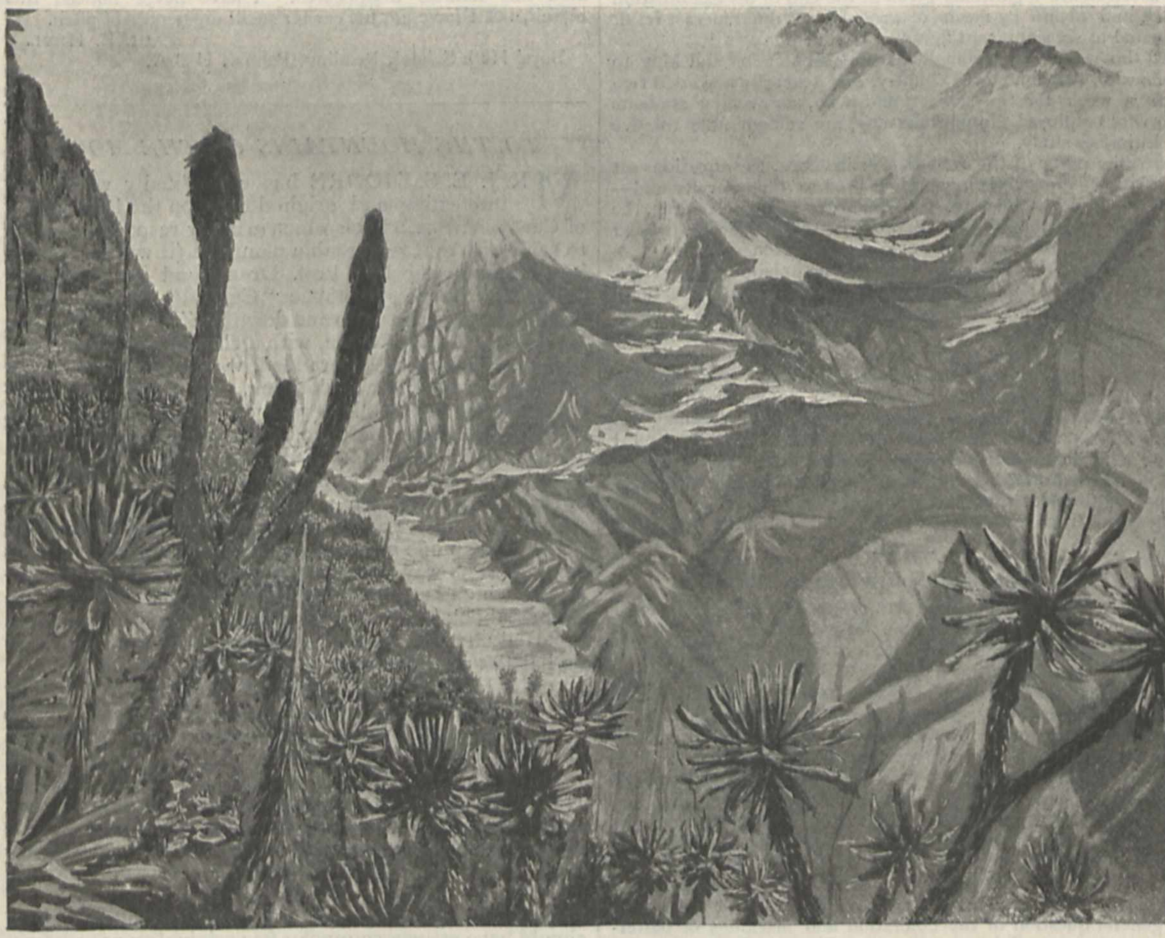

FIG. 1.—View of the small glacier between the Northern Snow Ridge of Ingomwimbi and Kanyangogwi from the former, at a height of 13,600 feet.

As regards the scientific results of Mr. Moore's expedition—the point of view from which most readers of NATURE will be interested or uninterested in the book—we are able to say very little, because Mr. Moore is reserving his reports on his biological studies for another volume. The chief matters of interest to scientific students of Africa in the work under review consist of the ascent of the still active volcano of Kirunga cha gungu and a plucky attempt to ascend one of the summits of the Ruwenzori range. Interesting observations were also made on and around Lake Kivu; and Mr. Moore's opinion that this lake was probably once connected with Albert Edward and the Nile system rather than with Tanganyika and the Congo, but that the severance between Kivu and the Nile in the Albertine

Mr. Wylde, of the Uganda Administration, also reached a point which he describes as under 15,000 feet in altitude. As Mr. Moore's and Mr. Wylde's observations were only taken by aneroid whereas Sir Harry Johnston's was by boiling-point thermometer, it is probable that all three explorers reached the same spot in total altitude, all being stopped there by the same obstacles of rocky precipices. Mr. Moore believes that the spot he reached was on the actual ridge of Ruwenzori, from which, theoretically, one might look down on the Semliki Valley or on Eastern Toro. Now from Sir Harry Johnston's observations, as given in his lecture of November 11 last, and his paper recently published in the Geographical Society's magazine, it is clear that this altitude of just under 15,000 feet is nowhere near, is perhaps a couple of thousand feet below, the top of the ridge which connects all the Ruwenzori snow-peaks. Assuming this ridge to be at something like 17,000 feet in altitude, the high peaks of Ruwenzori would again rise two or three thousand feet higher, and thus the supreme altitude of 20,000 feet of the highest point of Ruwenzori which has been predicted by Major Gibbons, Sir Harry Johnston, Mr. Wylde and others is more likely to be nearer the ultimate truth than Mr. Moore's assertion that the greatest height of Ruwenzori is probably not more than 17,000 feet in total altitude.

Mr. Moore makes some very interesting remarks on the causes which probably led to the formation of the park-like scenery so characteristic of tropical Africa. On recently formed alluvial flats those strange and hideous fleshy euphorbias commence to grow on what is, to begin with, a shadeless, sandy wilderness, where all seedlings which might form forest trees are burnt up and withered by the scorching sun. The euphorbia, however, resists the sun's rays, being distinctly a plant of the desert. As its candelabra branches increase in numbers and spread out to the right and left they create shade, while the fallen branches decay and form vegetable soil. Under this protection and by this nourishment seedlings of palms and forest trees survive and flourish. When they have got a good hold on the soil the original euphorbia is long since dead or hidden, and the park-like clumps of handsome trees have become a permanent feature over what was once a wind-swept, sun-scorched, barren plain.

We strongly recommend Mr. Moore's book to the attention of all who are interested in tropical Africa. His pessimistic description, however, of the future prospects for European trade with these countries can be easily corrected by a glance at the statistics issued by the African Protectorates. Countries the trade of which has risen in a few years from an annual value of 30,000*l.* to a quarter of a million, while their local revenue has grown from nothing a year to 50,000*l.* or 60,000*l.*, cannot be such hopeless investments for European commerce and enterprise as Mr. Moore would have us believe.

Mr. Moore was accompanied on his journey by a surveyor, Mr. Malcolm Ferguson, whose surveys are certainly one of the valuable results of the expedition. If Mr. Ferguson is to be regarded as more accurate than his predecessors his work will result in the shifting of the northern end of Lake Tanganyika nearly half a degree further to the west, while he will also have supplied us with the first approximately correct delineation of Lake Albert Edward.

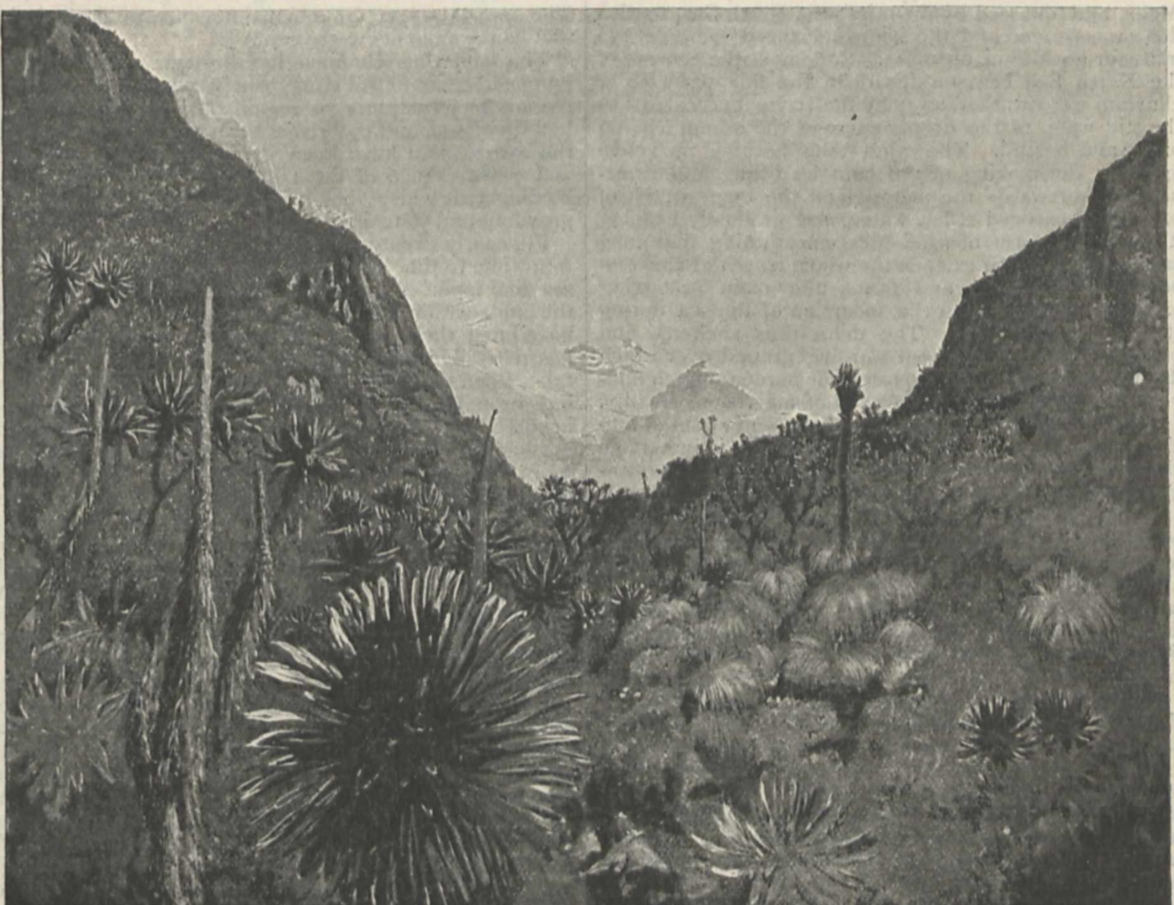

FIG. 2.—The Northern Snow Ridge of Ingomwimbi from a point about 12,500 feet.

THE RECLAMATION OF THE ZUIDERZEE.

IN a recent consular report from the Netherlands, issued by the Foreign Office, reference is made to a Bill which was introduced in the Second Chamber of the States General, for the purpose of obtaining authority to carry out the works required for the first portion of a scheme for reclaiming 800 square miles of land from the Zuiderzee, and for raising the necessary funds, estimated at eight million pounds, the cost of the entire scheme being put at 15¾ millions. A translation of the Bill and explanatory memorandum of the Minister of the Waterstaat are also given.

This scheme for adding land to the seven provinces of the United Netherlands is only a continuation of those bloodless conquests which Holland has been carrying on for the last twenty centuries, by which, little by little, the cultivated area of the country has been enlarged without annexation, or encroachment on neighbouring countries.

Holland affords the most remarkable example of the operations of Nature in that process of destruction and reconstruction of the earth on which we live that is always in process. The land is almost entirely composed of the off scourings of Swiss, German and French territory washed off the land by the rain, transported several hundred miles by the rivers Rhine, Scheldt and Maas, and dumped by them into the North Sea, until a delta was formed and the shore advanced seaward 130 miles for a width of 60 miles. So long as the storms of the North Sea beat on this delta the fine particles of alluvium were washed away by the waves and carried to the still water of the deeper parts of the ocean, leaving only sand behind. The wind then became an active agent in the making of the land by lifting and transporting shorewards the material off the long stretch of bare sands exposed at low water, and gradually heaping it up in the form of sand hills, constituting that long line of dunes which extends the whole length of the seaboard for 230 miles and forms the main protecting barrier of the land from the incursion of the sea during storms and high tides. The delta thus sheltered and protected became one vast warping ground over which the rivers continued to deposit their burden of rich alluvium, gradually building up a soil of marvellous fertility.

Through the surface thus raised the water poured into the delta found its way to sea through innumerable channels which finally concentrated in three main openings through the dunes. The surface thus became an amphibious country, half land and half water, divided by numerous channels into islands. At the time when historical records begin some of these islands had risen above the level of the tides, and the country consisted of large alluvial plains the greater part below mean sea level, large meres or lakes from 15 to 20 feet deep, and deep winding channels, the whole bordered by the higher plains on the south and east composed of sand and drift.

At this epoch man stepped in to gather the fruits of that which the contending forces of rain and rivers, storms and tempest, wind and tides had produced.

The Roman records afford some outline of the condition of Holland at this time, from which it is known that early in the Christian era the higher diluvial lands, dunes and heaths were occupied by the Batavians, who gained a precarious living by hunting, fishing, and pasturing cattle in summer on the alluvial islands.

Whether the first embanking and reclamation was done by the Batavians or by the Romans is uncertain, but records exist showing that the latter, recognising the value of these rich lands for corn growing, commenced a system of reclamation by making more direct channels for the flood waters, and embanking the lands.

This system of reclaiming the land of the delta has gone on persistently ever since. At first only the higher lands were embanked, but as population increased the aid of science was invoked, and mechanical agency was applied to the raising of the water from the shallower meres and lakes, the motive power being the wind. For four and a half centuries the fens and morasses, lakes and old river beds which had been converted into cultivated land were kept dry by the aid of innumerable windmills studded all over the country, some of the deeper polders requiring three engines, at different levels, to raise and discharge the water. About sixty years ago steam power was added to that of the wind, being first used for the drainage of Lake Harlem, by which 45,000 acres of rich land were recovered and a new province of 10,000 inhabitants added to the country. What was once a lake from 15 to 20 feet deep is now the great market garden of Amsterdam. "And so by the skill and genius of man there was thus driven from the bosom of the country a most dangerous enemy, and a province was conquered without tears and without bloodshed, the engineer taking the place of the general and the navvy that of the soldier."

Such is the physical history of the provinces of Holland known as the United Netherlands, which has a population of nearly five millions and covers an area of 12,738 square miles, of which about two-thirds consist of reclaimed lands, intersected by a system of main drains and navigable canals extending to a length of 2050 miles. The annual budget for the maintenance of these drains and banks amounts to 500,000*l*.

The land thus obtained has, however, only been held by one long-continued struggle between man and Nature; the ocean attempting to regain the land over which it had dominion, and the rivers striving to break through the barriers that have been imposed on them, the skill and perseverance of the Dutchmen being exercised in holding that which they had gained by the most careful guarding and watching.

For nearly twenty centuries the fight has been going on, from time to time the land being attacked both from the sea and land. At different periods the rivers, resenting the limits within which their waters have been restrained, have burst their bounds and flooded the country. This has generally happened after the breaking up of some great frost, when the water, flowing down in enormous volumes, has brought with it broken ice-drifts which, blocking in some bend or other obstruction, have stopped the progress of the flood. When this occurs the water finds relief by running over the top of the banks or breaking through them, covering thousands of acres and inundating villages and homesteads. Thus in the fifteenth century the Rhine burst its banks and flooded 100,000 acres and seventy villages. In another great flood nearly the whole of Holland was inundated and 400,000 lives were lost, the country being so depopulated owing to this vast loss of life that the damage done could not be made good, or the prosperity of the country restored, for many years.

Even more disastrous than the land floods have been the breaches made in the sand-hills and sea-dykes by abnormal high tides, due to gales lasting over several days, driving the water upon the shore. It was owing to one of these great storms, at the latter end of the thirteenth century, which lasted for several days, that the water of the North Sea was raised to an unprecedented height and driven by the north-west gale on the sandbanks which protected the north coast, breaking through these in several places and inundating an enormous tract of country lying behind. By this breach the province of Friesland was separated from that of North Holland, and the water, uniting with Lake Flevo, formed the Zuiderzee, a vast inland salt-water sea 80 miles long and in places 30 miles wide. Remains of the original coast-line exist in the islands of Texel, Vlieland, Tor Schelling and Ameland. In the Zee the higher parts of the inundated land are now marked by the islands of Wieringen, Schakland, Marken and Urk, the latter of which is so little above the level of the sea that the greater part of it is covered with water whenever extraordinarily high tides occur, the houses and church standing on mounds slightly elevated above the rest of the island. Numerous villages, with their churches and homesteads, which once contained a numerous population, now lie buried beneath the waters of the Zuiderzee, and it is stated that 80,000 of the inhabitants lost their lives.

For more than six centuries the area then drowned has remained an inland sea, on which a numerous fishing population gains its living, the plough and the waggon having given place to the net and the boat.

The reclamation of Lake Harlem having demonstrated the great advantages to be gained by such works, several schemes were subsequently brought forward for reclaiming the Zuiderzee and regaining what was thus stolen by the sea, the most extensive of these plans proposing the joining together of the islands which were left standing, and filling the gaps between them by embankments.

At last, in 1894, a Commission of twenty-seven members was appointed by the Government to make a thorough investigation of the subject, the commissioners being selected for their special capabilities for determining as to the practicability of the reclamation from an engineering point of view, and as to the cost; as to the adaptability of the land for agricultural purposes, and its value when reclaimed; as to the proper way of dealing with the interests of the fishermen who would be displaced; and generally the advantages that would occur to the State. This Commission reported in 1892, and recently a Bill was brought before the Dutch States General for carrying into effect the recommendations of the commissioners. Owing to a change in the Ministry the Bill lapsed before it had passed through the necessary stages, but there is no doubt that it will be revived in due course by the new Ministry.

The idea of entirely reclaiming the whole of the Zuiderzee by uniting the islands has been abandoned as commercially impracticable, and a modified scheme adopted for only enclosing the inner portion by an embankment 18 miles in length, extending from the North Holland coast near the island of Wieringen to the Friesland coast near Piaam. The top of this embankment will require to be 18 feet above mean high water, and it is proposed to construct in it two locks and six outfall sluices, giving a total waterway of 984 feet for the discharge of the water from the River Ysell. One of the locks is to be of sufficient size for sea-going craft, which will thus be able to get to Amsterdam through the locks at Schellingwoude and to other parts of Holland along the various canals that now have communication with the Zuiderzee. On the top will run a road and railway. The estimated cost of this bank is 3,000,000*l.* When the bank is completed it is proposed to reclaim two large areas of land on the west side which are now covered by water, containing together 131,450 acres, of which 115,000 acres will be available for cultivation, the remainder being occupied by roads, drainage canals and banks. For the drainage of these reclaimed polders eight steam pumps will be required, of an aggregate capacity of 4330 horse-power.

Subsequently it is intended to reclaim two further tracts containing 365,288 acres, but this reclamation was not included in the Bill now under consideration. When this is done there will remain a large area of water, practically the site of Lake Flevo, covering 560 square miles. It is considered that the depth of the water in this lake is too great for profitable reclamation. The cost of enclosing the two tracts of land and providing the necessary pumping machinery is estimated at 2,962,500*l.* For the interests of the fishery 375,000*l.* is allocated; for military defences, 666,000*l.*; for deepening the approaches to the harbours and other works in the interests of the navigation, 717,000*l.*, making, with the cost of the bank, a total estimated cost of 7,720,500*l.* The enclosure of the eastern polders, containing 365,288 acres of cultivatable land, is estimated at 7,862,500*l.*, making a grand total of 15,583,000*l.*

The enclosing dyke is reckoned to occupy nine years; the reclamation of the western polders would be completed at the end of fourteen years, and it would take thirty-three years before the whole reclamation could be completed.

It is proposed that the cost of the works, amounting to 7,720,500*l.*, shall be repaid by annual instalments spread over sixty years, requiring an annual charge of 166,667*l.* The renting value of the reclaimed land is estimated at 230,000*l.* a year, showing an annual financial gain of 63,333*l.*

It is considered that, even if no financial gain should ensue, the scheme is one that will be of eminent advantage in the increase in the general prosperity:—by creating a better condition of the Waterstaat over a considerable portion of the country, and in effecting a large saving in the cost at present incurred in pumping; and in the maintenance of the sea banks, the length of which will be reduced from 198 to 25 miles; by the establishment of direct communication by road and railway along the new bank between North Holland and Friesland, which will shorten the distance between Leuwarden and Amsterdam 35 miles; and, above all, by the economic advantages that will be derived from the cultivation of a very extensive tract of land, and the employment that will be given to a very large population.

W. H. WHEELER.

SMALL-POX IN LONDON.

THE statistical committee of the Metropolitan Asylums Board has recently presented an interesting report upon the cases of small-pox which have been treated by the Board during the year 1901. This report enables us to trace the growth of the present epidemic, and, so far as it goes, dealing with 1017 cases of small-pox, teaches us some very useful lessons upon a subject at the present time of the most profound interest, viz., the efficacy of vaccination as a protective measure.

It appears that in the early part of last year, in fact up to August, London was unusually free from small-pox, only slightly more than a dozen cases having occurred. From August 22 and on, however, the disease appeared to have obtained a strong hold in the parishes of St. Marylebone and St. Pancras. Subsequently cases occurred in every one of the thirty-one poor-law parishes and unions comprising the Metropolitan Asylum District. The average weekly admissions were as follows:—In August, 35·5, September, 37·75; October, 39·75; November, 113·6; December 1 to 28, 164·5; December 28 to January 4, 242·0.

With regard to gross mortality, this is given at 24·28 per cent. It must, however, be borne in mind that in arriving at this figure many cases of recent admissions have been included because they have already been completed by death, whereas the contemporary cases, which will probably nearly all recover ultimately, cannot be included until completed by discharge. The result is that the rate of mortality above must be admitted to be undoubtedly higher than it will be when all the cases have been completed and the final rate ascertained.

For the purpose of estimating the effect of vaccination upon the cases which have died or recovered during the year, these were divided into three classes: (1) cases with visible cicatrices, (2) doubtful cases, (3) unvaccinated cases. The total mortality rate per cent. of vaccinated cases was 14·21; of doubtful cases 65·08; of unvaccinated cases 50·52. It strikes one at first as odd that the mortality of the doubtful cases was ten per cent. higher than that of the admittedly unvaccinated. By definition it, however, appears that the doubtful cases most probably consisted of practically unvaccinated cases, and were very few in number. Perhaps one of the most marked features in these statistics is the protection from small-pox afforded by successful infantile vaccination. Under ten years of age only twelve vaccinated cases are recorded and no death. Infantile vaccination, further, seemed greatly to diminish the rate of mortality from the disease even up to forty, although there was a very rapid falling off of its power in this direction after twenty years of age.

With regard to the value of and necessity for re-vaccination, the experience of the committee confirms that of a similar committee which reported upon the small-pox epidemic of 1870-72. "No greater argument to prove the efficacy of this precaution," says this report, "can be adduced than the fact that out of upwards of 14,000 cases received into the hospitals only four well-authenticated ones were treated, in which revaccination had been properly performed, and these were slight attacks."

NOTES.

THE work of preparing Bushy House for the National Physical Laboratory is now approaching completion, and, His Royal Highness the Prince of Wales has fixed Wednesday, March 19, for the opening ceremony. The object of the Laboratory is to encourage the applications of physical science to manufactures and industry. This it will do by undertaking researches into questions of importance to either, and by testing apparatus and material used in trade.

PROF. J. W. GREGORY, F.R.S., has been temporarily appointed head of the Geological Survey of Victoria, with a view to its complete reorganisation and the substitution of a staff engaged on a permanent basis instead of the present temporary plan. The Victorian Government is paying for extra assistance in the geological department of the University while Prof. Gregory is engaged upon this work.

AN expedition to Lake Eyre, the great depression in Central Australia sinking below sea-level, has recently left Melbourne. The party consists of Prof. J. W. Gregory, his assistant, Mr. H. J. Grayson, and five students of the geological department of the Melbourne University. The main objects of the expedition are the study of the physical history of the Lake Eyre basin and the collection of fossils, especially the extinct giant vertebrates. The camel caravan starts from Hergott Springs, a station 440 miles north of Adelaide. It is hoped that the collections will throw light on some unexplained native traditions as to former giant animals that inhabited the Lake Eyre basin.

THE annual congress of the Sanitary Institute will be held in Manchester on September 9-13, when Earl Egerton of Tatton will preside. Section I. (Sanitary Science and Preventive Medicine) will be presided over by Sir J. Crichton Browne, F.R.S.; Section II. (Engineering and Architecture) by Sir Alexander Binnie; and Section III. (Physics, Chemistry and Biology) by Prof. A. Sheridan Delpéine. Eight technical conferences will also be held in connection with the congress.

IN the House of Commons on Monday, in reply to Mr. Field, who asked a question in regard to the proposed erection of a suitable College of Science in Dublin, Mr. Austen Chamberlain said:—"Thirteen thousand pounds was voted in 1899-1900 and applied towards the purchase of part of the site for a new college. I hope shortly to introduce a Bill for the acquisition of the rest of the site, for the provision of funds for the new building, and other purposes. I have satisfied myself by personal inspection of the existing college that that building is quite inadequate to the work which it is intended to perform."

THE American Society of Naturalists held a successful meeting at Chicago at the commencement of this month. There was a discussion on the relation of the Society to other scientific societies, an address by the president, Prof. Sedgwick, on the modern subjection of science and education to propaganda, dealing largely with attempts to prevent the experimental study of physiology, a lecture by Dr. Howard on international work with beneficial insects, and 244 papers on scientific subjects. The society will meet next winter at Washington, in conjunction with the American Association for the Advancement of Science. A committee was appointed to confer with a similar committee to be appointed by the naturalists of the central and western States in regard to the relations of the two societies. At the meeting to be held next year the president will be Prof. J. McKeen Cattell, and the vice-presidents Messrs. C. D. Wolcott, L. O. Howard and D. P. Penhallow.

WE learn from *Science* that Mr. Andrew Carnegie's gift of ten million dollars for scientific research has been transferred to a corporation to be known as "The Carnegie Institution." The original incorporators include Dr. D. C. Gilman, lately president of Johns Hopkins University, the Hon. Chas. D. Walcott, Director of the U.S. Geological Survey, Dr. John S. Billings, and the Hon. Edward D. White. The objects of the Institution, in addition to the promotion of research, are set forth as follows:—To acquire, hold and convey real estate and other property necessary for the purpose of the Institution and to establish general and specific funds. To conduct, endow and assist investigation in any department of scientific literature or art, and to this end to cooperate with Governments, universities, colleges, technical schools, learned societies and individuals. To appoint committees of experts to direct special lines of research. To publish and distribute documents, to conduct lectures and to hold meetings. To acquire and maintain a library and, in general, to do and perform all things necessary to promote the objects of the Institution.

ON January 17 Lord Rayleigh opened this season's Friday evening meetings at the Royal Institution with a discourse on the interference of sound. In the course of his remarks he described some of his recent experiments with fog-horns, made for Trinity House. Fog-horns with elliptic cones instead of circular ones were tried, the major axis being about four times longer than the minor one. The experiments showed that the sound was best spread in a horizontal direction when the long axis was exactly vertical. It appears to be doubtful whether the phenomenon of the silent area is really due to interference between waves of sound reaching the spot direct and those reflected from the sea. If the effect were merely due to interference in this way, it ought to be possible to recover the sound by the listener changing his altitude above the sea surface, but Lord Rayleigh has on several occasions tried this on board the *Irene* and has not recovered the sound. When two or more fog-horns are used at one station, it sometimes happens that owing to the different sound waves being out of phase they more or less neutralise one another at certain distances, so that one source of sound is sometimes better than several. At the close of Lord Rayleigh's discourse, the Duke of Northumberland, as president of the Institution, unveiled a bust of Sir Frederick Bramwell, formerly honorary secretary of the Institution, and formally presented it to the members on behalf of the managers and their friends as a token of esteem.

THE death is announced of Prof. H. von Ziemssen, professor of pathology and therapeutics in the University of Munich.

COMMISSARY-GENERAL G. D. LARDNER, whose death at the age of eighty-four we regret to see announced, was the eldest son of the renowned Dr. Dionysius Lardner, and, like his father, he did much to encourage the study of astronomy, though his writings and lessons did not reach so large a public. He was a Fellow of the Royal Astronomical Society, and devoted his leisure hours to scientific pursuits and to inspiring interest in natural knowledge in others. The death of such a man is a real loss to science.

ANNOUNCEMENT has already been made of the death, on December 24, 1901, of Mr. Clarence King, who for a short time was Director of the Geological Survey of the United States. His most important work was in connection with the geological exploration of the fortieth parallel, of which the main portion, published during the years 1876 and 1877, comprised various reports and the geological and topographical atlas of the Rocky Mountains, the Green River and Utah Basins, and the Nevada Plateau and Basin. At this date there were two other important geological surveys in the States apart from various local surveys; thus G. M. Wheeler was directing the surveys west of the 100th meridian, and F. V. Hayden was in charge of the Survey of the Territories. The three main surveys were consolidated in 1880 as the United States Geological Survey, under the directorship of Mr. King. Coming to the work from a long and successful experience, he elaborated a comprehensive plan of operations, and vigorously prosecuted the same through the assistance of a wisely selected corps of geologists and specialists. He directed investigations on Leadville in Colorado, on the Eureka district, and on the Comstock lode in Nevada. Mr. King, however, held office for a year only, retiring in 1881, as he believed he could render more important service to science as an independent investigator. He was succeeded by Major J. W. Powell, from whose introductory remarks in the second annual report of the United States Geological Survey we gather some of the above particulars. The hope entertained by Mr. King was not fulfilled, as unquestionably his most valuable contributions to science were his official maps and reports. In later years his most important paper was that on the age of the earth, which appeared in the annual report of the Smithsonian Institution for 1893.

SOME of the scientific results obtained by members of the National Antarctic Expedition during the voyage of the *Discovery* from the Cape to New Zealand are mentioned in an article in last Saturday's *Times*. It was part of the instructions of the expedition that the *Discovery* should proceed southwards towards the point of maximum total magnetic force. The despatches received state that on November 12, 1901, in latitude 50° S., longitude 131° E., Captain Scott determined to turn southwards towards this focus, running more or less on the line of no variation. The result was a very gradual increase of total force, while there were other points of interest in the observations of the dip and variation. The *Discovery* continued to push southwards till November 16, when the first ice was sighted. The detached pieces which were first met with were soon succeeded by a loose pack of drift ice, with occasional fragments of glaciers. On November 16 a sounding was taken in 2300 fathoms, while the magnetic observations showed a dip of 86°. The furthest south point reached was 62° 50′, in longitude 139° 40′ E. The highest glacier was seen on November 17, when another sounding was made in 2300 fathoms. The *Discovery* turned north-eastwards on November 17, and on the 18th a sounding was made in 1750 fathoms. Captain Scott then made as rapidly as possible for his destination in New Zealand. On November 22 Macquarie Island was reached. A landing was effected, and the naturalists did some good work. Auckland Island was sighted on November 25, and Lyttelton was reached on November 28. As already announced, the *Discovery* has since then turned her face southwards to enter upon the real work of the expedition. In order that the expedition may be in a position to complete the work for which it has been organised, it is essential that it should be free to remain away for at least two, and if possible three, years, as is the case with the cooperating German expedition. For this end more funds are absolutely necessary (1) to supplement the equipment of the main expedition, and (2) to send out a second ship in the autumn of 1902. The second ship is indispensable if the expedition is not to return after one year's work. It is required to take out a further supply of coal and other stores, to bring away any members of the expedition who may be incapacitated, and to leave suitable substitutes, as well as to obtain information as to the further plans of the expedition. About 6000*l*. has been subscribed for this purpose, and at least 10,000*l*. more is required in order to equip and man the ship which has been obtained. The urgency of the need should inspire those who have the means to come forward with liberal offers of assistance.

A PAPER on modern machine methods, by Mr. H. F. L. Orcutt, read at the Institution of Mechanical Engineers on Friday last, contains a large amount of information in illustration of the value of perfected methods of machining. The use of accurate limit gauges instead of measuring with micrometers or calipers is strongly urged, even in small shops. There is a widely spread and erroneous idea, particularly amongst European manufacturers who would emulate American manufacturers, that the latest methods cannot be economically adopted except where work is thoroughly standardised, specialised, and made in large quantities. Mr. Orcutt thinks otherwise, and remarks that a single hole is more cheaply bored in a chucking machine than in a lathe. It is more easily made to a limit gauge than when the skill of a workman in setting his calipers has to be trusted. One spindle is more cheaply finished in the grinding machine than in the lathe, quality duly considered, and, again, is more easily finished to a limit gauge than to calipers, with the employment of less skilful labour. The idea that big quantities and standard work are necessary before modern equipment begins to play an important part in the economics of manufacturing, is described as the delusion of those who have grasped but a small part of the problem. The advantages of possessing a well-equipped laboratory and testing department are pointed out. Materials should be studied with a view to selecting that which is most suitable for the purpose, which, being most suitable, can be most rapidly machined, and which, fulfilling all conditions, is the cheapest. This cannot be accomplished with the haphazard methods commonly employed. Where the size of a shop does not warrant the expenditure necessary to support its own department, several manufacturers ought to combine and contribute to the support of a fully equipped laboratory. There is, however, Mr. Orcutt states, no practical reason why every mechanical engineering establishment in the United Kingdom should not have a testing institution at its command which could be constantly in use. The realisation of this state of affairs would be of incalculable benefit to the industries and commerce of Great Britain.

THE report of the proceedings of the fifth Congress on Criminal Anthropology has just been issued. Prof. G. A. van Hamel, the president, briefly described, in his opening speech, the scope of anthropology so far as it is concerned with criminology. Prof. Lombroso gave the Congress a comprehensive sketch of the progress of anthropological research since 1897, and read a paper on the prevention and treatment of crime. He was of opinion that the passions which inspire many serious crimes, especially those committed from political motives, were energies which might be turned to the advantage of the community if only they were classified and directed into the proper channels. Profs. Lacassagnes and Martin, adopting as their text *les sociétés ont les criminels qu'elles méritent*, contended that the only way to stamp out *recidivistes* and habitual criminals was to enact drastic laws to limit the consumption of alcohol, and to provide against the dissemination of tuberculosis and venereal disease. Dr. Garnier, of Paris, stated that juvenile crime, which was rapidly increasing, was the result of the prevalence of alcoholism. Mr. Alexander Sutherland, of Melbourne, suggested that too much importance ought not to be attached to the theory of heredity, so far as it applied to crime, and pointed out that while in 1850 the population of Australia was composed of 135,000 individuals who were either convicts, or the children of convicts, and of only 105,000 normal persons, in 1880, after the course of but one generation, the number of criminals in Australia per 10,000 of the population was much below that in Prussia, Saxony, Italy and Sweden.

IN the *Scientific American* for January 4, Mr. L. P. Gratacap gives a popular and illustrated description of the discovery and preservation of the remains of the great dinosaur, brontosaurus, which have recently been placed in the Natural History Museum, New York. It was in 1898, under the direction of Prof. Osborn, that the colossal vertebræ, ribs and pelvic bone of the dinosaur were obtained from the Jurassic limestones of Wyoming. The total length of the animal has been estimated at more than sixty feet. The bones were taken out *en bloc* in the field, retained in the enveloping matrix, and shipped to New York, where a corps of skilled workmen finally extracted them from the stony matrix in the most perfect condition.

THE accompanying illustration of the Severn Bore is reproduced from a portion of the kinematograph picture recently obtained under Dr. Vaughan Cornish's direction with a bio-

scope camera and exhibited at the Royal Geographical Society. When first projected on the screen the Severn is seen at low water; in a few seconds the bore appears round the bend of the river about 500 yards distant, and it takes rather more than one minute to arrive at the position shown in the illustration. It is only upon reaching the shoal water near the camera that the wave curls over as here shown. The dark-fronted wave then rushes out of the field of view and the remainder of the film records the rapid current which follows close upon the bore. The film is 150 feet long with 2400 pictures, about half of which are views of the bore itself. The moving picture not only enables those who have never seen a tidal bore to realise the phenomenon with a completeness impossible from the examination of stationary photographs, but it provides a means for exhibiting at will a phenomenon which in nature is never precisely repeated. By repeating the projection of the picture as often as required, the various aspects of the phenomenon can be successively studied in a manner impossible to the observer of the bore itself. How much escapes observation when watching a transitory phenomenon, and the advantage of repeated projection on a screen, may be gathered from the various accounts which different spectators give of a kinematograph picture which all have seen simultaneously, but in which the points of attraction and interest are different in the case of different individuals.

SIR CHARLES TODD, K.C.M.G., F.R.S., has recently issued his comprehensive volume of meteorological observations in South Australia, for 1898. The work is divided into three parts; sections 1 and 2 deal with the observations at Adelaide and a number of other stations, and contain a valuable discussion on the exposure of thermometers in different screens. Section 3 gives the monthly and yearly totals of rainfall at 432 stations, and comparisons of the results with the averages for previous years. The annual distribution of rainfall is also clearly shown on a tinted map.

MR. J. E. CLARK has contributed an interesting paper to *Symons's Meteorological Magazine* for this month, entitled "Day Darkness in the City." He has recorded the number of quarter hours at which artificial light was necessary between 9h. a.m. and 5h. p.m. (Saturday afternoons and Sundays excepted) at the Wool Exchange, between October and March, 1897-1901. The tables show that November, December and January are preeminently the dark months, although, on the mean, November is a good deal behind the other two. The only really bad foggy months in the four years were December 1899 and January 1901, with which may be compared the prevalent fogs of November and December last. A diagram showing the distribution of dark quarter hours during the day shows a rapid rise between 9h. and 10h. and again about noon. The author points out that these anomalies are associated with the lighting of office fires and with preparations in the restaurants; in fact, smoke plays a main part in the darkness during both high and low fogs.

IN the *Bibliotheca mathematica* (iii. 2) for December 30, 1901, Prof. Gino Loria, of Genoa, gives an account of the late Prof. Beltrami, with a fairly detailed statement of the mathematical theorems and formulæ discovered by him. The paper is illustrated by a portrait of Beltrami.

SOME observations on the variation of position of the apparent horizon relative to the true horizon on the lake of Geneva are described by Prof. F. A. Forel, of Morges, in the *Comptes rendus de la Société helvétique* for the Neuchatel meeting of 1899, recently received. The extreme relative displacements of the horizons, due to refraction, during eight months' observation varied from $-272''$ to $+501''$, the telescope being 2·5 metres above the lake. A table is given of corrections for refraction in terms of the difference of temperature at the surface of the lake and at the altitude of observation.

A SHORT paper on the observatory of the University of Durham is given by Prof. R. A. Sampson in the *Proceedings* of the Durham Philosophical Society. The observatory was built in 1840, and the chief event in its annals was the tenure of the post of observer by Richard Carrington, which, however, he resigned in 1852, after holding it for three years. From that time on the observatory seems to have had a chequered career until 1891, when the old equatorial was replaced by a new one. In 1896 a new departure was made; instead of the transit circle being renewed an almucantar was provided, and with this it is hoped to do rather better work than could be expected with a meridian instrument.

WE are glad to learn that the gliding experiments with which Lilienthal and Pilcher sought to investigate the balance and stability of machines supported by aëroplanes and aërocurves have not been discontinued since the death of these two investigators. A great deal of valuable work has already been done in America by Mr. Octave Chanute, and in conjunction with him by Mr. Herring, both of whom have attained results in advance of those previously achieved, by the use of machines provided with movable wings. Still more recently, *i.e.* from October 1900 onwards, two other workers have attacked the problem, namely, Mr. Wilbur Wright and Mr. Orville Wright, of Dayton, Ohio. Mr. Wilbur Wright adopts a two-surfaced machine and assumes a horizontal position when gliding, with the view of diminishing head resistance. He has successfully worked with a surface area of double that used by previous experimenters, and has on several occasions extricated himself from the dangerous position in which Lilienthal and other observers have found themselves when suddenly brought to rest in a high wind.

PROF. V. MONTI has forwarded us three papers dealing with the question of prevention of hailstorms, which is now exciting so much interest in Italy. One of these, published by the Italian Meteorological Office, deals generally with the distribution of hailstorms in Italy at different seasons. Prof. Monti divides Italy roughly into three different regions, the "Padan" region, including the valley of the Po and certain Alpine stations, where hailstorms commence between the end of February and May and cease about November; the "Peninsular" region, where no month is altogether exempt from hail; and the "Calabro-Sicilian" region, which is characterised by an almost complete absence of hailstorms during the summer months. A second paper deals with the question of whether hailstorms are affected by the detonations accompanying volcanic eruptions. In it Prof. Monti discusses an account of a hailstorm on Stromboli, by M. Brun, of Geneva, and other writers, and he infers that (1) the fall of hail is not prevented by volcanic detonations; (2) hail may even be formed in storms of volcanic origin, contrary to Faye's theory. In the third paper Prof. Monti discusses the effect of thunder on the production of hail, and quotes letters on the subject. He finds that two-thirds of the heavy hailstorms that have been carefully studied are accompanied with loud thunder ("tuoni forti o fortissimi"), and that the frequency of the thunder, both before and during the hail, does not prevent the formation of large hailstones. In one storm at Campofreddo, near Genoa, where the hail was large and abundant, the thunder was so violent as to break windows. The theory according to which hail is dispersed by cannonades, as the result of the atmospheric waves produced, derives no support from the observed results in connection with either volcanic explosions or thunder.

THE latest issue of the *Zeitschrift für wissenschaftliche Zoologie* (vol. lxx. part iv.) contains four papers, as usual, of a highly technical nature. The first, by Dr. E. Botezat, treats of the terminations of nerves in the taste-corpuscles. In the second, Herr P. Morgenstern describes the development of the hydroid zoophyte *Cordylophora lacustris.* Certain reproductive organs of sharks form the subject of a long article by Herr O. Huber; while Dr. E. Ballowitz treats of the gastrulation of the ovum of the common grass-snake. All the articles are illustrated by plates.

IN a pamphlet published at Frankfurt-am-Maine and bearing the title "Der Zoologische Garten des Museu Goeldi in Pará (Brasilien)," Dr. G. Hagmann, an assistant on the staff, gives an excellent and well-illustrated account of the rise and progress of the menagerie which has been formed under the direction of Dr. E. Goeldi, the able chief of the museum. It was in 1893 that Dr. Goeldi, then attached to the museum at Rio, was appointed to take charge of and reorganise the museum at Para; but, owing to the military revolution which then disorganised the greater part of Brazil, it was not till late in the following year that he was able to assume the duties of his new post. It was not long before his attention was directed to the formation of a zoological garden to illustrate the local fauna, and by 1895 this was in full working order. In the present pamphlet we have a list of the vertebrates—all natives of Brazil—which have been exhibited in the garden between July, 1895, and July, 1901. These comprise sixty-five species or races of mammals, one hundred and twenty-seven of birds, thirty-five of reptiles and amphibians, and nine of fishes. Many of the species exhibited are very rare, and much new information has been acquired in regard to the habits of several. Judging from the photographs with which the pamphlet is illustrated, the appearance of the garden must be highly attractive, and the idea of devoting it entirely to the local fauna is most excellent.

NOTICING that the tang of the head of some Eskimo arrows are provided with a screw, Herr Krause asks whether the screw is an Eskimo invention (*Globus*, lxxix. 1901, p. 8), for it would be strange if a people still in their stone age had in a mechanical contrivance progressed beyond highly cultured, superfine Romans of the Empire. Dr. Karl von den Steinen (*Globus*, lxxix. p. 125) answers this question in the negative, and points to the considerable trade there has been between the natives and numerous European sailors during the last century, and any extensive collection of Eskimo objects will also demonstrate that borrowing has taken place. Mr. H. Newell Wardle replies to Dr. von den Steinen (*Globus*, lxxx. 1901, p. 226) and points out that the Eskimo sometimes made their harpoon heads of the tooth of the narwhal, and as this has a spiral twist there is no need to seek elsewhere for a screw; he therefore thinks it will probably always remain an open question. The relation of the sickle to the saw, on the one hand, and to the dagger on the other is the subject of a learned philological and ethnographical treatise by Herr Hugo Schuchardt in *Globus* (lxxx. pp. 181 and 204).

A SECOND edition of the second volume of Prof. J. R. Green's "Manual of Botany" has been published by Messrs. J. and A. Churchill. The volume is concerned with plant classification and physiology, and several additions have been made with the view of increasing its usefulness and rendering it more readable. Prof. Green provides students with a valuable course of training in systematic botany and plant physiology.

WE have received the following botanical reprints from the United States, the first three being from the *Botanical Gazette*:—"A Study of the Sporangia and Gametophytes of *Selaginella apus* and *S. rupestris*," by Florence M. Lyon, a very careful study, illustrated by five plates; "Development of the Pollen in the Asclepiadaceæ," by T. C. Frye, from which it would appear that the connection of the pollen-grains into pollinia in this order is not associated with any speciality in the mode of development of the sporange; "Further Notes on the Physiology of Polymorphism in Green Algæ," by B. E. Livingston, relating chiefly to the effect on Algæ of cultivation in various nutrient solutions; "The Seed-coats of certain Species of the Genus Brassica," by A. J. Pieters and Vera K. Charles, being *Bulletin* No. 29 of the U.S. Department of Agriculture, Division of Botany; "The Progress made in Botany during the Nineteenth Century," by Wm. Trelease, from the *Transactions* of the Academy of Sciences of St. Louis.

THE fact that the atomic weights of some of the most important elements have not as yet been determined with a sufficient degree of precision is clearly illustrated by a new determination of the atomic weight of calcium by F. W. Hinrichsen, the results of which are published in the last number of the *Zeitschrift für physikalische Chemie*. In spite of the importance of this element and numerous investigations carried out to determine its atomic weight, the latter cannot be said to be known with certainty. The value generally accepted as being most trustworthy is the result of a determination by Erdmann and Marchand in 1850, in which they obtained Ca = 40·00.

This is the number given on the tables of atomic weight issued by the German Chemical Society. Hinrichsen's method consists in the conversion of extremely pure Iceland spar into oxide of calcium. The only measurable impurity present in the spar was iron, the amount of which expressed as ferric oxide was ·032 per cent. The conversion into oxide was effected in specially constructed platinum crucibles, the latter being heated in an electric oven at a temperature of 1200–1400° C. Four determinations of the atomic weight gave respectively 40·144, 40·141, 40·142 and 40·141—mean =40·142. This number deviates considerably from that which up to the present time has been generally accepted.

IN a paper on the fossil shells of the Colorado desert, published in a recent issue (No. 1256) of the *Proceedings* of the U.S. Museum, Dr. R. E. C. Stearns gives an interesting account of the formation of the desert itself. Surrounded by mountains except in the south, where it opens out, the Colorado desert of California was evidently once an extension of the Californian Gulf, which must once have reached inland some two hundred miles further than at present. The separation of the upper end of this old gulf, now forming the desert, has been caused by the sediment brought down on the east side by the Colorado river, which gradually silted up this portion of the gulf till the present desert area was isolated. Throughout the desert are to be found thousands of small fresh-water subfossil shells, mostly referable to the genera Paludestrina and Physa, which appear to have been transported partly by whirlwinds, but chiefly by birds. Some of the species of these molluscs are still living in certain localities in the desert. The remarkable variation exhibited by the shells of certain species is described in detail.

THE additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mr. F. S. Davidson; a Verreaux's Guinea-fowl (*Guttera edouardi*), a West African Python (*Python sebae*, var. *natalensis*) from Natal, presented by Mr. W. Champion; a Hudson Bay Squirrel (*Sciurus hudsonius*) from the Rocky Mountains, presented by Mr. Edward Whymper; a Lesser Sulphur-crested Cockatoo (*Cacatua sulphurea*) from Moluccas, deposited.

OUR ASTRONOMICAL COLUMN.

DIMENSIONS OF THE PLANETS AND SATELLITES.—In the *Astronomische Nachrichten* (Bd. 157, No. 3760), Prof. E. E. Barnard presents a series of revised reductions of measures made at the Lick Observatory in 1894 and 1895, together with recent determinations with the 40-inch refractor at the Yerkes Observatory.

Mercury.—The measures of diameter were made in the daytime, when the disc of the planet was little brighter than the sky background. Powers of 230, 460 and 700 diameters were used, and a piece of amber-coloured glass was placed as a screen over the eye-piece. The resulting mean value of the diameter was 2965 miles. During the observations the disc of the planet was carefully examined for the linear canal system described by other workers, but no such markings were seen. Under excellent conditions (especially on August 31, 1900), however, decided details in the form of three or four large darkish spots were readily distinguished, and were comparable to the markings on the moon as seen with the unaided eye.

Venus.—Measures were made of this planet specially to determine the extent of variation due to irradiation; night and day measures were both made with the full aperture of 40 inches, but the amber screen was used for the day series. The value obtained for the irradiation was 0″·25. The day diameter of the planet is given as 7713 miles. A series of dusky markings were the only features observed on the disc, similar to but fainter than those on Mercury.

Minor Planets.—Measures of the albedos and diameters of the four chief asteroids were obtained, with the following results:—

	Albedo. Mars = 1.	Diameter.
Ceres ...	0·67 ...	477 miles.
Pallas ...	0·88 ...	304 ,,
Juno ...	1·67 ...	120 ,,
Vesta ...	2·77 ...	239 ,,

As seen in the 36-inch and 40-inch telescopes the discs of such asteroids as are measurable always appear well defined and round, with no traces of markings on their surfaces. The corrected values for the other planets are as under:—

	Diameter.
Mars (Equatorial)	4352 miles.
,, (Polar)	4312 ,,
Jupiter (Equatorial)	90,190 ,,
,, (Polar)	84,570 ,,
,, Satellite I.	2452 ,,
,, ,, II.	2045 ,,
,, ,, III.	3558 ,,
,, ,, IV.	3345 ,,
Saturn (Equatorial)	76,470 ,,
,, (Polar)	69,780 ,,
,, Satellite Titan... ...	2720 ,,
Uranus (Equatorial)	35,820 ,,
,, (Polar)	33,921 ,,
Neptune	32,900 ,,

No markings were observed on Neptune, and its disc always appeared round.

HARVARD COLLEGE OBSERVATORY REPORT, 1901.—In his report for the year ending September 30, 1901, Prof. E. C. Pickering first mentions that of the three important astronomical events of the year, the Harvard College Observatory staff only participated in the determination of the light variation of Eros and the complete investigation of the changes of Nova Persei. The reason why no measures of Eros for parallax were made was that some fifty other institutions were cooperating in the work, rendering observations at Harvard unnecessary; in the case of the total eclipse in Sumatra the conditions were not considered sufficiently favourable to justify any large expenditure.

East Equatorial.—This instrument has been employed, as in former years, for photometric light comparisons with the achromatic prism polarising photometer; more than 16,000 settings have been made, including 1224 measures of the magnitude of Nova Persei. For double stars, &c., too close for examination with the above instrument, a second photometer has been adapted, and 2278 settings made with it. Other work with this equatorial has been the photometric measurement of Jupiter's satellites while undergoing eclipse, the light variations of the minor planet Eros and the asteroids Vesta and Tercidina, comparisons of long-period variables, and the selection and measurement of twelfth-magnitude standards.

West Equatorial.—This has been employed for similar photometric work on variables and comparison stars.

Meridian Circle.—Work with this instrument has chiefly consisted of zone observations to compare results obtained by use of crossed spider threads or ruled glass plates. The conclusions have been published in *Annals*, vol. xli. No. 7.

12-inch Meridian Photometer.—With this instrument 54,448 settings have been made by the director on 126 nights. A catalogue of 9233 Durchmusterung stars has been completed, and the planet Eros observed on 56 nights.

Meridian Photometer.—33,316 settings have been made on 98 nights, the principal work being the observation of a catalogue of 376 standard stars of the fifth magnitude; also comparison stars for Eros and other similar objects.

Henry Draper Memorial.—With the 11-inch Draper telescope 673 photographs have been obtained, and with the 8-inch instrument 1766 photographs. The total number of photographs taken during the year was 4081. Two new variables, three stars with peculiar spectra, and the presence of bright hydrogen lines in the spectrum of U Andromedæ, have been detected. Photographs of the spectrum of lightning were obtained with the Draper telescope with objective prism during the summer.

Respecting the production of stellar spectra two new devices are announced. For photographing the spectra of stars near the horizon, below 10° altitude, the plan has been adopted of turning the objective prism by a computed amount so as to correct for the atmospheric refraction in declination. The stellar spectra have been shaded automatically during the process of reproduction so as to equalise the intensity throughout.

As systematic work the 8-inch telescope covers all parts of the sky north of declination $-12°\cdot5$ from two to four times a year; the Cooke lens covers all parts available two or more times a month, and the transit photometer records all stars visible to the naked eye crossing the meridian every clear night.

Arequipa Station.—The 13-inch Boyden telescope has been used for photographing clusters containing probable variable stars. With this instrument 140 plates have been obtained; 2269 with the 8-inch Bache telescope and 919 with the 24-inch Bruce lens. From the examination of these latter plates 298 new nebulæ have been found, of which 9 are spiral and 3 ring nebulæ.

The long focus telescope is now back from Jamaica, where a long series of photographs of the lunar surface has been obtained under five different illuminations. These will furnish material for a photographic atlas. The diameter of the moon's image is about fifteen inches.

Blue Hill Meteorological Station.—Continued experiments are being made in the exploration of the upper atmosphere by means of kites, altitudes up to 12,550 feet having been obtained. Considerable success has attended the endeavour to fly the kites from ocean-going vessels in order to record weather conditions away from land surfaces.

TOTAL ECLIPSE OF THE SUN, MAY 18, 1901.—In *Popular Astronomy* (vol. x. pp. 1–4, January), Prof. A. N. Skinner gives an account of the expedition to Sumatra from the United States Naval Observatory. Three stations were selected, at two of which the weather conditions were unfavourable. At the third, Fort de Koch, excellent photographs of the corona and the chromospheric spectrum were obtained. The former were taken with a lens of 5 inches aperture and 39 feet focal length; two of these are reproduced with the article; the spectroscopic equipment consisted of a 30-feet concave grating spectrograph, with which six photographs were obtained.

A MAGAZINE OF SCIENCE AND PHILOSOPHY.[1]

"ANOTHER new magazine!" But the editor, in anticipating this exclamation, suggests that it is no more reasonable than would be "Another new flower in the fields!" or "Another new tree in the wood!" Still, one is not obliged to pluck the flower or to cut down the tree; but a new magazine makes a certain claim on the attention of the public, especially as it is addressed to the scientific public as well as to philosophers in the stricter sense of the word. Indeed, it is an attempt to induce men of science to interest themselves more in philosophy and students of philosophy to pay more attention to modern science. It is not intended to serve as a means of popularising either of these regions of thought, and the editor promises to exclude all purely speculative matter for which an experimental basis is wanting.

The first number contains an interesting article by Mach on "Similarity and Analogy as an aid to Investigation," in which Huygens, Faraday, Maxwell and Kelvin are held up as examples of investigators who have made sound use of analogy and have contributed, in consequence, greatly to the progress of human knowledge. Wald contributes "Critical Studies on the most important Fundamental Conceptions of Chemistry." It must be confessed that this introduction (for more is promised hereafter) is not very intelligible. "The Principle of Continuity in the Mathematical Treatment of Natural Phenomena" is the title of an article by Anton Scheye. The first chapter considers the principle as illustrated in the calculus; the second deals with the principle of continuity in natural science; the third, in mechanics; the fourth, in electrical and thermal phenomena; in the fifth the kinetic theory of gases is discussed; and the sixth chapter treats of the hypothesis of matter and of energetics. Here objections are raised to Ostwald's conclusion that "Our senses tell us of differences in energy between them and their surroundings"; for it is remarked that if equal quantities of energy be imparted to two bodies of equal mass yet of different specific heat, having the same initial temperature, while the final temperature of each will be the same, heat will have passed from the one of lower to the one of higher specific heat; and yet each will affect the sense of temperature equally, though they have gained different amounts of energy. He insists, therefore, that besides energy there must exist some other magnitude which must not only be capable of mathematical treatment, but must be as necessary for the true description of occurrences as energy itself. He also questions whether the doctrine of energy suffices to describe such a stationary condition as two equal light-rays polarised at right-angles to each other, or to picture the stationary state which exists when energy flows in a field of permanent magnets and charged conductors, according to Poynting's law. For these and other reasons he regards it as probable that an interpretation of the universe will be more complicated than would be the case were Ostwald's energetic conception possible.

Ostwald contributes a critical article on Kant's "Metaphysical Basis of Science." To Kant's statement that true science must treat its subject-matter according to *a priori* principles, and that only science falsely so-called deals with laws deduced from experiment, Ostwald replies by denying the possibility of *a priori* conclusions, and maintains that all knowledge is derived from experience. Another celebrated dictum of Kant's is that in any investigation of Nature only so much real science is present as is expressible in mathematical terms; Ostwald insists, however, that mathematics is only a language in which the results of experiments may be conveniently expressed, and that it can contain nothing more in its conclusions than what experiment lends to its premisses. And while Kant, although acknowledging that in principle his scientific treatise has a close connection with the ordinary province of metaphysics, to wit, God, Freedom and Immortality, distinguished them sharply, regarding the former "as a shoot from the same root as the latter, but one which hinders its regular growth," Ostwald maintains that no stronger argument can be found for the necessity of a purely experimental basis for all branches of knowledge.

A somewhat technical article by Arthur von Oettingen on "The Dual System of Harmony," and one by E. Sievers on "Melody of Voice in (Reciting) German Poetry," are followed by reviews of new books by the editor. Among these it is somewhat amusing to find Judge Stallo's "Concepts of Physics," which has only now reached the German public, through its translator, H. Kleinpeter. W. R.

[1] *Annalen der Naturphilosophie.* Edited by Wilhelm Ostwald. (Veit and Co.). Price 14 Marks, yearly.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. T. H. Middleton, professor of agriculture in the Durham College of Science, Newcastle-on-Tyne, has been elected to the chair recently vacated by Dr. Somerville.

Dr. Barclay-Smith has been reappointed senior demonstrator of anatomy.

The Vice-Chancellor, Prof. J. J. Thomson, and Mr. R. T. Wright will represent the University at the jubilee of Owens College, Manchester, to be celebrated next March.

EDUCATION was given first place in the King's speech to the Commons at the opening of Parliament last Thursday. The words used were "Proposals for the Co-ordination and improvement of Primary and Secondary Education will be laid before you." It is to be hoped that a comprehensive measure will be introduced early in the session, and that nothing will be permitted to interfere with the settlement of the questions involved in it.

THE adoption of the metric system of weights and measures would be so much to the advantage of the work of education and commerce in this country that efforts should be made to bring the subject forward on every suitable occasion. We are, therefore, glad to see that the following resolution was passed at a general meeting of Convocation of the University of London on Monday:—"That this House is of opinion that, in the interests of commerce, science and education, legislation should be promptly undertaken to make compulsory in this kingdom, after a proper interval, the use of the metric system of weights and measures for all purposes."

PROF. ALFRED LODGE stated the case for reform in methods of teaching geometry at the annual meeting of the Mathematical Association held on Saturday last. He urged that a new text-book of geometry, framed more or less on the model of books used in France, should be introduced as soon as possible to supersede Euclid's elements. Text-books adapted to modern needs are in use in the United States of America, and their chief characteristics are:—(1) The more orderly arrangement of propositions; (2) the entire separation of theorems from problems of construction, hypothetical constructions being used in proving a theorem; (3) the closer association of a proposition and its converse when both were true; (4) the adoption of arithmetical notions and algebraic processes; (5) the early introduction of simple *loci*; (6) insistence on accurate figures drawn by accurate and practical processes; (7) practice in exercises from the very beginning. It had been suggested to Prof. Lodge that he should add, "Attention paid to the various phases of a theorem as the figure changes, and (as the student progresses) to the easier forms of generalisation." The greater part of these improvements could be adopted at once, provided that the sanction of the great examining bodies could be obtained. A committee of the Association is being formed to coöperate with the committee of the British Association in advancing the reforms advocated in mathematical teaching.

THE work of the Sir John Cass Technical Institute, London, was inaugurated on January 15, when an introductory address was given by Sir William Roberts-Austen, K.C.B., F.R.S. The institute has been founded by the governors of Sir John Cass's Foundation, and is one of the London polytechnics aided by the Technical Education Board of the London County Council and by the City Parochial Foundation. The institute is situated in Jewry Street, Aldgate, and is readily accessible. It is provided with good laboratories for chemistry, metallurgy and physics, and on the art side with workshops and drawing rooms for the department of arts and crafts. Dr. C. A. Kohn is the principal of the institute. Sir William Roberts-Austen in his introductory address dealt chiefly with the subject of metallurgy. It was, he said, an industrial art depending for its success on what were called the applications of science, but he heartily wished that the term "applied science" had never been devised. There was no essential difference between what was called pure science and what was called applied. In industrial life they simply applied the facts of science to a particular set of conditions or to the solution of definite problems. This view was illustrated by reference to the process of cupellation, the history of which was described and illustrated by suitable experiments. The diffusion of solids was then referred to, and a summary was given of the steps that had led Sir William to the investigation of the diffusion of metals.

THE importance of geography in education was the subject of an address delivered by Mr. James Bryce, M.P., at the annual meeting of the Geographical Association held last week, Mr. Douglas W. Freshfield, president, being in the chair. The Association aims at the improvement of the teaching of geography by spreading the knowledge of all such methods as call out the pupil's intelligence and reasoning powers and make geography a real educational discipline, instead of merely loading the memory with names and isolated facts. After expressing his hearty sympathy with the objects of the Association, Mr. Bryce considered the place of geography in education under three aspects, viz., as the gateway to the physical sciences, the key to history, and the basis of commerce. In this country, as in Germany for some time, it is thoroughly realised by all progressive teachers that geography must be made as much as possible an experimental science—that the pupil's mind must be brought into contact with facts and not alone with words. The pupil taught to observe has it suggested to him how things are connected with one another; he acquires the habit of looking at the country and asking himself what are the physical causes which make the district what it is, and what is the relation between those different causes. As to geography being regarded as the basis of commerce, Mr. Bryce said that the producer and merchant ought to know where each article could be best produced, where the raw material comes from, what are the conditions of labour, which are the best points of manufacture, where are the best markets, and what are the lines of communication and transport. Although the commercial man has to rely upon trained observers he would do better if he acquired geographical knowledge himself, because he could develop for himself certain lines of policy upon which he could conduct his operations; his wider knowledge of the world would enable him to take, not only a more intelligent, but a more practically serviceable view of the action which in each particular case was to be taken, and which, of course, would be constantly shifting. If the heads of great business houses were thoroughly trained to observe these things and to look at them in a scientific way, a great deal would be done to enable the country to hold its place in the great commercial world.

IN view of the recognition with which scientific training is now meeting, as part of our educational system, some of the suggestions made at the Conference of Public School Science Masters on January 18 are of interest. Those responsible for the framing of the regulations for Army examinations were unanimously recommended by scientific men from all the great public schools, and from many others, to lay more stress upon the practical side of the science work. It was, further, suggested to them that quantitative work should be introduced and that physics should be given the place it deserves in the compulsory science papers. Moreover, what is to be sought is not knowledge-worship, but training, not the old-fashioned theoretical questions with which examiners find it so easy to elicit facts, but the construction of problems which, when worked out practically under their own eyes, will truly tell them the capabilities of the candidates. Testimony was also forthcoming that there are examiners who will take the trouble to examine in the latter way, and the meeting was in favour of allowing that greater scope to assistant practical examiners which they must have if large numbers of persons are to be examined at one time. The pernicious specialisation which takes place in schools as a result of the examinations for science scholarships at the Universities of Oxford and Cambridge was made abundantly clear, and some system advocated which will prevent this and at the same time ensure all boys in the school—and not the "intellectual refuse" and Army classes alone—having a proper scientific training for several years, whether they be classical or modern, literary or mathematical. A committee, it has been arranged, is to take up the matter. A sidewind during the discussion, as to whether classical boys do better than others in scientific work elicited the fact that at Woolwich, for instance, no rule one way or the other could be laid down. The necessity of culture as well as scientific education was a point that was touched upon, and might well form the subject of a future discussion. Biology as a school subject was rather pooh-poohed by one representative from Cambridge University, while its importance was just as strongly urged by a public school master. It came as no surprise to those familiar with what occurred last year, that a definite association was formed as a result of the conference which will arrange for similar and possibly more frequent meetings in the future. Principal Rücker has consented to become the first president of the Association of Public School Science Masters—a body the constitution of which will be somewhat elastic, as it is difficult to define what is a public school science master, but the title is sufficiently rigid to specify the character of the Association.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 20, 1901.—"The Anomalous Dispersion of Sodium Vapour." By R. W. Wood, Professor of Experimental Physics, Johns Hopkins University, U.S.A.

The modern theories of dispersion show that the effect of an absorption band is to lower abnormally the refractive index of the medium on the side of the shorter wave-lengths and raise it on the side of the longer wave-lengths. In some cases even the refractive index may fall below one on the blue side of the band, which means that light of a certain wave-length travels through the medium at a higher velocity than in a vacuum. Substances showing this peculiarity are exceedingly opaque to light, a thickness of a few wave-lengths absorbing completely all of the light for which this peculiarity exists.

It is quite possible to conceive of a medium with a strong absorption band in the middle of the visible spectrum having a refractive index greater than unity for all waves longer than the absorbed waves, and a refractive index less than unity for all shorter waves. A prism made of such a substance would deviate half of the spectrum in one direction and half in another direction, something in the manner of the direct-vision prism, except that the arrangement of the colours would be anomalous. Such a medium has been found in metallic sodium vapour, which is most beautifully transparent in addition to having the peculiarity before mentioned. By means of prisms of sodium vapour it is possible to form a complete anomalous spectrum, in which all the colours between the extreme red and violet are present, with the exception of a very narrow range at the D lines. It has been found that the refractive index is one for the extreme violet, greater than one for all colours on the red side of the D lines, and less than one for all colours on the other side, the maximum and minimum values occurring, of course, close to absorptionbands (the D lines).

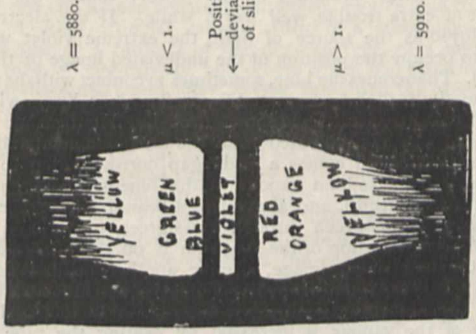

FIG. 1.

In the spectrum produced by a prism of sodium vapour the violet occupies the position of the undeviated image of the slit, the red and orange flaring off to one side, and the blue, green and yellow to the other, as is shown in Fig. 1.[1]

Inasmuch as sodium vapour appears to be the substance best adapted to class demonstration of anomalous dispersion, it is worth while to describe in some detail the apparatus by which the remarkable optical properties of the vapour can be exhibited, referring the reader to the original paper for a more complete discussion. (The paper is to appear also in the *Philosophical Magazine.*)

The first experiments were made with a large prism of cast iron, furnished with windows of mica or thin plate glass, in which the metal was heated in an atmosphere of hydrogen. Very beautiful results were at once obtained, but certain peculiarities of the vapour's action showed that the refraction was due chiefly to the action of a non-homogeneous medium, the planes of constant density being horizontal. Great trouble was caused by the windows, which soon became covered with a white deposit, which cut off most of the light. It being apparent, however, that the oblique faces played but a very small part, the effect being due almost wholly to the variable density of the vapour, it seemed best to make the most of this circumstance and dispense with the trouble entirely by removing the glass plates to such a distance from the heated vapour that no deposit took place. The arrangement finally adopted was simply a tube of glass about 30 cm. long, provided with plate-glass ends cemented on with sealing-wax. Hydrogen dried by passage over calcium chloride was conducted into and out of the tube by means of two fine glass tubes, arranged as shown in Fig. 2.

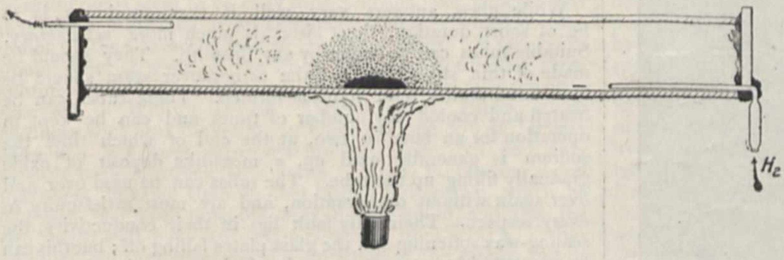

FIG. 2.

The diameter of the tubes should not be more than 2 mm., and they should lie close against the sides of the large tube in order not to cut off any of the light. The most suitable diameter for the large tube is 2 cm. The ends of the tube are first warmed and thickly coated with sealing-wax. One of the glass straws is placed in position, and a small piece of plate glass, previously warmed, applied to the end of the tube, any crevices around the straw being closed with wax. The leading-in tube is next placed in position and a piece of freshly cut sodium (about 5 mm. on a side) inserted. The other window is then cemented to the tube and the current of hydrogen started as soon as possible. Some experience is necessary to regulate properly the hydrogen stream during the experiment. When the tube is first heated much white smoke forms. If a stream corresponding to about one bubble per second is allowed to flow, the smoke will usually clear up in a few minutes and give little trouble. The tube should be heated by means of a Bunsen burner turned down low, the tip of the flame playing against the bottom of the tube. If a sodium flame is placed behind the tube the formation of the vapour can be watched, for it appears almost jet black against the flame, though quite colourless in white light. The behaviour of the vapour is somewhat peculiar. It grows out from the sodium globule as a dark atmosphere with a sharply defined surface, which clings to the globule with great tenacity. It resembles at first a thick growth of mould more than anything else, and a sudden gust of hydrogen scarcely moves it at all. A wire pushed up through it drags a certain amount above the free surface, in much the same manner as a stick pushed up through the surface of thick molasses would do. If the tube be inverted the black cloud clings to the upper surface, behaving, on the whole, like a very viscous mass. It is even possible to dip some of it up on a wire.

These peculiar physical properties of the metallic vapour have as yet only been studied in a very superficial manner, and they are mentioned now only because it appears that there is some connection between them and the optical behaviour of the medium.

The opinion is expressed that the apparent viscosity is an illusion; that the sharply defined surface is merely the boundary at which either condensation or chemical action (the hydrogen was not absolutely pure) is taking place. The process of dipping the vapour up on the wire might be explained by condensation on the wire followed by vaporisation. A more careful study of the physical behaviour of the vapour will be made some time in the future.

The apparatus employed in the study of the dispersion of the vapour was essentially identical with that used by Becquerel. The light of an arc lamp was focussed on the *horizontal* slit of a collimator, after traversing which the rays passed lengthwise through the dispersion tube. A second lens brought them to a focus on the slit of a spectroscope when the dispersion was to be studied by the method of crossed prisms, or in the focus of an eye-piece when the anomalous spectrum was to be viewed subjectively (Fig. 3).

The first experiments were made by the method of crossed prisms, the spectrometer being furnished with a Rowland plane grating, which showed the sodium lines widely separated. It was at once apparent that far better results could be obtained with the dispersion tubes than had ever been observed with prismatic flames. The curved branches of the diffraction

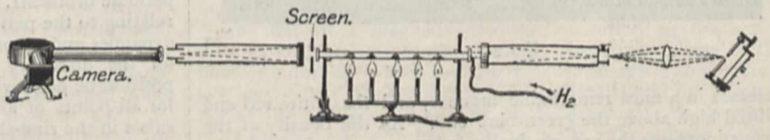

FIG. 3.

[1] This spectrum is illustrated by a coloured plate in the original paper.

spectrum on each side of the D lines were perfectly sharp and steady, and the dispersion could be traced a considerable distance up and down the spectrum. On the slit of the spectrometer appeared, instead of the white image of the horizontal slit, a most beautiful anomalous spectrum of great brilliancy and purity. The spectrometer was at once removed and an eye-piece put in its place, when a most superb spectrum revealed itself (Fig. 1).

Before discussing this spectrum in detail it will be better to take up the results of the experiments made by the method of crossed prisms. On first heating the tube the curvature of the

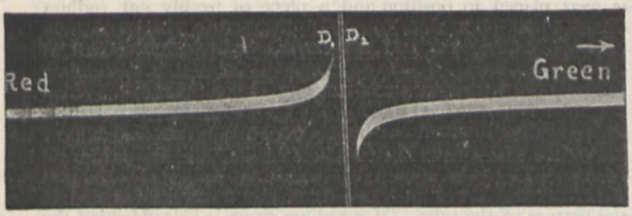

FIG. 4.

spectrum between the D lines as well as on each side is observed, the appearance being identical with that figured by Becquerel, but in a few seconds the vapour becomes so dense that total absorption of all the light between the lines occurs. The oppositely curved branches adjacent to the region of absorption extend rapidly up and down as the tube grows hotter, the ends finally passing out of the field of the instrument. A beautiful fluted absorption appears in the red and the greenish-blue, which finally blots out a region in the blue almost entirely. Meanwhile the curvature of the spectrum

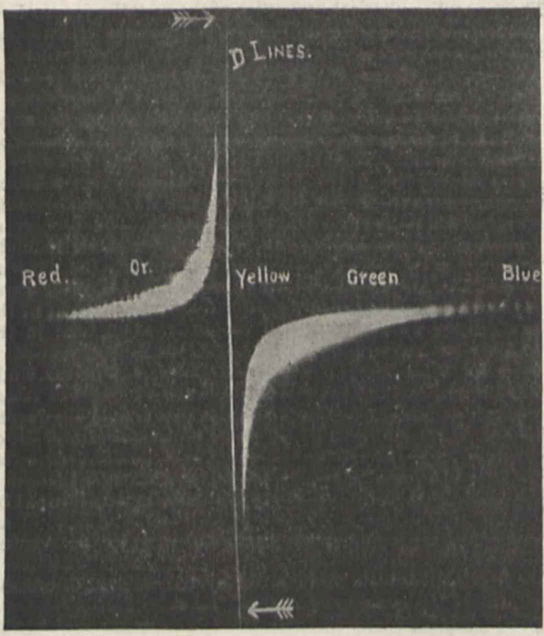

FIG. 5.

increases in a most remarkable manner, and the entire red end is lifted high above the green-blue end. As the density of the vapour increases the red gradually fades away, leaving only the yellow and green and the remote blue and violet, the curvature increasing all the while.

Figs. 4 and 5 are photographs of the continuous spectrum after dispersion by means of a prism of sodium vapour. They give a very good idea of what is seen with the apparatus arranged as shown in Fig. 3. The sodium lines were impressed on the plate by holding a sodium flame in front of the slit of the spectrometer after the exposure was over. In Fig. 5 the arrows indicate the points to which the curved branches could be traced in the original negative. Eye observations enable them to be traced much farther, for they are very feeble at the tips, and the light is not very actinic.

For the exhibition of the actual spectrum produced by a prism of sodium vapour a long dispersion tube with a battery of four or five prisms gives the best results. A small Bunsen burner should be used for each of the fragments of sodium, which should be at least 6 or 8 cm. apart. A coloured drawing of the spectrum, which has already been mentioned, was made when the spectrum was obtained in this manner. A single prism gives a very pretty anomalous spectrum, but the magnificent effect produced by the battery makes the slight amount of extra trouble well worth while. If the electric arc is employed as the source of light, the extreme violet will be found to occupy the position of the undeviated image of the slit (Fig. 1). Then comes the blue, sometimes in contact with the violet and sometimes slightly separated by a fine dark line, owing to the fact that the violet light comes from the fluted carbon band of the arc, which is separated from the blue by a comparatively dark region. Then comes a wide gap corresponding to light absorbed by the sodium vapour in the blue-green region (the channelled spectrum), and above this a beautiful flare of colour ranging from blue-green through grass-green to yellow. The red and orange portion of the spectrum is on the other side, or below the undeviated image, forming another brilliant flare of colour. It is separated from the violet by a wide dark band, due to the absorption in the vicinity of the D lines. If the density of the vapour is increased by heating the tube to a higher temperature, the red flare extends lower down, grows fainter, and finally fades away owing to the presence of the fluted absorption bands in the red. The green and blue persist, however, becoming more widely separated, but finally the green disappears almost entirely. It is best to arrange the gas cock so that the height of the flames can be controlled without leaving the eye-piece, for it is surprising how slight a change is necessary to completely alter the general appearance of the spectrum. The glass tube should not be allowed to cool until the experiment is at an end, otherwise it will immediately fly to pieces when the flame is again applied to it.

While glass answers very well if the experiment is to be of short duration, sheet iron is much more satisfactory. Suitable tubes can be made by any tinsmith. They should be made of thin sheet iron, and the turned-over seam should be hammered until a tight joint is formed. These tubes can be heated and cooled any number of times and can be kept in operation for an hour or two, at the end of which time the sodium is generally used up, a moss-like deposit of oxide gradually filling up the tube. The tubes can be used over and over again without deterioration, and are most satisfactory in every respect. Their only fault lies in their conductivity, the sealing-wax softening and the glass plates falling off; but this can be prevented by wrapping a strip of cloth around each end and wetting it from time to time. One tube was made with water jackets at each end, but it seems to have no especial advantage, and is more complicated. Porcelain tubes are quite satisfactory, but the iron is to be preferred on the whole.

By employing a tube of about 5 cm. diameter the anomalous spectrum can be projected, but the appearance is so very inferior to that of the phenomenon when seen subjectively that the method is not recommended.

Royal Astronomical Society, January 10.—Dr. J. W. L. Glaisher, F.R.S., president, in the chair.—In a paper on periodic orbits Mr. E. T. Whittaker communicated two theorems relating to the periodic solutions of the differential equations of dynamics and astronomy. The first theorem furnished a criterion for the discovery of periodic orbits; if a certain function of position be negative for all points of a closed curve and positive for all points of a curve enclosing this, then a periodic orbit exists in the ring-shaped space between the curves. The second theorem was concerned with an integral, the value of which when integrated over the region bounded by a periodic orbit is equal to the number of centres of force enclosed by the orbit.—Prof. H. H. Turner read a paper by Major Burrard, of the Indian Survey, on the attraction of the Himalaya Mountains upon the plumb-line in India. A chart was exhibited, showing a supposed underground source of attraction running across central India.—Lantern slides were shown of photographs taken by

Mr. Ritchey at the Yerkes Observatory of the nebula surrounding the new star in Perseus, and Mr. Newall described Prof. Kapteyn's suggested explanation of the apparent rapid motion of the nebula as shown in the photographs.—Mr. Lewis read a paper on the orbit of the binary star Σ 1639 in Coma Berenices. —The secretary read a paper by Mr. Robinson, of the Radcliffe Observatory, Oxford, upon a comparison of the visual and photographic magnitudes of Nova Persei.

Linnean Society, December 19, 1901.—Prof. S. H. Vines, F.R.S., president, in the chair.—Prof. G. B. Howes exhibited a marine organism received from Dr. Gilchrist, of South Africa. It measures 15 cm. in length, and is structureless and transparent, in section four-sided, with its angles prolonged and each intervening area concave. A central tubular cavity is present, and at one end a deep constriction, which may be due to wave-action or other artificial causes. Ideas of a ctenophoran, the cast-off test of a tunicate of the distoma type, of a myxicolid worm-tube, an egg-capsule, and others which had occurred, had all been discarded; and after having submitted the object to a dozen trained experts, he put it forward in the hope of obtaining a clue to its significance and zoological position. In commenting upon this exhibit, the president said he believed the occasion was probably the first in the history of the Society upon which an object had been laid upon the table to which no one could give a name.—Prof. Howes also exhibited a mounted specimen of the giant argulus (*A. scutiformis*) from a Japanese Tetrodon. —Mr. J. E. S. Moore exhibited the entire specimen and a microscopic preparation, with drawings, of a new polyzoon, encrusting the shell of Paramelania, dredged on the west coast of Lake Tanganyika, at a depth of 25 fathoms. He showed it to be typically gymnotæmatous, and to present characters most nearly suggestive of the marine genus Arachnidium.—Dr. C. W. Andrews gave a short account of his recent visit to Egypt, and showed lantern-slides illustrating some of the districts in which vertebrate fossils were collected. The most important journeys were to Mozara with Mr. T. Barrow, and to the Fayûm with Mr. H. J. L. Beadnell, officers of the Egyptian Geological Survey. In the former locality remains of Mastodon, Brachyodus and other vertebrates of Lower Miocene age were found; and in the latter a large series of bones from Middle and Upper Eocene beds was collected. These bones include a number of very interesting forms, some of which (Palæomastodon and Mœritherium) seem to be early proboscidians, and indicate that that group originated in an Ethiopian land-area which became united to the Palæarctic land in Oligocene times. A number of plaster-casts of some of the more important specimens were shown.—Mr. Miller Christy exhibited and made remarks on a specimen of White's Thrush, *Turdus varius*, Pallas, which had been shot near Clavering, in Essex, so long ago as January 1894, and had been preserved for Mr. Rolfe, but had only recently been identified as a rarity. Mr. J. E. Harting stated that about the same time another bird of this species, which he had seen, had been procured near Southampton, and that the two might well have arrived in company from Siberia. After pointing out the geographical distribution of the species and its distinguishing characters, he exhibited coloured figures of the egg, which is one of the rarest in collections; and, for comparison, a figure of the egg and nest of the allied *Turdus lunulatus* of Australia.—The Rev. John Gerard exhibited a nest of the sand-martin (*Cotile riparia*) made within the nest of a dipper (*Cinclus aquaticus*), found near Bashall Hall, Yorkshire, in which eggs of the former bird had been laid and hatched after the latter had ceased to occupy it.—Mr. S. Pace exhibited specimens of the common Torres Straits snail *Planispira* (*Trachiopsis*) *delessertiana*. He likewise exhibited a specimen and drawings from life of a rare pelagic tectibranch, *Euselenops* (*Neda*) *luniceps*, taken in Friday Island Passage, Torres Straits. —Mr. S. Pace read a paper on the gasteropod Pontiothauma, Sm., giving an account of the anatomy of this remarkable genus, with special reference to the proboscis and its associated parts, as observed in a specimen from the Indian seas, furnished some years ago by Dr. Alcock, of the Calcutta Museum.—Mr. F. Chapman read a paper on the Ostracoda collected round the Funafuti Atoll. This collection, which had been placed in his hands for examination and description by Prof. Judd, C.B., F.R.S., was obtained from various sources during the work of the expedition for the purpose of boring in the Atoll. The specimens represented the recent deposits obtained by dredging outside the Atoll, chiefly at moderate depths, but many were also selected from the dredgings in the lagoon, as well as from the beach-sands, the deep-sea deposits and the sands from the Atoll boring. The total number of species was fifty-two, six of which were found to be undescribed. The occurrence of the genus Limnocythere was considered noteworthy on account of its fresh-water habit.

Royal Meteorological Society, December 15, 1901.—Mr. W. H. Dines, president, in the chair.—The Symons gold medal was presented to Dr. Alexander Buchan, F.R.S., for his work in connection with meteorological science.—The president in his address dealt with the theory of probability applied to various meteorological problems. He considered that for all practical purposes weather conditions may be looked upon as purely accidental, and that we may apply to them the laws of chance. They are not by any means in reality a matter of chance, for although we cannot discover it, there is doubtless a cause for each kind of weather, normal or abnormal. After speaking upon the subject of weather forecasting, he dealt with the question, How long is required to obtain a true average? He has come to the conclusion that ten years' temperature observations give a mean of which the probable error is a little under one degree; thirty years reduce this to half a degree, fifty years to one-third of a degree, and a hundred years to one-quarter of a degree. After dealing with barometer observations and rainfall, he proceeded to speak of weather almanacs, cycles, &c. In conclusion he said that meteorology is far more than a statistical science, and is very closely dependent upon theoretical mechanics and thermodynamics, and in the application of these subjects to meteorology lies the best hope of advance. The council for the ensuing year were then elected, Mr. W. H. Dines being the president and Mr. F. C. Bayard and Dr. H. R. Mill secretaries.

PARIS.

Academy of Sciences, January 13.—M. Bouquet de la Grye in the chair.—On the periods of double integrals and on a class of linear differential equations, by M. Émile Picard.—The preparation and properties of the hydride of sodium, by M. Henri Moissan. Metallic sodium is attacked by hydrogen gas at a temperature of about 400° C., the hydride thus formed dissolving in the excess of metal, from which it can be isolated in a slightly impure state by treatment with liquefied ammonia at −40° C. Pure sodium hydride was finally obtained by heating sodium wire in hydrogen at 370° C., keeping the upper portion of the tube slightly cooler. Under these conditions the hydride condenses on the cooler part in crystals, which upon analysis proved to be NaH. It is attacked by the slightest trace of water and catches fire in moist air. The hydride is attacked by gaseous fluorine and chlorine, but remains unaltered in the presence of liquid chlorine at −35° C. It resembles potassium hydride in its powerful reducing properties.—The cultivation of lucerne upon soils without lime, by MM. P. Dehérain and E. Demoussy. Lucerne and clover grow feebly in soils without lime if the bacteria-producing nodosities are present. The addition of lime increases the vigour of growth in both cases.—On integral parameters, by M. Alf. Guldberg.—On the theory of entire functions, by M. Pierre Boutroux.—On radioactive bodies, by M. P. Curie and Mdme. S. Curie. The authors have taken two hypotheses as guiding principles in their researches on the radioactive bodies; that radioactivity is an atomic property of bodies, and that each atom of a radioactive substance behaves as a constant source of energy. Experiments carried out over several years show that for uranium, thorium, radium and probably actinium, the radiant activity remains constant if the chemical and physical state of the radioactive body remains the same. Polonium alone appears to be an exception to this rule. —A principle relating to the distribution of the lines of magnetic induction, by M. Vasilesco Karpen. The principle is laid down that in a magnetic medium submitted to the action of a certain number of magnetomotive forces, the course of the lines of induction is such that the intrinsic energy of the medium is a maximum.—On the difference of potential and the deadening of the oscillatory spark, by M. F. Beaulard. A correction of an arithmetical error in a previous paper.—Telephony without wires through the earth, by M. E. Ducretet. By the use of a microphone, messages were transmitted through the earth with remarkable clearness, without any of the secondary noises so annoying in telephony with conducting wires.—The influence of low barometric pressures on the frequency of the polar aurora, by M. H. Stassano. A clear connection is traced between the frequency of the appearance of the aurora and a low barometer.—The earthquakes due to folding in the Erzgebirge, by M. F. de Montessus de Ballore. The numerous slight earthquakes in this region are traced to the effect of three long folds in the strata, the Erzebirge being the longest and highest of the three.—On the aberration of sphericity of the eye, by M. Georges Weiss.—The preparation and properties of strontium hydride, by M. Henri Gautier. A strontium-cadmium alloy containing about 45 per cent. of strontium is heated in a current of hydrogen to a dull red heat. The hydrogen is slowly absorbed and the cadmium volatilised. Towards the end of the operation the temperature is raised until the mass is fused. Analyses of the compound showed that its composition was SrH_2. It proved to be analogous both in composition and properties to the calcium hydride of Moissan.—On the chemical equilibrium of the iron-carbon systems, by MM. Georges Charpy and Louis Grenet. The theory of Bakhuis-Roozeboom on the constitution of the compounds of iron and carbon, although complete from the theoretical side, has met with some objections from the practical point of view. The separation of graphite would appear to be largely conditioned by the amount of silicon present. An experimental study of the effect of silicon is given in the present paper.—On the thermoelectricity of steels and nickel-steels, by M. G. Belloc. The proportions of nickel in the nickel-steels studied varied from 5 to 35 per cent. The general form of the curve giving the relation between the electromotive force and the temperature for platinum-nickel steel couples is parabolic, the alloy containing 5 per cent. of nickel being exceptional in this respect. The steels containing 5 per cent. and 28 per cent. of nickel at about 400° to 500° C. show brusque variations, indicating molecular transformations. The 28 per cent. nickel steel is remarkable for its high neutral point and the great electromotive force developed.—The action of mixed organo-magnesium compounds upon trioxymethylene, by MM. V. Grignard and L. Tissier. Trioxymethylene reacts slowly at the boiling temperature upon an ethereal solution of the organo-magnesium compounds with the formation of primary alcohols. Numerous alcohols have been thus prepared synthetically, and the method appears to be of wide generality. Thus starting with ethyl bromide, normal propyl alcohol is obtained with a 65 per cent. yield; the reaction also holds in the aromatic series.—The preparation and properties of the imido-dithiocarbonic esters, by M. Marcel Delépine.—On the inversion of saccharose, by M. P. Petit. An attempt at the direct measurement of the heat of inversion of sugar.—On the solubility of calcium phosphate in pure water, by M. A. Rindell.—On the methods for the volumetric estimation of copper, iron, antimony, zinc dust, sulphur in sulphides, and glucose by means of stannous chloride, by M. Fred. Weil.—On the geographical distribution and adaptation to fresh water of some marine forms, by MM. C. Vaney and A. Conte.—On a crustacean commensal with Pagurus, *Gnathomysis Gerlachei*, a type of a new family of schizopods, by MM. Jules Bonnier and Charles Pérez.—The action of tannins and colouring matters on the activity of yeasts, by M. A. Rosenstiehl.—The mechanism of synthesis of an isomeric leucine, by MM. A. Etard and A. Vila. Leucine derived synthetically from amyl alcohol is different from biological leucine.—On the extraction of boletol, by M. Gabriel Bertrand.—On the fracture of the fore-arm due to a premature explosion in an automobile motor, by M. H. Soret.—The discovery of the mammoth and of a Palæolithic station in Basse-Provence, by M. Repelin.—On the structure of the subterranean hydrographic network in limestone regions, by M. F. Fournier.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 23.

ROYAL SOCIETY, at 4.30.—(1) Mathematical Contributions to the Theory of Evolution. XI. On the Influence of Natural Selection on the Variability and Correlation of Organs; (2) On the Correlation of Intellectual Ability with the Size and Shape of the Head. Preliminary Notice: Prof. K. Pearson, F.R.S.—A Short Description of the Culicidæ of India, with Descriptions of New Species of Anopheles: F. V. Theobald.—The Affinity of Tmesipteris with the Sphenophyllales: Prof. A. P. W. Thomas.—On the Excretory Organs of Amphioxus: E. S. Goodrich.—On the Mechanism of the so-called "Peripheral Reflex Secretion" of the Pancreas. Preliminary Communication: Dr. W. M. Bayliss and Prof. E. H. Starling, F.R.S.

ROYAL INSTITUTION, at 3.—Recent Excavations at Delphi and in the Greek Islands: Dr. A. S. Murray.

SOCIETY OF ARTS, at 4.30.—Bengal: the Land and its People: F. H. Skrine.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Earth Currents derived from Distributing Systems: E. B. Wedmore.

FRIDAY, JANUARY 24.

ROYAL INSTITUTION, at 9.—The Discovery of the Future: H. G. Wells

PHYSICAL SOCIETY, at 5.—The Factors of Heat. Part I.: James Swinburne.—Exhibition of some Twinned Crystals of Selenite: Eustace Large.

SATURDAY, JANUARY 25.

ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford, Essex), at 6.30.—Note on Occurrence of *Amanita citrina*, Gon. and Rab., in Epping Forest: George Massee.—Local Archæological Exploration: Charles H. Read.

MONDAY, JANUARY 27.

SOCIETY OF ARTS, at 8.—The Purification and Sterilisation of Water: Dr. Samuel Rideal.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Maldive Islands: J. Stanley Gardiner.

INSTITUTE OF ACTUARIES, at 5.30.—The Actuarial Aspects of Recent Legislation, in the United Kingdom and other Countries, on the Subject of Compensation to Workmen for Accidents: John Nicoll.

TUESDAY, JANUARY 28.

ROYAL INSTITUTION, at 3.—The Cell: its Means of Offence and Defence: Dr. Allan Macfadyen.

SOCIETY OF ARTS, at 4.30.—To the Victoria Nyanza by the Uganda Railway: Commander B. Whitehouse.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Sewerage Systems of Sydney, N.S.W., and its Suburbs: J. Davis.—The Bacterial Treatment of Trades Waste: W. Naylor.

WEDNESDAY, JANUARY 29.

SOCIETY OF ARTS, at 8.—Technical Education as applied to Paper Making: Clayton Beadle.

THURSDAY, JANUARY 30.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Chemical Origins of the Lines in Nova Persei: Sir N. Lockyer, K.C.B., F.R.S.—The Specific Volumes of Oxygen and Nitrogen Vapour at the Boiling Point of Oxygen: Prof. James Dewar, F.R.S.—The Distribution of Magnetism as affected by Induced Currents in an Iron Cylinder when rotated in a Magnetic Field: Prof. Ernest Wilson.

ROYAL INSTITUTION, at 3.—Recent Excavations at Delphi and in the Greek Islands: Dr. A. S. Murray.

FRIDAY, JANUARY 31.

ROYAL INSTITUTION, at 9.—The Ions of Electrolysis: Prof. A. Crum Brown, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Quay-Walls of Keysham Harbour: J. C. Collett and W. H. C. Clay.

CONTENTS.