again; how much information this will convey to a student we leave our readers to judge. The answers to the various questions which are asked on the sextant are far better than the definitions, as are also the answers to the questions on cyclones. The questions on the deviation of the compass, for masters' certificates, are also fairly well answered, although a little further explanation of Napier's diagram, which forms the frontispiece, might have been given with advantage.

For reference to the questions given, the book will no doubt be very useful to intending candidates, but the answers given are good examples of the system of cramming for examinations, which cannot be too strongly condemned.

Guatemala: The Land of the Quetzal. By William T. Brigham. (London: Fisher Unwin.)

MR. BRIGHAM, an American author, has made three journeys in Guatemala, and in the present volume he has brought together all that seemed to be important in the notes written during his travels. The work is one of great interest, and ought to be not less welcome to the general reader than to persons who have special reasons for studying the subject. Mr. Brigham is a keen observer, and records his impressions clearly, simply, and effectively. No one who, in imagination, attends him in his course across the continent to Coban, from Coban to Quezaltenango, from Quezaltenango to the Pacific, will fail to be attracted by what he has to say about the physical features of the country and about the manners of its inhabitants. There are also excellent chapters on Guatemala city, and on Esquipulas and Quirigua. A sufficiently full account is given of the vegetable and animal productions of Guatemala, and of its earthquakes and volcanoes. In an introductory chapter, Mr. Brigham has something to tell us about Central America generally, and it may be worth noting that these regions will one day, in his opinion, be "the garden and orchard of the United States, not necessarily by political annexation, but by commercial intercourse." Great care has been taken to secure the accuracy of the illustrations, most of which are direct reproductions from negatives.

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.]

Weismann's Theory of Variation.

I THINK it may be reasonably objected to Mr. Cunningham's ingenious *reductio ad absurdum* of Weismann's theory, that because we cannot exactly state what happens in the mysterious fusion of sperm- and germ-nucleus, it by no means follows that such fusion does not largely account for the observed variation. I say largely, because Prof. Weismann's more recent paper, "Ueber die Zahl der Richtungskörper und über ihre Bedeutung für die Vererbung" (Jena, 1887), completes in a most important manner the paper quoted and criticized by Mr. Cunningham.

The argument is briefly as follows. The expulsion of the second polar body by sexual eggs is the removal of half the ancestral germ-plasms in order to make room for those which are added in fertilization. For this reason we must suppose that an equivalent reduction of the sperm-nucleus also takes place. If this reduction did not occur, the number of germ-plasms would be doubled in each sexually-produced generation—an unthinkable result.

If there were only one kind of germ-plasm in each nucleus, and sexual reproduction commenced, there would be 1024 distinct germ-plasms in each of them at the end of ten generations. But the number of generations must be so vastly in excess of ten that the number of ancestral germ-plasms in each sperm- and

germ-nucleus must be considered to be infinite, or at any rate so large that the expelled halves would never be the same. It therefore follows that no two sperm- or germ-nuclei can be alike, and individual variation must follow. A little consideration also shows that while the children of the same parents must differ, they must also resemble each other more than the children of other parents, and while they must differ from their parents they must also resemble them more than the parents of other children.

The occurrence of atavism may be explained as a direct consequence of an unusual predominance of ancestral germ-plasms; the fact that atavism is a rare exception also follows from the fact that the expulsion of half the germ-plasms in each generation will nearly always prevent such predominance.

It is impossible to carry the subject further in the scope of a letter, or one might refer to the evidence for the absence of variability in parthenogenetic species, in which the second polar body is not expelled from the ovum; and to the identity of twins produced from a single ovum which has presumably divided after fertilization.

E. B. POULTON.

Oxford.

A Correction.

WITH reference to my communication in last week's NATURE, Prof. Oliver Lodge has called our attention to the fact that we had made a mistake in stating that the wave-length of the vibration was 33 centimetres. It is the semi-wave-length that is 33 centimetres; the wave-length is 66 centimetres, as is evident on consideration of the size of the "vibrator."

FRED. T. TROUTON.

Temperature Observations in Rivers.

THE Committee appointed at the Bath meeting of the British Association to investigate seasonal variations of temperature in rivers and streams was able to arrange through local scientific Societies for thirty observers, commencing work in January 1889. Of these there are ten in England, ten in Scotland, and ten in Ireland. Each observer is supplied with a specially designed thermometer (costing 2s. 6d.) which has been compared with a standard instrument, and books for recording the observations and full instructions are provided by the Committee. It is desirable to extend the observations to rivers not yet taken up, and I therefore wish to direct the attention of local scientific Societies, of meteorological observers and others interested in similar work, to the opportunity now offered of taking part in a systematic investigation, the preliminary results of which show many interesting features. I shall be pleased to answer any inquiries of intending observers.

HUGH ROBERT MILL,

Secretary Brit. Assoc. Committee.

Heriot-Watt College, Edinburgh, February 20.

"Bishop's Ring."

IN your review of the Report of the Krakatão Committee of the Royal Society, it is stated that "Bishop's ring" has quite disappeared. Now this is hardly correct, for although I have not heard of anyone perceiving it in the middle of the day for a long time past, it is still visible about sunrise and sunset, though becoming on the whole gradually fainter. I presume that it is really the same phenomenon. At the time when "Bishop's ring" was most conspicuous in the full day-time, it was always far more so when the sun was rising and setting.

Sunderland, February 20.

T. W. BACKHOUSE.

Peripatus in Australia.

Peripatus has been found not only in Queensland and Victoria, but also at Cassilis, in New South Wales, by Mr. A. S. Olliff, of Sydney. The Victorian and New South Wales localities are recorded in a postscript appended to my monograph of the genus as reprinted from vol. iv. of the "Studies from the Morphological Laboratory of the University of Cambridge." My knowledge of them is due to Mr. Olliff, who was kind enough to send me his specimen and his description of it (Proc. Linn. Soc. of

New South Wales, November 30, 1887). The New South Wales species is, I think, identical with that found in Queensland, and I should be inclined to doubt the distinctness of the Victorian species recorded by Mr. Dendy in *NATURE* (p. 366), and previously by Mr. Fletcher.

Mr. Dendy appears to lay some stress on the differences of colour as between his specimen and the specimens of *P. leuckarti* hitherto described, but it must be remembered that in some species of *Peripatus*—e.g. *capensis* and *novæ-zealandiæ*—the range of individual colour-variation is very considerable.

All the species that I have seen are very beautiful when alive; but the beauty, which is partly due to the texture of the skin, is very hard to reproduce in a drawing.

It is a remarkable fact that a creature which lives so entirely in the dark as does *Peripatus* should present such rich coloration and such complicated markings.

The egg of *Peripatus leuckarti* is heavily yolked and of a fair size, but smaller apparently than that of the New Zealand species. Its development cannot fail to be of the greatest interest, and it is sincerely to be hoped that the Australian zoologists will lose no time in working it out.

A. SEDGWICK.

Trinity College, Cambridge, February 18.

Anthelia.

I HAVE been following with much interest your notices of anthelia, and was about to add my mite to the information given, when, by the mail just in, I have your issue of October 25 last, wherein is a notice of the phenomenon as observed in Ceylon. I have witnessed it there scores and scores of times in my early tramps bird collecting, and I have also seen it at the Cape, in Brazil, on the Amazon, in Fiji, and in this island. On turning up my dear old friend Sir E. Tennant's book on Ceylon, I find that at p. 73, vol. i., he gives a very fair figure of the effect produced. It may be, as he says, that the Buddhists took from it the idea of a "halo" or "flame" for the head of Buddha, but there is one peculiarity about these flames that always struck me. In whatever position you find the Buddha, the flame is invariably in a straight line with the body even if the figure is recumbent. In form it always resembles the "tongues of fire" depicted by old painters as falling on the apostles on the Day of Pentecost.

I have seen many instances of what I suppose may be called "anthelia" in calm water, but the appearance is usually more rayed. I have an exquisite engraving in my print collection of the "Madonna and Dead Christ" by Aldegrevier (1502-58). It has often occurred to me, in looking at it, that the artist has taken his idea of the halo round the Virgin's head from the appearance presented by the "anthelia" in water. There is the same luminous centre, and then the divergent rays. The halo round the head of the dead Christ in her lap is a four-cornered luminous star, issuing rays, of which three points only are visible—like nothing in nature with which I am acquainted.

E. L. LAYARD.

British Consulate, Noumea, January 3.

Mass and Inertia.

I AM pleased to see that Dr. Lodge has adopted my suggestion made in the *Engineer* about four years ago of using the term inertia for the quantity mass-acceleration. In making the suggestion I considered that I merely asked a return to the meaning implied by Newton in the phrase "*vis inertia*."

Unless this is the meaning of the term, the reason why Σmr^2 is called moment of inertia is almost incomprehensible. With it the connection is obvious; for, if ψ is the angular acceleration of a body about an axis, and r the distance of any particle, its linear acceleration is ψr , its inertia $m\psi r$, and its moment of inertia $rm\psi r$, or $m\psi r^2$. As the angular acceleration is the same for all particles of the body, the moment of inertia of the body is $\psi \Sigma mr^2$.

As Dr. Lodge mentions that he is bringing the matter before the British Association Committee on Units and Nomenclature, might I suggest that in future Σmr^2 should be called the *moment of inertia constant*, thereby implying the existence of the *variable factor* ψ , the angular acceleration, in the expression for moment of inertia.

E. LOUSLEY.

Royal College of Science, Dublin, February 16.

To find the Factors of any Proposed Number.

It has long been a desideratum of mathematicians to discover a formula or method for ascertaining the factors of any proposed number, and also determining whether it be a prime or not. Their endeavours during the twenty centuries that have elapsed since Eratosthenes (B.C. 276-196) made the first recorded attempt to produce a practical rule for the purpose have not been attended with success.

As it may interest many readers of *NATURE*, and others, I propose, with a few preliminary remarks, to make known a simple arithmetical method by which this desideratum can now be attained.

Factors of an even number can readily be found, as 2 is always one of them, but it is not always so easy to find the factors of an odd number, especially if it be a high one, and, if the number be the product of two primes, the difficulty in this respect is still greater, because they are its only factors. Hitherto they could be ascertained only by trying in succession, as divisors, the prime numbers of less magnitude than its square root.

To find by such process the factors of 8616460799 (the square root of which is between 92824 and 92825), it might, possibly, be necessary to try 8967 prime numbers as divisors (out of the 8969 that there are) before they could be ascertained. By my process, division sums are altogether avoided. This high number occurs in a chapter on "Induction as an Inverse Operation," in "Principles of Science," by Stanley Jevons, second edition. His emphatic remarks as to the difficulties attending on inverse operations in general, and particularly those with reference to finding the factors of this number, were the incentive to my endeavouring to discover some process for ascertaining them which might possibly have escaped being previously tried. He states:—"The inverse process in mathematics is far more difficult than the direct process. . . . In an infinite majority of cases it surpasses the resources of mathematicians. . . . There are no infallible rules for its accomplishment. . . . It must be done by trial, . . . by guess-work. . . . This difficulty occurs in many scientific processes. . . . Can any reader say what two numbers multiplied together will produce 8616460799? I think it unlikely that anyone but myself will ever know. They are two prime numbers, and can only be discovered by trying in succession a long series of prime divisors, until the right one be fallen upon. The work would probably occupy a good computer many weeks. It occupied only a few minutes to multiply them together."

Mr. Jevons adds: "There is no direct process known for discovering whether any number be a prime or not, except by the process known as the 'sieve of Eratosthenes,' the results being registered in tables of prime numbers."

In the article on prime numbers in "Rees's Cyclopædia" (ed. 1819), the writer states: "It is in fact demonstrable that no such formula" (for discovering whether a number be a prime or not) "can be found, though some formulæ of this kind are remarkable for the number of primes included in them."

The difficulty of finding the factors of numbers is also referred to by the eminent writer (at that time President of the Mathematical Society)—under the initials C. W. M.—of an interesting review of "Glaisher's Factor Tables," in *NATURE*, vol. xxi. p. 462. In course of his remarks he mentions the number 3979769, and respecting it says: "It would require hundreds of division sums to ascertain by trial that it had 1979 for a divisor, and that consequently it was the product of 1979 $\times$ 2011;" and he adds, ". . . there is no general mathematical principle which enables us to dispense with the trial, or even to shorten it, so as to bring it within practical limits."

These extracts afford conclusive evidence that no direct rule or method has hitherto been known, by which the factors of a number could be ascertained, and also that it is considered it would be a task of almost insuperable difficulty to devise one. Yet it seemed to me not unreasonable to think that, as two factors multiplied together formed a product, it ought to be possible to unmultiply or split up (as "C. W. M." expresses it) that product into its factors again, "without the enormous labour of trying for its divisors."

Strongly impressed with this idea, I attempted to realize it, and before long succeeded in discovering a simple arithmetical process for the purpose, and different from any previously tried. When applied to find the factors of 8616460799, instead of "many weeks being occupied" in the task, it showed, within a very reasonable time, that they were 96079 $\times$ 89681. When