the climate of eastern equatorial Africa was more humid than at present; he now attributes the change to artificial deforestation of the country. The most interesting paper in the number is one by St. Paul Hilaire, which gives an account of the laws of inheritance of the different tribes on the coast near Tanga. In the actual coast towns the people are either Mohammedan, or under Mohammedan influence, and the author has little new to record, except a list of native writings. The Bantu people of the district considered belong to four tribes, of which the report deals only with the Wa digo, one of the most intelligent people on the East African coast. St. Paul-Hilaire first states the laws on the inheritance of property, which passes to the relatives of the mother. Thus a man's wives and children are inherited by the nearest male maternal relative. The rest of the report summarises the rules in regard to marriage. The last article in the volume continues the publication of Dr. Steinbach's important meteorological observations on the Marshall Islands.

FOR several years the American Public Health Association has had a special committee on pollution of water supplies. At the meeting of the Association in Montreal, this committee recommended that a co-operative investigation be instituted with regard to the bacteriology of water supplies, and, as an outcome of this proposal, a convention was held in New York, in June last, to consider methods and elaborate a standard scheme of work which would secure some sort of uniformity in the differentiation of species of bacteria. The verbatim report of the proceedings of this convention (which was attended by most of the prominent American bacteriologists), together with the papers presented, make up the October *Journal* of the Association. The subjects considered relate almost exclusively to certain technical matters, which required elucidation before a satisfactory scheme of work could be drawn up; among these questions being: colour nomenclature for bacteriologists; how variability is to be regarded; the methods to be followed in determining the relation of bacteria to temperature; methods for the separation of bacteria into groups, and for the identification of species; the nature of the flagella, and their value in the systematic classification of bacteria; the grouping of water bacteria, and the influence of variations in the composition of nutrient gelatine upon their development. No decision was reached on any of the questions discussed; but the whole series was referred to a committee, with the understanding that the convention would accept its decision, and that its members would modify their laboratory methods in accordance therewith. The decisions of this committee have not, however, yet been published.

THE literature of marine biology has just been increased by the publication of the fourth volume of "Reports upon the Fauna of Liverpool Bay and the neighbouring Seas," written by the members of the Liverpool Marine Biology Committee and other naturalists, and edited by Prof. W. A. Herdman, F.R.S. The volume commences the record of the investigations carried on at the committee's biological station at Port Erin, Isle of Man. At this station, which was opened in 1892, several important investigations have already been carried out, and there is every reason to believe that the work will develop in the future, as the facilities for observations are increased. We notice among the papers included in the volume, one on the vascular systems of the Starfishes, by Mr. H. C. Chadwick, and another on the Cerata of Nudibranchs, by Mr. J. A. Clubb. There are also reports on Turbellaria, by Mr. F. W. Gamble; on Copepoda, by Mr. Isaac C. Thompson; on Nemertines, by Mr. J. H. Vanstone and W. I. Beaumont; on Medusæ, by Mr. E. T. Browne; and on Amphipoda, by Mr. A. O. Walker. These, with a valuable paper, by Dr. R. Hanitsch, on the nomenclature and classification of British sponges, and three reports, by Prof. Herdman, upon the work of the Liverpool Marine Biology Committee and their biological station, make up a very creditable volume. The Liverpool naturalists deserve to be congratulated for accomplishing so much work in a modest establishment, and without any funds except those raised by private subscriptions.

TWO memoirs on Entomophytes have recently been published. The one is by Mr. R. H. Pettit on "Studies in Artificial Cultures of Entomogenous Fungi," and emanates from the Cornell University Agricultural Experiment Station, U.S.A. The other is by Mr. A. S. Olliff on "Australian Entomophytes, or Entomogenous Fungi, and some account of their Insect-Hosts," and is issued by the Department of Agriculture, Sydney, N.S.W. Both are well illustrated, and deal largely with Cordyceps and Isaria. The loose, white, cottony growth which sometimes envelopes dead insects is a familiar sight, and Mr. Pettit, in discussing the possible use of entomogenous fungi for insecticidal purposes, refers to the suggestion that has been made to employ *Sporotrichum globuliferum* against the chinch-bug. Mr. Olliff is prepared to make the assertion that all the larger fungi of the genus Cordyceps live upon, and at the expense of, subterranean larvæ and pupæ, in proof of which he points to the fact that all the bulky species of which the hosts are definitely known have been found upon root-feeding insects. Of Hyphomyceteæ there are various minute entomogenous forms recognised as Australian. Some of these are variously found on aphides infesting pumpkin leaves, on dead ants, and on red scale of the orange. *Botrytis tenella*, Sacc. (*Isaria densa*), on larvæ and pupæ of Diptera, wasps, and cockchafers, has been introduced into Australia from Europe for the purpose of killing Lamellicorn larvæ, but the attempts have not succeeded. Mr. Olliff adds that in view of the large numbers of *Cordyceps Gunnii*, and *C. Selkirki* that are found in a limited area, and of the extensive injuries to useful timber and shade trees which often result from the attacks of the subterranean larvæ of Pielus and Trictena, the hosts of these parasitic fungi, it is evident that the native species of Cordyceps have a considerable economic value. He hopes that the Department of Agriculture at Sydney will shortly be able to make investigations to test the possibility of utilising these fungi artificially for the destruction of injurious root-feeding insects.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*) from India, presented by Mr. V. Roger; a Smooth-headed Capuchin (*Cebus monachus*) from South-east Brazil, presented by Major F. A. White; a Kittiwake (*Rissa tridactyla*), British, presented by Mr. Walter Butters, jun.; three Poë Honey Eaters (*Prosthemadera novæ-Zealandiæ*) from New Zealand, presented by Mr. Morton Campbell; a Bearded Lizard (*Amphibolurus barbatus*), a Diamond Snake (*Morelia spilotes*) from Australia, presented by Mr. Frederick G. Aflalo; a Four-lined Snake (*Coluber quadrilineatus*), European, presented by Captain Allen Keys; a Poë Honey Eater (*Prosthemadera novæ-Zealandiæ*) from New Zealand, deposited.

OUR ASTRONOMICAL COLUMN.

A NEW COMET.—A bright comet was discovered by Mr. Brooks, at Geneva, on November 21, in R.A. 9h 52m. and Decl. 17° 4′ S. An observation of the comet at Copenhagen shows that it is moving northwards at the rate of nearly three degrees per day. On November 24, at 17h. 37m. 9s., it was in R.A. 9h. 42m. 33s. and Decl. 10° 40′ 32″ S. The comet is not far from α Hydræ, and rises about 12.30 a.m.

COMET PERRINE.—The comet discovered by Mr. Perrine at the Lick Observatory, on November 16, was observed by Dr. Lamp at Kiel, on November 18, its position at 17h. 34·2m. Kiel mean time being R.A. 13h. 48m. 8s., Decl. 0° 50′ 24″ N. *Edinburgh Circular* No. 47 reports that the comet was also

observed by Dr. Halm, at Blackford Hill, as follows:- November 18, 18h. 26m. 14s. G.M.T.; R.A. 13h. 48m. 15s., Decl. 0° 48′ 18″·8 N. The movement of the comet is in a direction south-east by east, and it now rises about 4 a.m. Dr. Lamp states that the comet is moderately bright, but not visible to the naked eye; it is round, with a central condensation, and a straight tail (*Ast. Nach.* 3318).

VARIABLE STAR CLUSTERS.—Harvard College Observatory *Circular*, No. 2, announces that an extraordinary number of variable stars has been discovered in certain globular clusters which have been photographed by Prof. Bailey at Arequipa with the 13-inch Boyden telescope. At least eighty-seven of the stars in the cluster M3 (N.G.C. 5272), in Canes Venatici, have been found to be variable, and in some cases the change of light amounts to two magnitudes or more. In the cluster M5 (N.G.C. 5904), forty-six variables were found, out of 750 stars examined, so that they form about six per cent. of the whole; of the sixteen stars, contained in a circle 110″ in diameter, six are variable. Smaller numbers of variables have been found in other clusters, but in other cases not a single variable has been detected out of the hundreds of stars which have been photographed; the conditions of the search, however, not taking account of long period changes. In general, no variables have been found within about one minute from the centres of the clusters, on account of the closeness of the stars, and none are more than ten minutes distant from the centres. Some of the newly-discovered variables have short periods, in some cases of only a few hours. Thus, five photographs of N.G.C. 5904, taken at intervals of an hour on July 1, 1895, give for the magnitude of a star about three minutes of arc preceding the centre of the cluster, 14·3, 13·5, 13·8, 13·9, and 14·3; four plates, taken at similar intervals on August 9, gave the magnitudes 14·2, 14·6, 14·8, and 15·0.

ON A METHOD OF PHOTOGRAPHY IN NATURAL COLOURS.[1]

IN 1861 Clerk Maxwell described a method of colour photography, based upon his experiments on the theory of colour vision, and made the following experiment. Three photographs of a coloured object were taken through three several coloured solutions giving images which separately represented the object as it would be seen by each of the three sets of colour nerves postulated by Young. When these were superposed the original colours of the object were reproduced, save for the defect that the red and green components suffered from the insensitiveness of the photographic plate of Maxwell's time to the longer wave-lengths. Maxwell added the remark that when the photographic plate was improved as regards sensitiveness to the less refrangible rays, the representation of colour would be improved.[2]

Since Maxwell's day the colour blindness of the plate has been almost completely remedied, thanks to the discovery of Vogel, and it is now possible, proceeding on the lines laid down by Maxwell, to produce by triple projection upon the screen a picture which may be illusively like nature. For the application of modern resources and the suggestion of photographing to the colour vision curves by special colour screens, we have to thank Mr. Ives.

Composite colour photography deals with the subjective reproduction of all visible wave-lengths in two stages; a photographic analysis and an optical synthesis. In the first operation the several wave-lengths are caused to produce three separate photographic images according to their physiological activity in exciting the supposed fundamental red, green, and violet sensations. That is, if the image bears, for example, a yellow colour (suppose such a yellow as the spectral yellow near the D line), one of the plates must record an image of the object having a density of silver deposit corresponding to the degree in which this wave-length can excite the red-seeing nerve, and a second must acquire a density corresponding to the degree in which this same wave-length can excite the green-seeing nerve. The third plate records no impression, for the wave-lengths near D excite no violet sensation; but this yellow sensation is the resultant of two physiological effects only, a red and a green sensation in certain proportions obtained by colour measurements effected upon normal colour sight. We have now obtained three negatives possessing densities of silver deposit corresponding to the degrees in which the three several fundamental colour sensations are stimulated. These degrees of density will be interpreted as degrees of transparency in the positives. The first positive, if backed with a red glass, will transmit a quantity of red light corresponding to the intensity of the physiological excitation of redness in the "red" nerves; the second, backed with green, similarly represents the stimulation of the "green" nerves by the yellow colour of the object; the third positive is backed with blue-violet glass, but is quite opaque, and no violet light is transmitted through it. The projection now of all three images superposed upon the screen forms the second stage of the procedure; the optical synthesis of the original colours. The eye regarding the superposed image receives, in fact, the same amounts of red and green sensation, and experiences the same absence of violet sensation which would have attended the formation of the image of the original object upon the retina.

This process, if accurate reproduction of colour is sought, necessitates the use of two distinct sets of colour selective screens; for the analysing screens will by no means possess the tints ultimately required in the optical synthesis. This is evident since the measurements on colour vision reveal that the wave-lengths near D are more strongly stimulative of red sensation than are the purely red exciting wave-lengths near C, and the wave-lengths again diminish in their power of producing stimulation of the "red" nerves on the more refrangible side of D. Hence, in order to photograph the wave-lengths of the spectrum, we require to produce a greater photographic effect by the D wave-lengths than by the C wave-lengths, and a photographic

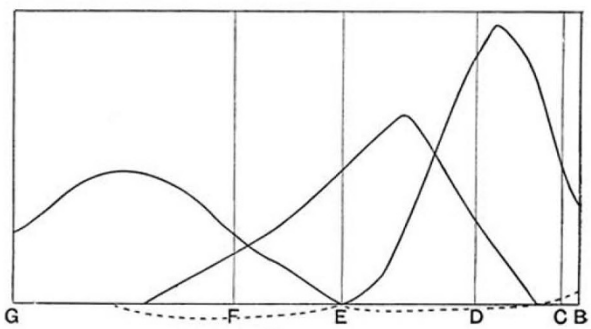

FIG. 1.

effect diminishing above D in the same degree as the power of the waves to excite the fundamental red sensation diminishes. To effect this analysis of the light a screen transmitting as predominant wave-length, a wave-length near D must be used for obtaining the image which is to represent the appreciation of light peculiar to the "red" nerves. Such a screen has a yellow-orange colour, which is not the sensation excited in or transmitted by the "red" nerves. In the optical synthesis this must afterwards be represented by a C red colour. The same remarks apply to the other screens.

Maxwell's curves (Fig. 1) are not colour sensation curves (Abney: "Colour Vision," Tyndall Lectures, 1895), and it is misleading to speak of the foregoing method as effected on colour sensation curves. Maxwell's curves represent, in fact, the subjective synthesis of the spectrum out of three chosen wave-lengths—a red, a green, and a blue-violet. The question as to how far one or all these chosen wave-lengths may excite more than the one set of nerves remains over, and indeed can only be gone into by examination of abnormal colour vision. In Kœnig's curves of colour vision, colour sensations are plotted. These are shown in the named curves of Fig. 2.

If, from the knowledge afforded by Kœnig's curves of the compound nature of the green sensation, Maxwell's curves be examined with reference to their suitability to serve the purposes of the photographic method, it will be found that, assuming Maxwell's E green to excite the proportionate amounts of red and violet sensation revealed by Kœnig's curves, a correct synthesis of the F green by Maxwell's curves is impossible. Although such a comparison is not strictly allowable owing to

[1] Abstract of a paper read before the Royal Dublin Society, by Dr. J. Joly, F.R.S.

[2] "On the Theory of Three Primary Colours." "Collected Papers," p. 449.