hour it will be advantageous to take them in opposite directions (*e.g.* south-west and north-east). A reseau of five photographs would practically cover the whole visible sky when an average lens is employed, and it is accordingly recommended that, when possible, one photograph should be taken towards each of the points north, east, south, and west, and one towards the zenith. Photographers should be particularly careful to mark their plates in some way, so that the photographs in the different directions may be readily recognised after development; the inclusion of a small strip of horizon might be advisable for this purpose. In the case of the zenith photograph, a small part of some object might be included (*e.g.* the top of a tree or the corner of the roof of a house) to indicate the orientation of the plate.

The main object is not to secure artistic effects, but rather to obtain clearly defined records of the cloud forms present, and therefore "contrasty" results are preferable.

Photographers who are willing to take part voluntarily in this work are invited to send their names to one of us at Stoner Hill, Petersfield, and these volunteers will be supplied with the necessary instructions when these are ready for distribution. At the request of Col. Delcambre, of the French Meteorological Service, instructions for taking the photographs have been drawn up by one of us and are to be circulated internationally.

C. J. P. CAVE.
G. AUBOURNE CLARKE.

An Einstein Paradox: an Apology.

ALLOW me to express regret for having misinterpreted Prof. Einstein's symbols. My mistake was caused by the fixed idea that it was impossible for K_1 *in motion* to learn anything about the signal at L *until the light reached him.*

I owe to Mr. C. O. Bartrum the explanation that there are three events, namely, (1) the emission of light-signal at L; (2) its reception by K_1; (3) its reception by K; and that each requires its own double set of space-time co-ordinates; thus (x_1, t_1), (x_2, t_2), (x_3, t_3) in K's system and the same letters with accents for K_1's. There will then be three pairs of Einstein equations.

I find, however, from letters received, that opinions differ as to the interpretation of the t's. Some think that they are the actual times recorded by the clocks; others that they have to be corrected by allowances for the passage of light. Some think that a body in motion actually contracts and that a carried clock goes slow; others that the body only seems to contract and that each of the two observers thinks that the other's clock goes slow. The latter have a difficulty in explaining the constant c.

The simple problem of which the Newtonian solution was given in NATURE of June 2 ought to admit of a solution by relativity methods. I should be greatly obliged to any of your readers who would send me one showing the time on K's clock when the signal reaches K, viz. $x_1/v + x_1/c$.

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Colour Vision and Colour Vision Theories.

PROF. PEDDIE, in NATURE of August 4, p. 163, has dealt with some of my strictures of the trichromatic theory. Whilst nothing can be said against his mathematical presentation of the theory, it can easily be shown that, when a case of colour blindness is fully and carefully examined, the mathematical presentation will not account for the facts. All the facts which are explained by the trichromatic theory are, however, consistent with my theory.

The trichromatic theory becomes more and more complicated with subsidiary hypotheses, inconsistent with each other. I have examined a man stated to be completely red blind, but tested with my lantern he recognised red as easily as a normal-sighted person. How do 50 per cent. of the dangerously colour blind get through the wool test? The trichromatic theory completely fails to explain the trichromic class of the colour blind. The trichromic have no yellow sensation, regarding this region of the spectrum as red-green and marking out in the spectrum a monochromatic division including yellow, orange-yellow, and yellow-green.

If the trichromatic theory were true the point where the hypothetical curves cut should be shifted towards the defective sensation; this is not found. Let the trichrome now be examined by colour-mixing methods, and he may make an equation R + G + V = W, with too much red in the mixed light, and then make an equation with too much green in the mixed light. Again, he may agree with the normal match, or in other cases only agree with the normal match when the comparison white light is diminished in one case or increased in another, thus matching two white lights of different luminosities.

F. W. EDRIDGE-GREEN.

London, August 7.

Stirling's Theorem.

THE recent correspondence in the columns of NATURE on this subject prompts me to add to the collection a formula which I deduced about three years ago. It was then communicated to a mathematical friend, but has not otherwise been published.

The ordinary Euler-Maclaurin series for $\log_e n!$ is

$$\log\sqrt{2\pi} + (n+\tfrac{1}{2})\log n - n + 1/12n - 1/360n^3 + 1/1260n^5 \ldots$$

It is easily shown that the last three terms printed above are reproduced exactly by the first three terms of the binomial

$$\frac{1}{12n}\left(1+\frac{113}{210n^2}\right)^{-7/113};$$

while the simpler binomial

$$\frac{1}{12n}\left(1+\frac{8}{15n^2}\right)^{-1/16}, \text{ or } \frac{1}{12n}\left(\frac{15n^2}{15n^2+8}\right)^{1/16},$$

reproduces exactly the terms in $1/n$ and $1/n^3$ and very approximately the term in $1/n^5$. Adopting the simpler form, we have

$$\log n! \doteq \log\sqrt{2\pi} + (n+\tfrac{1}{2})\log n - n + \frac{1}{12n}\left(\frac{15n^2}{15n^2+8}\right)^{1/16},$$

or passing to common logs (M = modulus),

$$\log_{10} n! \doteq 0{\cdot}39908993 \ldots + (n+\tfrac{1}{2})\log_{10} n - nM + \frac{M}{12n}\left(\frac{15n^2}{15n^2+8}\right)^{1/16}.$$

This formula gives for 1! (true value 1), 1·00007 . . .; for 2! (true value 2), 2·000002 . . .; for 3! and 5! no discrepancy is shown by 7-figure logs and 9-figure logs respectively. The degree of approximation is therefore high and even remarkable; but it may be doubted whether this formula or any of those under discussion is really to be preferred to the direct use of the series of which we can easily take as many terms as may be required for the order of accuracy desired.

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9 St. Andrew Square, Edinburgh,
July 24.