

Little is known about louping ill viraemia in small mammals. In one experiment, a wood mouse inoculated intraperitoneally with louping ill virus had viraemia on the first, second, third and fifth day after inoculation and survived to develop antibodies. The highest titre, 1.1 log mouse LD_{50} per 0.03 ml., was obtained on the third day. This may be below the threshold required to infect feeding larvae. Small mammals such as shrews, voles and wood mice may be of particular importance in their peak population years when they probably act as amplifiers of the infection. They may do this in two ways: (1) The larger number of larval hosts present in these years probably substantially increases the proportion of larvae which succeed in feeding and thus in surviving. (2) At the same time a proportion of the larvae probably become infected. Together these will increase the risk of infection in sheep in subsequent years. A similar phenomenon has been shown to happen in Czechoslovakia, where outbreaks of tick-borne encephalitis in human beings have followed 'mouse years'⁹.

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¹ Findlay, G. M., and Elton, C., *J. Comp. Path.*, **26**, 126 (1933).

² Dunn, A. M., *Brit. Vet. J.*, **116**, 284 (1960).

³ Williams, H., Thorburn, H., and Ziffo, G. S., *Nature*, **200**, 193 (1963).

⁴ Smith, C. E. G. (unpublished information).

⁵ Smith, C. E. G., McMahon, D. A., O'Reilly, K. J., Wilson, A. L., and Robertson, J. M., *J. Hyg. (Camb.)*, **62**, 53 (1964).

⁶ Southern, H. N. (edit.), *The Handbook of British Mammals* (Blackwell Scientific Publications, Oxford, 1964).

⁷ Varma, M. G. R. (in the press).

⁸ Rosicky, B., *Cesk. Parasit.*, **1**, 15 (1954).

⁹ Havlik, O., *Czech. Hyg. Epidemiol. Mikrobiol. Immunol.*, Prague, **3**, 300 (1954).

PSYCHOLOGY

Sensitivity of Hands to Visible Light

RECENTLY, reports have appeared in the press of experiments demonstrating the existence of a dermal sensitivity to intensities and wave-lengths of visible light. Many of the experiments do not appear to have precluded thermal effects, and B. Konstantinov has suggested¹ that the results may be explained by the perception of reflected infra-red radiation emitted by the hand. In the experiment recorded here these effects have been reduced, and college-age subjects have been required to discriminate between black and white.

In the experiment the subject placed one hand in a dark box, above two (2 in. × 4 in.), 1 in. deep, black chambers, one of which contained a white lint-covered plate and the other a black. The interchangeable plates were illuminated by an external fluorescent lamp, and were separated from the subject's hand by a 3-mm thick window of heat-absorbent glass (Chance ON20 which transmits less than 5 per cent of the incident infra-red). The intensity, above the window, of the light reflected from the white plate was 0.00012 lumens/cm², this being 3.5 times the intensity above the black.

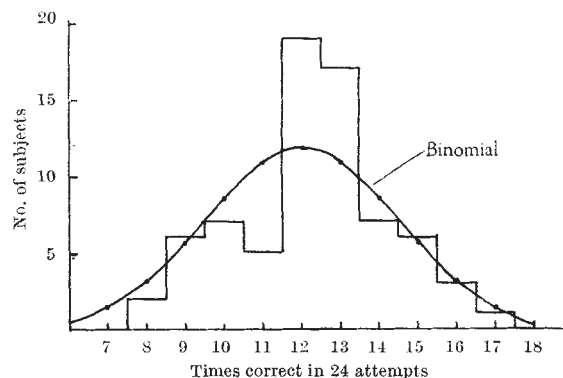


Fig. 1

The subject was given a few minutes in which to learn the difference between black and white before being tested 24 times. Before each test the plates were placed in the chambers on a pre-determined random basis by an experimenter invisible behind a screen. The subject was given no knowledge of her performance until the end.

The results for a total of 73 subjects (66 women) are shown in Fig. 1. No individual showed significance at the 5 per cent level. The results were combined and a significance level of 8 per cent was obtained ($\chi^2 = 14.4$, 8 *d.f.*)—reflecting a slight tendency for the subject to be right rather than wrong. A test merely for discrimination (curve folded) gave a significance level of 11 per cent ($\chi^2 = 7.6$, 4 *d.f.*).

At this relatively low light intensity the experiment does not appear to support the proposition that hands are sensitive to visible light.

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¹ *Soviet News*, Feb. 10, 1964.

Central Adaptation in Mechanisms of Form Vision

PERCEPTION of any visual pattern is subject to three well-known forms of adaptation. In the first place a 'negative after-image' is formed which tends to reduce the contrast between the brightnesses of neighbouring areas. Secondly, after more prolonged fixation, peripheral parts of the visual field tend to fade from view in large patches. With a stabilized retinal image, it is well known that a third type of adaptation can occur, in which the whole field fades and reappears intermittently.

With a randomly structured field such as an enlarged photograph of sandpaper (Fig. 1a) I have recently observed a fourth type of adaptation which seems to be distinct from all of those mentioned. After ten or twenty seconds' fixation, monocular or binocular, the clarity of one's visual image is unimpaired but the texture of the field assumes a curiously uniform character. The coarser features disappear and leave a mottled pattern reminiscent of a tufted carpet. Some observers report that the mottling has a roughly periodic character, the unit cell subtending an angle of the order of 1 degree. There is evidence also that the character of the uniform field seen is partly determined by the form of the region of the random field fixated. During monocular fixation a kind of rivalry is observed between the mottled image and a dark field, subjectively associated with the occluded eye, criss-crossed by a highly active population of randomly distributed dots and lines in motion.

The original pattern at once reappears, with enhanced vividness, if fixation is displaced by a few degrees. If the

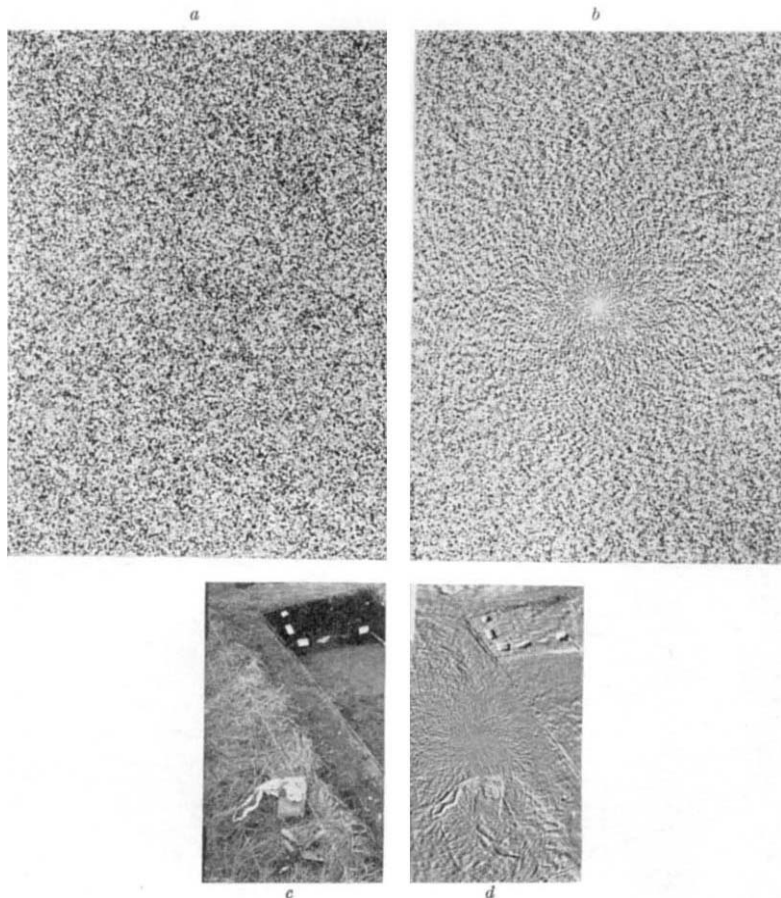


Fig. 1

originally fixated position is resumed within 1-2 sec, the uniformly mottled appearance returns, proving that the adaptations concerned are local to each area of the visual field stimulated. Though this might at first seem in some way to implicate local retinal adaptation to brightness, two further observations indicate that the phenomenon is different in origin. In the first place, the use of intermittent illumination, which partially overcomes brightness adaptation, does not restore the original form. Secondly, the same tendency towards homogeneity is found with the

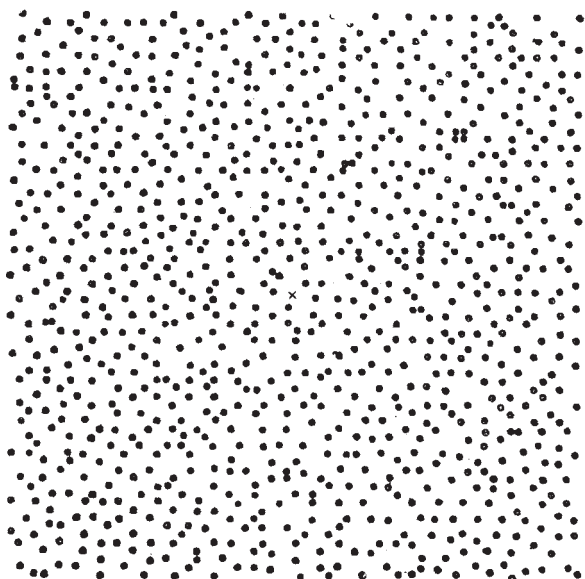


Fig. 2

'all-or-none' pattern of Fig. 2, in which simple brightness adaptation could affect only the contrast.

It is tempting to interpret this phenomenon in terms of the contour-detecting and other form-sensitive neural mechanisms adumbrated by earlier observations¹ and reported recently in lower animals²⁻⁴. It would not be surprising if the long-range interactions between receptive fields required for the computation of form were more vulnerable to adaptation than those concerned with the signalling of brightness contrast, particularly when the redundancy of the pattern is low. The latter qualification is reinforced by the observation that with pages of newsprint, and other massive stimuli in which regular contours are present, such 'figural' adaptation is not observed to anything like the same extent.

The foregoing effects should be distinguished from another visual phenomenon observable on prolonged fixation of such random fields, namely, the transient appearance of spiral patterns. These seem to have a simpler explanation. As the reader can easily verify, they can be produced at will by suddenly rotating the fixation field by a degree or two. It seems reasonable, therefore, to attribute them to small torsional eye-movements.

It is not perhaps obvious at first sight why rotation in this case should generate spirals rather than circles. The reason becomes clear, I think, if one superimposes positive and negative photographic images of identical fields, such as Figs. 1a and c, with a slight relative rotation. The results are shown in Figs. 1b and d. Close to the centre of rotation, only edges which happen to lie radially are sufficiently displaced to be enhanced. At greater distances from the centre of rotation the optimal displacement for contour enhancement is exceeded for edges lying radially, but is achieved for those lying at progressively larger angles to the radius. The loci suggested by these enhanced contours thus tend to be spiral. Figs. 1c and d have been included to indicate that the effect is strengthened when the primary image is rich in long black or white edges at all angles. In the production of spirals observed when viewing a field such as Fig. 1a, the part of 'negative' is presumably played by the adapted retina.

Notwithstanding its irrelevance to the first phenomenon described, this mechanism of spiral-production may possibly be of interest in connexion with another type of central adaptation—the generation of spiral 'complementary images' when a field of random visual noise is viewed through or against a pattern of radial lines^{1,5}. Since it is known that in this case eye movements are not responsible⁶, the appearance of spirals raises the question whether lateral inhibitory action along the radial contours produces in effect a displaced 'negative' of the figure of neural excitation, which combines with the primary figure in analogous fashion to Figs. 1b and d.

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¹ MacKay, D. M., *Nature*, **180**, 849 (1957).

² Lettvin, J. Y., Maturana, H. R., McCulloch, W. S., and Pitts, W. H., *Proc. Inst. Radio Eng., N.Y.*, **47**, 1940 (1959).

³ Hubel, D. H., and Wiesel, T. N., *J. Physiol.*, **148**, 574 (1959).

⁴ Arden, G. B., *J. Physiol.*, **166**, 468 (1963).

⁵ MacKay, D. M., in *Sensory Communication*, edit. by Rosenblith, W. A., 339 (M.I.T. and Wiley, 1961).

⁶ MacKay, D. M., *Nature*, **180**, 1145 (1957).