have been obtained for three subjects, and all showed the same net pattern of change. Details of the experiment were as follows. A short bright line subtended $6' \times 1.0'$ at the eye, and was presented at 7-sec intervals against an illuminated background. The brightness of the short line was at that level which gave optimal acuity, which was first established for each exposure time. The subject (D. P. A.) adjusted the slope between flashes until satisfied that it matched that of a long thread near by, which was at one of 14 inclinations. This matching was repeated 17 times to give the mean bias ($\bar{x}$); the S.E. of $\bar{x}$ ranged between 0.15° and 0.3° (within-run), but $\bar{x}$ is also subject to drift between runs which will affect reliability, since the experiment took several days. Each inclination of the comparison thread was used for 6 successive runs at the different exposure times. The sequences of these 6 runs and of the 14 comparison inclinations were randomized.

All measurements are in degrees, measured clockwise from the vertical for θ , with $\bar{x}$ measured from θ . The graphs show the 'stretch' effects already described. Gradients around the horizontal, vertical and $\pm 45^\circ$ directions undergo systematic changes as a function of exposure duration.

A further indication that F-outputs are subject to adaptation can be seen in the last two lines of Fig. 1, which show the θ -bias function for continuous exposure, and the same function six months earlier. Although the general shape of the function is the same in the two cases, the actual values of bias differ considerably. This drift is co-ordinated: the biases at neighbouring orientations have drifted by similar amounts. Similar drifting has been found to affect the biases depending on the position of the stimulus line in the field; in this case, the drift was co-ordinated spatially over a foveal region $40'$ square.

This drifting is evidently held within limits of some kind, or the pattern of the results would change as well as the actual values. The adaptation hypothesis (5) is an economical explanation of these phenomena. Such a mechanism has the advantage that the nervous system does not have to encode exact values of orientation, which frees it from a difficult engineering problem. So long as the sequence of orientation values is preserved reasonably well throughout the transmission lines, the system can supply a satisfactory scale of perceived orientation at the receiving end.

I thank Prof. D. M. MacKay, Dr. H. B. Barlow and Dr. J. P. Wilson for their advice and comments.

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True Venous Pulse Wave

THE classical jugular phlebogram (JP) is a composite record of arterial and venous pulsations. Mackenzie¹ noted that if the carotid arterial pulse wave could be subtracted from the JP we would have what he called "the true venous pulse wave". He was, however, unable to obtain such a record experimentally.

An approach to this problem was made as follows. Pulse recording elements were placed, first, in the position where classically the JP is recorded (in the angle formed by the origin of the right sternomastoid muscle and the upper and inner margin of the clavicle) and, secondly,

over the right carotid artery as high as was feasible in the neck. A technique was devised to ensure the temporal alignment of the carotid pulsations from both recording sites. The magnitude of the pulsations was also balanced. The subject was supine on a tilting table 10° head-up. These two sets of pulsations were recorded through a differential gauge made by Statham, Puerto Rico (P 23 H, No. 113). Fig. 1A shows a typical record made with a Grass Polygraph. Reading from the top the records are ECG, jugular phlebogram, true venous pulse (TVP) and right carotid. The differential record of the TVP is obtained by subtracting the carotid record (line 4) from the JP (line 2).

Fig. 1

The most obvious difference between the JP and the TVP records is the change in the 'c' wave. This may be absent. If it is present it is small and coincident with the early part of the anacrotic limb of the carotid pulsation (see Fig. 1B). The 'a', 'v' and 'h' waves are superimposed on a rising base line which starts at the bottom of the X^2 wave and rises to the summit of the 'a' wave. This base line in the JP is usually horizontal. Another feature of the negative wave X^2 is that it is more prominent, with a rapid descending limb from the summit of 'a'.

This work was supported by grant HE 07722 from the U.S. Public Health Service.

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