The clips were prepared from ordinary umbilical clamps (*1*) by covering the simple branch (the one not bearing a hook) with rubber tubing. After shaving the back of the animal with electric clippers, a skin fold was taken up between the fingers and compressed by the clip, which was left in position for 9 hours. The times of treatment are indicated in Table 1, the application of the clip being 0 hour. The techniques used for production of stress have been described in detail elsewhere (*2*). Intensity of necrosis was appraised, by semiquantitative inspection, in terms of a scale of + to +++ and was verified histologically (periodic acid-Schiff reaction and van Gieson technique) on the 4th day. Lesions in and immediately around the roughly circular line directly compressed by the clip were disregarded. Crust formation with subsequent rejection of the skin over all or part of the clipped area were taken as indicators of necrosis. Serial examinations on control rats, killed at intervals, showed that just after the removal of the clip the ischemic area was virtually normal except for intense degranulation of the mast cells. Edema with numerous hemorrhages in the microcirculation appeared approximately 15 minutes after the clip was removed, which suggests that the vascular system was particularly affected. This was followed, 6 hours later, by the formation of thrombi, consisting of aggregations of erythrocytes, and infiltration of serum and erythrocytes into the walls of larger arterioles and venules. Beginning at about this time the nuclei of all cells in the affected area underwent pycnosis, eventually disintegrating into amorphous basophilic bodies, while the collagen fibers became a homogeneous mass. Inflammatory infiltration and reactive hyperemia were noted only in the areas beneath the clips. Figure 1 shows the histologic appearance of both necrotic and essentially normal skin.

As shown by Table 1, all the severe stressors, as well as the high doses of catecholamines and chlorpromazine, offered considerable and, in some cases, total protection against the necrosis induced by prolonged interruption of the circulation. However, preliminary experiments had shown that smaller doses of catecholamines or chlorpromazine possess little, if any, prophylactic effect; hence, it remains to be seen whether these agents act merely as stressors or through their specific pharmacologic properties. Conceivably, during systemic stress, endogenous catecholamines might act as mediators of the protective action. It is dubious, however, whether efficacious amounts of these hormones could have been secreted, although selective release at nerve endings or activation by stress-induced conditioning factors may have augmented their potency. It is clear that even the enormous doses of glucocorticoids, administered either chronically as a pretreatment or suddenly just before application of the clip, failed to duplicate the protective action of stress.

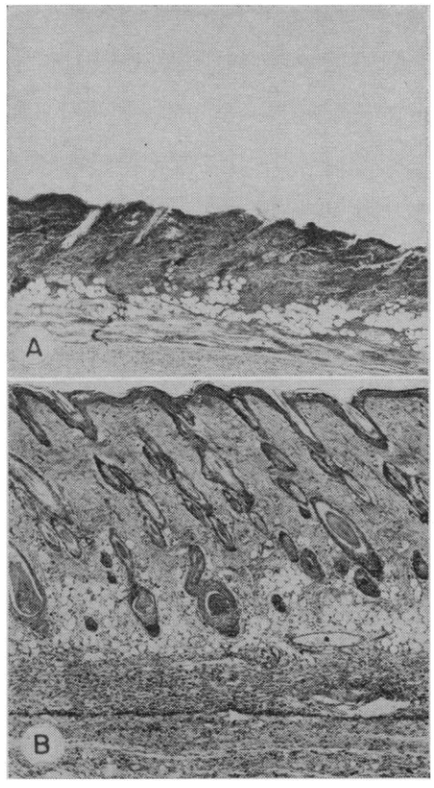

Fig. 1. (A) Histologic appearance of necrotic skin from control animal. (B) Essentially normal histologic structure of skin, except for mild inflammatory infiltration and degeneration of hair roots, in animal protected by chlorpromazine.

Chlorpromazine was tested because we had noted earlier that phenothiazines can protect the heart of the rat against infarctoid necroses elicited by chemical means (*3*, *4*). However, pretreatment with systemic stressors can also offer protection against this type of cardiac necrosis (*2*); hence, even here, the specificity of the pharmacologic action remains to be demonstrated.

Earlier work had shown that exposure to stress can protect the organism against a great variety of morbid lesions, including several forms of calciphylaxis, calcergy, inflammation (*3*), and thrombohemorrhagic phenomena (*5*). The observations reported here indicate that even the tissue damage induced by prolonged total interruption of the circulation can be prevented by systemic stress.

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Visual Discrimination of Temporal Order

Abstract. *Past research addressed to the minimum temporal separation necessary for the judgment of visual stimulus order has failed to control peripheral adaptation and masking effects. The present study employed pairs of brief stimuli with each member presented to a separate eye; that is, dichoptic presentations. Under these conditions, minimum separations for the correct discrimination of order were found to be far less than those obtained in experiments in which both stimuli were presented to the same eye or to both eyes.*

Several recent studies of perceived order (*1*) appear to have been inspired by the earlier research of Hirsh and Sherrick (*2*) in which vision, touch, and audition were compared with respect to the temporal separations necessary for the correct judgment of stimulus sequence. The compelling finding of Hirsh and Sherrick was the relative constancy of 20 msec among the three modalities and within vision irrespective of the retinal locus stimulated. Given the well-established differences among the senses in the discrimination of "one" versus "two" judgments (that is, judgments of fusion), Hirsh and Sherrick considered the modality independence obtained in the judgment of

order to be suggestive of "some kind of time-organizing system that is both independent of and central to the sensory mechanisms" (*2*, p. 431). Babkoff and Sutton (*1*) reexamined the issue of peripheral versus central mechanisms in the auditory perception of order on the premise that loudness cues may have been significant in the Hirsh and Sherrick experiment. In requiring that their subjects judge both loudness and order, Babkoff and Sutton found that correct judgments of order depended significantly upon the percentage of correct loudness judgments. Extrapolating from this dependency, Babkoff and Sutton suggest the possible confounding effects of similar variables in vision; that is, adaptation, masking, metacontrast, and so forth. The experiment reported here was undertaken to determine requisite temporal separations for the judgment of visual order with peripheral influences eliminated by presentation of stimuli dichoptically.

Stimulus pairs consisted of a square and a triangular homogeneous patch of light subtending 1° of visual angle at the subject's view. Stimuli were presented in a Scientific Prototype three-channel tachistoscope. This instrument consists of three separate stimulus fields, each housing argon-mercury vapor-discharge lamps that illuminate frames positioned between them and the viewing end. In my experiment, lamp outputs were diffused by opal diffusing glass. One field was equipped with an opaque mask containing a centrally placed square opening illuminated by the diffuse source behind it. A similar mask with a centrally placed triangular opening was inserted in the second field. A mask was inserted in the third field and centered in it was a large circular opening that served as a fixation patch, illuminated by a dim red-tinted lamp. The dimensions of the openings were such as to provide a square and triangle of 1° angular subtense at the viewing end and a circular red fixation patch of 5° angular subtense. Square and triangle were photometrically matched (Ilford SEI exposure photometer) at 5.0 mlam. The fixation patch was approximately 0.5 mlam and was easily visible to the subject after several minutes of dark adaptation.

Under dichoptic viewing, the fields of the tachistoscope containing triangle and square were equipped with plane polarizers so that the left eye could receive stimulation from the fixation field and from the square field but not from the triangular field. The triangular field and the fixation patch were visible to the right eye, but the square field was not. When presented, square and triangle appeared in the center of the circular fixation field. It should be noted that each polarizing filter attenuated the field luminance by 3 db. Luminance values given above were measured with all filters in place.

Preliminary research involved three subjects (college students), under binocular conditions (all stimuli visible to both eyes), instructed to report "square" or "triangle" depending upon which was seen first. Intervals of dark between the flashes were 5, 10, 20, 75, and 150 msec, and each flash was of 10 msec duration. The results of this research were essentially identical to those reported by Hirsh and Sherrick (*2*) who used monocular viewing; that is, all three subjects correctly identified stimulus order between 60 and 80 percent of the time at separations of 20 msec. At the 75-msec separation, all subjects were correct 100 percent of the time (ten trials at each interval with order of presentation assigned unsystematically).

These same subjects were given dichoptic presentations of square and triangle under the same luminance (5 mlam) and duration conditions as those employed binocularly. Intervals were extended to include 0 (simultaneous onsets), 5, 10, 20, 40, 50, 75, and 150 msec with ten trials at each interval; five of "square-first" and five of "triangle-first" alternated randomly. Under this dichoptic viewing condition, all subjects correctly perceived presentation order 100 percent of the time at all intervals except 0. In the latter case, judgments were partitioned equally between square-first and triangle-first.

The foregoing experiments reveal considerable differences in temporal resolution of order between binocular and dichoptic conditions and seem to indicate that the 20 msec invariance reported by Hirsh and Sherrick may have been due largely to peripheral processes. In the absence of such "preprocessing," the central time-organizing mechanisms alluded to by Hirsh and Sherrick appear to have far greater temporal resolution capabilities than are suggested by data obtained with monocular or binocular viewing.

With respect to the locus of stimulation, I did not consider this variable in the research reported here. A recent study by Rutschmann (*1*) challenges earlier research (*2*) in finding a significant dependence of order judgments upon retinal locus of stimulation. Both the disparity and the comparability of Rutschmann's research are, however, equivocal. First, she used long (500 msec) temporally overlapping stimuli and, second, at least one and perhaps two of her five subjects yielded data that were not obviously different from those reported by Hirsh and Sherrick. Under such diverse experimental conditions, it is not unexpected that results differ; that is, responses of the visual system to two overlapping flashes, each of 0.5-second duration and with no "silent" separating interval, should not be expected to be the same as responses to 5-msec "impulse" stimuli separated by off intervals. In fact, in the former case, the conditions are particularly congenial to peripheral recurrent (inhibitory and disinhibitory) influences different from those resulting from the latter case (*3*). Furthermore, with such long flashes and with a non-Maxwellian optical system, the spread of stimulation resulting from eye-movement or optics, or both, would appear to render difficult the task of accurately specifying a given retinal region.

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