tory character does not prove that these animals had no appreciation of the imminence of the successive shocks.

Variation in pulse, blood volume, respiration, metabolism, galvanic skin resistance, and other "physiological changes" have, of course, commonly been employed as indices of apprehension, and for some purposes they have turned out to be very useful. However, much the same criticism applies to them that has just been made of tonicity changes and overt agitation as measures of this psychologically significant phenomenon, namely, that they give positive results only when anticipation becomes sufficiently intense to "overflow," in this case, into the autonomic nervous system. The

FIG. 3.—Hypothetical course of expectancy of a stimulus. This diagram, reproduced from an earlier study by the writer (Mowrer, 1938c), represents the hypothetical course of expectancy between successive presentations of a psychologically significant stimulus. While admittedly schematic, the general shape of the upper line was suggested by the comments of subjects who had served in a study of the galvanic skin response to electric shock.

upper black line in Figure 2 represents the breathing of the rat whose leg flexions are recorded immediately below. It will be observed that this "physiological" measure gives no reliable indication of expectation of the shock prior to its occurrence.

In an analysis of the learning process as exemplified in conditioning, which has appeared elsewhere (Mowrer, 1938c), the writer has posited (on the basis of the spontaneous comments of subjects used in an investigation of the galvanic skin reaction to electric shock) that if a stimulus is presented recurrently, at regular temporal intervals, expectation of that stimulus rises and falls in the manner indicated in the schematic diagram reproduced in Figure 3. The assumption that was made at the time of the original publication of this diagram, but not incorporated in it, was that if a stimulus does not occur at the expected point, expectancy may remain constant for a time, or perhaps even mount a little higher than usual, and will then undergo a relatively gradual decay.

As early as 1929, Schilder published a somewhat similar curve, also based on introspective data, purporting to show the rise and fall of expectation (as manifested by feelings of "tension") when a flash of light occurred and was regularly followed, five seconds later, by an electric shock. Here, again, the actual occurrence of the expected event, although painful, is represented as bringing

about "relief," in the sense of lowering tension (cf. Figure 1).[5] Schilder's original diagram is reproduced in Figure 4.

Apparently unfamiliar with either of the diagrams just referred

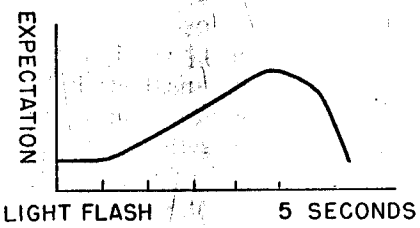

FIG. 4.—Schilder's curve of rise and fall of expectancy. Schilder (1929) has presented the above curve purporting to show the rise and fall of expectancy when a light is flashed and is then followed, 5 seconds later, by an electric shock. The curve is based on the introspective reports of human subjects.

to, Woodworth (1938) published three hypothetical curves showing possible ways in which "readiness" might be assumed to develop during a twenty-four-second "foreperiod" between a warning signal and the stimulus to which a simple, overt reaction is to be

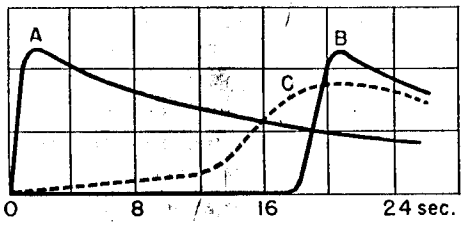

FIG. 5.—Woodworth's "possible curves of readiness." "Possible curves of readiness in a long foreperiod. The fore-signal comes at 0. If curve *A* is correct, readiness is immediately pushed to maximum. If *B* is correct, readiness is pushed to a maximum at the moment when the stimulus is expected. If *C* is correct, there is no sharp peak of readiness in a long foreperiod" (Woodworth, 1938, p. 317).

made. These curves are reproduced in Figure 5. Curve *C*, it will be noted, follows somewhat the same course as the curves reproduced in Figures 3 and 4.

[5] [This is probably the dynamics of "masochism." "Dabrowsky (1937) has recently reported an interesting study on self-torture and comes to the conclusion that self-inflicted physical pain usually serves to alleviate a more excruciating form of inner, mental anguish. Freud (1920a) has repeatedly commented upon the tendency for hysterical and other neurotic symptoms to disappear whenever a form of physical suffering intervenes. Thus, masochistic behavior in general can be regarded as relieving, through the infliction of one form of pain or tension increase, another and less tolerable form of suffering" (Mowrer, 1938c, p. 87).]

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Selected Papers

By

O. HOBART MOWRER, Ph.D.

RESEARCH PROFESSOR OF PSYCHOLOGY
UNIVERSITY OF ILLINOIS

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