Surely, the association has a much greater stake in teaching than in delighting. It can best upgrade the average level of literacy of its readers regarding other people's specialties by providing unbiased, straightforward, factual reports and balanced analyses. Above all, it must avoid the appearance of concurring in the bizarre proposition that the star of scientific advancement should be hitched to a particular political wagon.

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Effects of Punishment on Behavior

In his report entitled "Punishment in the squirrel monkey *Saimiri sciurea*" (*1*), James B. Appel states "little is known about the effects of punishment on the behavior of higher organisms." He presents his observations in the evident belief that long-lasting effects have not previously been reported.

Evidence has for many years been available that punishment by electric shock can condition extremely persistent anxiety reactions to previously "neutral" stimuli, accompanied by inhibition of other responses in the presence of the conditioned stimuli, just as Appel observed in his monkeys. The existence of this evidence may have been obscured by its coming under the heading "experimental neurosis." The first reports, as usual, came from Pavlov's laboratories, where dogs were the subjects; subsequently, similar effects were reported in cats by Dimmick, Ludlow, and Whiteman (*2*) and by Masserman (*3*). The Russian workers believed that the persistent behavioral changes in their animals were the result of a "clash" between excitation and inhibition, and Dimmick *et al.* and Masserman attributed the changes in theirs to conflict between feeding and avoidance motivations, because all their animals were punished in circumstances in which food-approach behavior had been conditioned. However, a few years later I demonstrated (*4*) that in cats subjected, without any preliminary training with food in the experimental cage, to high-voltage, low-amperage shocks in the cage situation, the same persistent behavior, characterized by marked anxiety responses, is conditioned. Thus, despite the opinions of the earlier experimenters, the effects reported by them must be regarded as a straightforward conditioning of emotional and other reactions primarily evoked by electric shock.

Though these conditioned autonomic reactions do not disappear through

the ordinary process of extinction, it is relatively easy to eliminate them by counterposing other emotional responses that are antagonistic to the anxiety in the sense that their evocation is accompanied by reciprocal inhibition of anxiety responses (*4*). The extension of this principle to persistent unadaptive habits (neuroses) in human subjects has led to significant new methods of therapy (*5*).

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Wolpe's letter points toward two problems which have existed in the behavioral sciences for many years. The first concerns the categorization, communication, and (perhaps most unforunately) selection of evidence.

While the studies Wolpe mentions, and many others besides, such as those of Solomon and Wynne on "traumatic avoidance" (*1*), indicate that "persistent anxiety reactions" may develop after exposure to electric shock, there is an equally imposing number of investigations which seem to suggest that shock has generally temporary effects or, at best, may facilitate the acquisition of responses which are incompatible with that for which the subject is being punished. I chose to limit my brief remarks to the experiments of Estes (*2*) and Azrin (*3*), because the experimental procedures of these authors closely resembled my own. Moreover, I was interested, together with Estes and Azrin, in *punishment* rather than conflict, anxiety, or experimental neurosis.

It is unfortunate that similar or even identical bits of information are often overlooked, as such, or are confused in a mass of professional jargon even within the field of experimental psychology. This is, I believe, a result of the many different conceptualizations investigators impose upon their data when reporting their results. The confusion would be attenuated if events were described objectively in terms of the variables manipulated. It is obvious that a statement about the effects of electric shock upon the rate of response on a variable-interval schedule of reinforcement is much clearer than a similar account of the effects of conflict on the production of anxiety states.

A second and far more important problem arises indirectly from Wolpe's

comments. If it is true that contradictory conclusions have been drawn from the results of experiments concerned with the effects of electric shock, one might wonder why enough systematic studies have not been made to relate this variability to experimental parameters such as species, shock intensity, and previous history of the animal. Such a program has been largely neglected in favor of short, exciting theoretical studies which may be reinforcing to the experimenter but which seem to have added little to the store of communal knowledge about one of the great problems in contemporary behavioral science, that of aversive control.

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Quantum Mechanics and Biology

The molecular basis of energy transduction in biological systems has been excellently reviewed by Green and Hatefi *(1)*. However, quantum mechanical contributions make it possible to relate these energy changes to more fundamental submolecular processes. Indeed, the application of quantum theory offers the most promising approach to as yet unanswered problems. This viewpoint has been eloquently expressed by Szent-Györgyi *(2)*.

Green and Hatefi *(1)* quite correctly conclude that electron flow in transport systems is not a result of simple molecular collision. Quantum mechanics is more specific. The rapidity of electron flow stems from the redistribution—a practically instantaneous process—of molecular orbital energies. Energy transduction based on such redistributions need not contemplate any appreciable linear movement of the electrons. The quantum-mechanically derived π-electron system fully satisfies the requirements for a catalytically functioning mechanism. This is particularly true for the unsaturated conjugated structures in which the electrons are coupled resonators. This completely allows for both instantaneous and distant site transfer of energy. The known facts concerning biologically active compounds (purines and pyrimidines) are in accord with these concepts. They are predominantly unsaturated, conjugated structures.

As pointed out by Green and Hatefi *(1)*, the mitochondrial lipids are char-