prevalent among other ideologies. If we employ absolute, nonscientific, emotion-packed phraseology, and startling but meaningless metaphors to present our findings to the public, naturally the nonscientist will harbor grave doubts regarding the alleged objectivity of scientists.

The fact is, Telford and Guthrie showed again that scientists can effectively evaluate the hazards inherent in the use of new products and can avoid most, if not all, of those hazards. Since no one was adversely affected by the widespread use of DDT as an insecticide, their conclusions seem valid. The contrary impression has been left in many a lay mind, because scientists have used the false and fantastic principles employed in so-called good writing of the present day.

In April 1949, I discussed the DDT scandal with a group of entomologists in Columbus, Ohio. I was urged to publish my findings and conclusions. I could state, for example, that Virus X and X disease were known before DDT was used. Therefore, the declaration that the insecticide was the sole cause of these conditions was based on a curious bit of retroactive and illogical reasoning. Although the article was much shorter than the scandalous bombast appearing in newspapers and magazines—although it was packed with facts instead of emotionalized fiction—publication was refused by several journals.

May I point out that this is a common experience of scientists producing honest, important, well-written, but nonsensational articles or statements. A brief quotation from a recent editorial (*Agr. Chemicals,* 6, 33) illustrates the statement:

> The viewpoint of the public, however, is somewhat jaded by newspaper stories which magnify the fears expressed by some witnesses that the country is being poisoned by use of these pesticides and that cancer, TB, polio, and heart disease are all products of these agricultural chemicals. Almost completely silent, however, are the newspapers, when sound (but unsensational) testimony is presented by witnesses of the caliber of Dr. Charles E. Palm, Dr. F. C. Bishopp, Dr. Frank Princi and Dr. George C. Decker, to name but a few of the many able and reliable scientists who have appeared.

Anyone who questions the ability of the above-named gentlemen to produce readable prose is referred to their several papers.

The articles that produced the DDT scandal and the *Saturday Evening Post's* editorial on the alleged suppression of Velikovsky's book do not differ in principle. Both took a minimum of reported facts, added a good dose of free fancy "to jazz it up," and described the result in bombastic terms. Both reject the honest relative phrase and employ the absolute sensational word. This is the essence of brief, modern "good writing," as opposed to an honest, scientific presentation. The effect upon the reader, whether the material is written by a scientist or by a *Post* editor, has frequently proved most unfortunate.

To generalize from such limited evidence may seem extremely hazardous, but space does not permit the marshalling of numerous other cases. To my way of thinking, the scientist or science writer who employs the sensational methods peculiar to so-called good writing in modern America will find ready acceptance of his productions by editors, but his literary activities will prove repugnant and embarrassing to his colleagues. The net result of his efforts will be a disservice to the advancement of science, for "good writing", or acceptable writing by modern standards, will rarely accommodate the important findings of science. I would like to explore further the reasons for this unfortunate situation, but this letter is already too long. I shall risk being classed as a defeatist by bringing it to a close.

Both this journal and the writer have in the past advocated a course of action similar or identical to that which John Pfeiffer advocated in SCIENCE. Unfortunately, experience clearly demonstrates that the recommended course of action leads to the same offense we deplore in lay writings, because it uses the same sensational techniques. Protestations that accuracy will avoid such pitfalls are useless, for the techniques employed in present-day "good writing" inevitably aggravate the tendency toward exaggeration among editors and scientists alike. Consequently, similar techniques lead to similar denouements, of which the DDT scandal and the *Post's* "Silly Season" are but two of many. The relative phrases of the laboratory, which are necessary to an honest, clear presentation of science, are not acceptable under modern standards, which demand the absolute or the sensational. The problem is more difficult than indicated by a simple shift from scientific terminology to popular phraseology. Its solution is desirable—even necessary and urgent—but not simple or easy.

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Numbness, Body-Image, and the Japanese Illusion

A VARIATION of the Japanese illusion not described by Schilder (*1*), who made frequent mention of this trick in his monograph on body-image, shows how one can "feel a sensation" in someone else's finger.

To perform the Japanese illusion in the usual way, the arms are pronated and the wrists crossed so that the palms are facing each other; then the fingers are interlocked, and the clasped hands are brought toward the body and rotated until a view of the fingers is obtained. When a person thus entwined is asked by pointing to move a certain finger, he frequently errs by moving the finger of the opposite side. Apparently an optic agnosia of right and left fingers temporarily exists until rectified by movement.

The variation lies in performance of the trick jointly by two individuals, using the right hand of one and the left of the other. When a person who is doing the trick for the first time is asked to stroke, with a finger on his free hand, one of his partner's fingers in the clasped hands, he will often say in surprise: "It feels like my finger, but it's asleep!"

What are the facts and implications of this simple experiment?

Foremost is the fact that the numbness is felt outside actual bodily limits. The subject "projects" a feeling of numbness to the locality of his partner's finger.

This use of *numbness,* meaning completely "dead" or "asleep," does not include partial sensation, such as tingling. It is like the numbness that is felt in an arm asleep over one's head when it must be lifted as a dead, heavy weight. It is like the feeling in one's lip experienced upon self-palpation after a dentist's injection of novocaine has completely numbed it. Whether this feeling is to be regarded as a negative tactile sensation, a positive tactile sensation, or a tactile sensation at all, poses an interesting semantic problem.

Three sources of stimulation may be recognized peripherally in the two-person Japanese illusion: cutaneous stimuli from the tip of the stroking finger, kinesthetic stimuli from the movement of stroking, and visual stimuli from observation of the act.

Conspicuously absent are cutaneous stimuli from the finger that is being stroked. But it has texture fairly like one's own finger, is in a position commonly occupied by it, and looks fairly like it. The brain's interpretation is then one previously learned for a similar pattern of sensory impulses: the part is asleep.

Certainly in the two-person illusion, and probably in other instances of this numbness, the feeling is entirely independent of cutaneous sensory impulses from the locality that feels numb. Visual stimuli (not to exclude visual imagery) are dispensable, since the illusion can be felt by the subject when his eyes are closed. But three subjects felt a numbness while watching the partner stroke his own finger! Apparently the numbness can also be felt upon the visual stimulation of watching the act and in the absence of the kinesthetic stimulation of the stroking movement. The implication is that criteria for this sort of numbness in a bodily part are: (1) palpation of the part (usually self-palpation), (2) absence of cutaneous sensory impulses from the part, and (3) self-identification of the part.

The third criterion, self-identification of the part touched, is interesting in the light of the concept of body-image. The central notion of body-image, developed and extended somewhat variously by Head (*2*), Schilder (*1*), and Lhermitte (*3*), is that every person holds in his nervous system a plastic model or idea of his own body, built up from past sensory experience (vision, touch, kinesthesis, etc.) and constantly modified by new experience. The body-image of a person gives the cues that permit him to locate accurately the parts of his own body, to judge properly the boundaries of his body in relation to other objects, and to have successful sensorimotor behavior in general. When a limb is amputated, the body-image is expressed in continued "projection" of sensation into a phantom limb; the body-image is said to be thus unmasked. Our experiment can also be said to unmask the body-image by demonstrating a potentiality of the nervous system for "projection" of numbness to a foreign bodily part under conditions sufficiently resembling those with which an own bodily part is identified.

An individual who immediately conceptualizes the experiment by properly identifying the fingers involved is not susceptible to the illusion. But when persistently asked if the stroked finger doesn't feel a little like his, he may presently report that he has captured the feeling. A suggestible person may almost turn the illusion on or off by persistently imagining that the stroked finger either is, or is not, his own. Similarly, concentrating attention on the stroked finger facilitates the illusion; on the stroking finger inhibits it. With repetition one may find that the illusion is increasingly difficult to produce. This suggests a learning of the new position or its incorporation into the body-image as other sensory data are brought to bear upon the problem.

A consideration of the phenomena of this and related experiments calls for greater structural definity of the still rather amorphous concept of body-image. Its review and elaboration bear on a physiological explanation of how somatic sensations are localized.

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The Mechanism of Visual Excitation

A significant advance toward the understanding of the mechanism of visual excitation has been made recently by Wald and Brown (*1*). They found that "the bleaching of rhodopsin by light exposes new sulfhydryl groups on opsin, two such —SH groups for each molecule of retinene liberated. The sulfhydryl group is highly reactive; it is weakly acidic, readily binds metal ions, and is a strong reducing agent." In particular, the sulfhydryl groups combine readily with silver ions.

The mechanism seems to become even clearer if we note that the *affinity of the sulfhydryl groups for such positive ions makes the totality of such groups an effective cathode.* But we already know that a nerve becomes excited under the cathode when the stimulus becomes sufficiently strong. One would therefore expect that the rod cells would become excited when a certain critical amount of rhodopsin has been bleached, thus producing a sufficient number of sulfhydryl groups.

The problem of how such effective cathodes cause