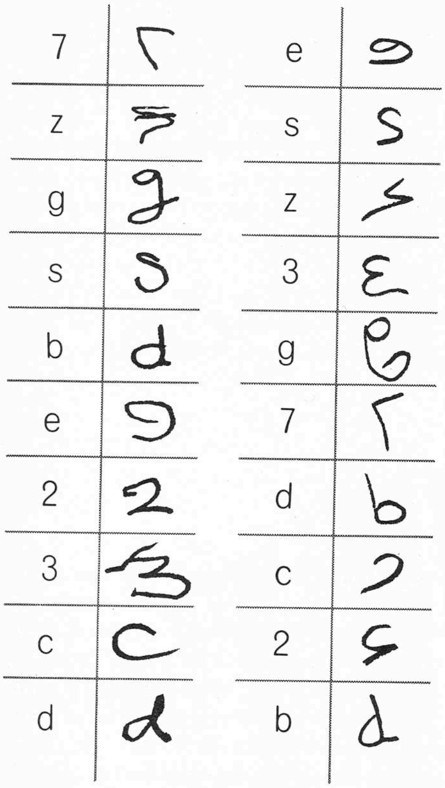

WRITING ABERRATIONS of two subjects after exposure to reversing prisms are represented. The letters and numbers they were asked to write are at left; what they wrote is at right. In the second sample only the *S* is normal; that was the only letter the subject thought she had written backward.

tion he selected by touch alone a square that he felt was the same size as the previously experienced one-inch square. The great majority of subjects chose a larger square as matching the standard than they had before. The larger square now felt smaller than it was.

What would happen if there were a more dramatic conflict between vision and touch, as in experiments on inversion or reversal of the retinal image? If a subject looks through reversing prisms, for example, while moving his hand from left to right, could he be misled into feeling it as moving right to left? An experiment undertaken by one of us (Harris) and Judith Harris showed that vision is powerful enough to accomplish even this radical a misperception.

We had the subject look through a right-angle prism, which acts like a mirror, reversing the visual field right for left [*see illustration on preceding page*]. The prism was attached to a rigid frame. The subject watched his hand through the prism, while drawing and doodling, for 15 minutes a day on four different days. For reasons that will soon become evident, he was not allowed to write or see any letters or numbers while looking through the prism.

For most subjects there was no immediate visual capture. When they felt their hand move in one direction, they saw it stubbornly going in the opposite direction. The felt hand and the seen hand seemed to be separate things.

Within a matter of minutes, however, visual capture took over. Most subjects no longer experienced any discrepancy between how they saw their hands move and how they felt them move. They no longer had trouble drawing or doodling or reaching for locations indicated by the experimenter.

In order to determine if there was an aftereffect of this visual capture, we hit on the following simple procedure. At the end of each prism period we slid a metal plate in front of the prism, blocking the subject's view. We then asked him to quickly write 10 letters and numbers as we dictated them. We had previously told the subjects that the adaptation procedure might make them write an occasional letter backward and that they must be sure to tell us whenever they thought they had done so.

Actually a subject could have two kinds of misperception. He could believe a letter was normal when it was really backward, and he could believe a letter was backward when it was really normal. We found that both kinds of misperception occurred; every one of our eight subjects made at least one such error. In fact, immediately after looking through the prism the subjects misperceived fully 30 percent of the letters and numbers they wrote. (In the pretests given before the use of the prism, of course, no subject ever misperceived what he was writing.) The results, some of which are shown in the illustration on this page, are particularly surprising in view of the fact that writing normal letters and numbers is such a highly practiced skill.

Our experiments all show, then, that when a subject's sense of touch conveys information that disagrees with what he is seeing, the visual information determines his perception. What happens during such a conflict to the information the sense of touch is providing? Is it blocked before it reaches the brain, is it ignored or is it transformed? After sufficient exposure to an intersensory disagreement there is a change in the sense of touch itself. Since the subject continues to misperceive by touch even with his eyes closed, he cannot be blocking or ignoring the information provided by touch. It is therefore a reasonable guess that the information is not blocked or ignored when his eyes are open either. Instead it must be transformed into new touch perceptions that are consistent with visual perception.

The further implications of our experiments are less clear, particularly for situations that are more normal than the restricted conditions under which our subjects worked. What kind of adaptation to altered retinal images takes place when a subject can move about freely and can see much more of his environment than our subjects saw? The experimental data are still fragmentary enough to allow us to disagree on this point.

One of us (Rock) believes visual perception can change if a person subjected to optical distortion has adequate visual information about the distortion. For example, the world might look upside down through reversing prisms, but if the subject can see his own body—the image of which would also be inverted—he realizes that the world is not upside down in relation to himself. Similarly, if a seated subject looks at a straight vertical line through prisms that at first make it appear curved and he then stands up, the appearance of the line will change in a way that would not be the case if the line were really curved. Hence he may come to see that the line is straight. This argument maintains that a change in visual perception can occur but acknowledges that information from touch alone is insufficient to cause such a change.

The other of us (Harris) thinks all substantial adaptation to optical distortions probably results from changes in the sense of the position of the limbs, the head or the eyes. If a person felt that his arms and legs were where he saw them through inverting or reversing prisms, he would make responses like those reported by Stratton and Kohler. If he felt that his eyes were pointing directly ahead or tracing a straight path when they were actually pointing somewhat to one side or tracing a curved path, he would show the kind of adaptation to displacement or curvature that is found in some other experiments.

Our disagreement does not affect the basic points demonstrated by our separate experiments. Those points are that there is no convincing evidence for the time-honored theory that touch educates vision and that there is strong evidence for the contrary theory. Further experiments along these lines can be expected to clarify the points that remain obscure.