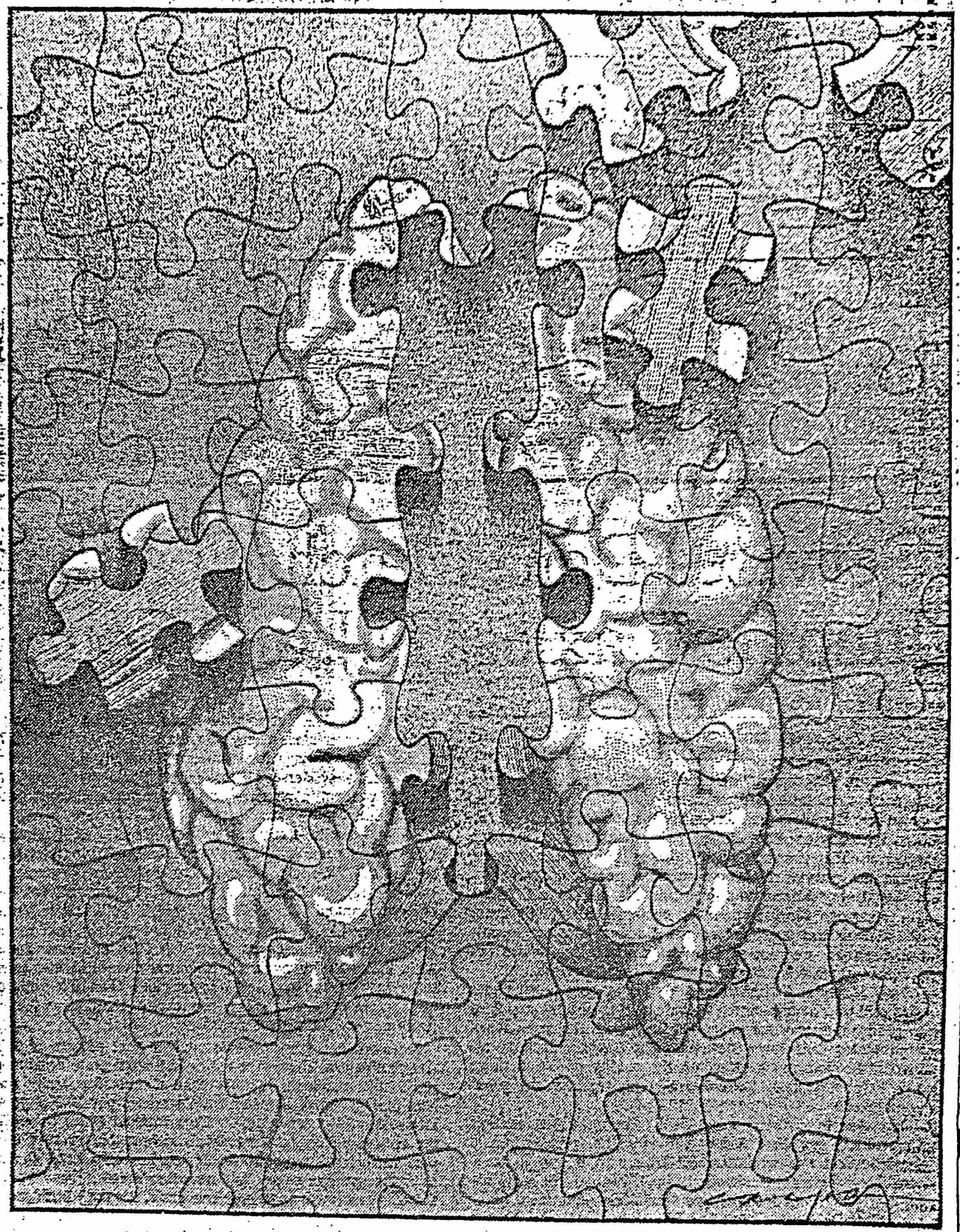
Scientists Are Updating Cherished Ideas



John Cayea

The Hemispheres of the Brain Have Minds of Their Own

By RICHARD M. RESTAK

At the age of 5, Walter Bowers was paralyzed on the right side, wracked by frequent *grand mal* seizures, showed severely disturbed speech and was found on testing to have a mental age of 4. After medication failed to stop the seizures, Walter's doctors reluctantly carried out a drastic operation: the removal of the whole left hemisphere of Walter's brain. Today, 21 years later, Walter Bowers is an industrial executive and part-time student carrying simultaneous majors in sociology and business administration. On neuropsychological testing he demonstrates "above normal language and intelligence."

Contact with patients such as Mr. Bowers is stimulating brain scientists to rethink and update cherished concepts about how the two hemispheres of the brain work.

Ordinarily the hemispheres are in constant communication with each other via the corpus callosum, a bridge of 200 million connecting fibers, each carrying about 20 impulses a second from one hemisphere to the other. In most cases these connections result in increasing integration between the two hemispheres. But sometimes the connections can result in problems. In some forms of epilepsy, for instance, the connections allow seizures originating in one hemisphere to cross over and trigger seizure discharges in the opposite hemisphere. In the 1960's, Prof. Roger Sperry, a psychobiologist at the California Institute of Technology, and his associates were able to block the passage of seizures across hemispheres by severing the corpus callosum in intractable epileptics. This operation, known as corpus callosum transection, also made possible the first study ever made of how the two hemispheres operate individually. Until very recently, concepts of "right and left brain" function were largely based on Professor Sperry's investigation.

Using a group of "split-brain" patients (those with transection of the corpus callosum) Professor Sperry found significant differences in right and left hemisphere function: the left hemisphere appeared to be dominant for mental, intellectual and analytical tasks, while the right hemisphere seemed to be preferentially involved in spatial and constructional concepts. Although subsequent investigators generally confirmed Professor Sperry's findings, there were early clues that these strict divisions into distinct right and left hemisphere functions were greatly oversimplified.

For one thing, increasing numbers of patients like Walter Bowers were reported—patients who dramatically demonstrated the potentiality for fully developed language function by the right hemisphere.

Very young children could usually recover normal or even superior language ability after left hemisphere damage or removal, clearly implying right hemisphere language capability. But if the damage or surgical removal of a hemisphere occurred at a later though not precisely determined time, normal language performance was lost forever, implying that once specialization of hemisphere function occurred, sometime in late childhood or early adolescence, the right hemisphere was not involved at all in language. But recent experimental data gathered by Dr. Eran Zaidel, a biologist and an associate of Professor Sperry at Cal Tech, has now convincingly demonstrated elaborate and complicated language performance by the adult right hemisphere.

Normally, due to crossing of the visual fibers, some impulses from each eye are sent to both hemispheres, making it impossible to be sure which hemisphere is responding to experimental visual testing. Dr. Zaidel constructed an optical system capable of projecting the stimulus image exclusively to one hemisphere. Using his system Dr. Zaidel has been able to show that the adult right hemisphere can read and follow instructions despite the inability of the subjects to repeat them back, normally a left hemisphere function. The written instruction to the right hemisphere "Write your name and address," for instance, was followed by compliance but, when asked what he had done, the subject replied "I don't know."

Although it is still too early for any final assessment of Dr. Zaidel's research, the discovery of language capacity in the adult right hemisphere calls for new considerations about hemisphere specialization. If the language capacity of the right hemisphere can be tapped it may well revolutionize present methods for language rehabilitation after strokes or accidents.

Dr. Zaidel's work also leads to other new approaches toward research on right-left hemisphere function. For example, neurologists have observed for years that patients afflicted by a stroke involving the right hemisphere are often relatively untroubled about their incapacity, while those with left hemisphere strokes, by contrast, often suffer profound mental anguish. Some experimenters are now tentatively suggesting that emotion itself is a right-hemisphere function.

Dr. Gary Schwartz and his collaborators at Harvard observed eye movements in response to both neutral and emotionally-loaded questions. Ordinarily, when questioned, people's eyes turn briefly to the side opposite their most activated cerebral hemisphere. Lawyers and doctors, for instance, who deal largely in verbal concepts, will usually turn their eyes quickly to the right when presented with a legal or medical question. Artists and architects, in contrast, preferentially turn their eyes leftward when using their right hemisphere for spatial or constructional problems. By introducing emotional elements into verbal or spatial questions (i.e., "Visualize your father's face. Now what emotion are you feeling?") Dr. Schwartz was able to influence his subject's eye movements, reducing them for verbal questions and increasing them for spatial ones. His group is now combining eye-movement recordings with electroencephalographic analysis in an attempt to further define emotion as a right hemisphere function.

Possible Applications

Dr. P. Flor-Henry, associate clinical professor of psychiatry at the University of Alberta, suggests that differences in hemisphere function can also be applied to the diagnosis and treatment of different forms of mental illness. At the New York Academy of Sciences, Dr. Flor-Henry reported recently on differences in the electroencephalographic patterns of the right hemisphere in manic depression, with predominantly left hemisphere changes occurring in schizophrenia. Some borderline diagnoses have even been resolved by Dr. Flor-Henry's methods.

But possible applications of the new research on right-left hemisphere functioning are not limited to medicine. Traditional classroom educational methods may be influenced as we learn more about the dependence of early learning experiences on interhemisphere integration. Native-born Israelis, for instance, have been shown to make more mistakes as adults in right-left orientation than those who immigrated as children. This is postulated to be based on early reading patterns, which are from right to left in Hebrew and left to right in English and European languages. Left-to-right reading enables early interhemisphere integration and lessens the likelihood for mistakes in right-left orientation later in life.

Studies of such things as reading patterns and handedness (left-handers as a group are different from right handers in I.Q. and other test profiles) hold promise as a means of formulating a measure of a child's "cognitive style"—the way his brain characteristically functions when evaluating his environment. Such neuropsychological profiles may make possible teaching methods based on the child's unique pattern of brain function. It may also facilitate greater interhemisphere integration in those children who are lopsidedly right or left hemisphere oriented. For example, new teaching methods in Israel could compensate for any integration deficiency resulting from the right-to-left pattern of Hebrew.

Finally, studies on hemisphere function may cast some light on questions as fundamental as the origin of human speech. Dr. Ronald E. Myers of the Laboratory of Perinatal Physiology of the National Institute of Neurological and Communicative Disorders and Strokes has studied the comparative neurology of vocalization and speech. His research indicates that human speech developed spontaneously at a certain level of hemisphere integration and is totally unrelated to the crude vocalization of the other primates. Efforts are now under way to continue this research and elucidate the contributions of both hemispheres to the development of the uniquely symbolic pattern of vocalization that comprises human speech.

Richard M. Restak is a neurologist in Washington, D.C.