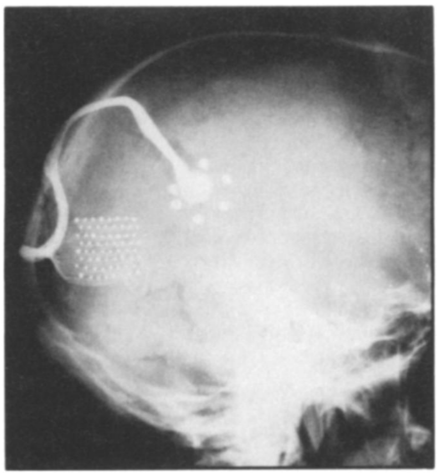
SCIENCE NEWS OF THE WEEK

Artificial Vision: A Quantum Leap Forward



Electrode implant in Craig's cortex.

Photos: University of Utah Medical Center

In 1974 a team of neuroscientists at the University of Utah and the University of Western Ontario made one of the most significant advances ever toward helping blind people to see artificially. They electrically stimulated the visual cortex (back of the brain) of several blind patients so that the patients "saw" letters of the alphabet. Now the neuroscientists have achieved something even more crucial in their efforts to create artificial vision for the blind. They have stimulated the visual cortex of a blind patient so that he could actually "read" sentences.

The investigators are William H. Dobelle, Michael G. Mladejovsky and Jerald R. Evans of the Institute for Biomedical Engineering, University of Utah; T.S. Roberts of the Department of Surgery at the University of Utah Medical Center, and J.P. Girvin of the Department of Clinical Neurological Sciences, University of Western Ontario. "These experiments . . . are the first demonstration of potentially useful information transfer by cortical stimulation," they declare in the Jan. 15 NATURE.

It all started back in 1968 when Giles Brindley of the University of London and Walpole Lewin of Addenbrooke's Hospital in Cambridge made a vital discovery. It was that blind persons, as well as people who can see, could perceive spots of light called phosphenes when their visual cortexes were electrically stimulated. Dobelle and his team set out immediately to capitalize on this discovery and expand it into artificial vision for the blind. In 1970 they traveled around the United States and Canada exploring the phosphene vision of persons undergoing operations on their visual cortexes. Then they undertook experiments on two blind patients.

In each patient they temporarily implanted electrodes on the visual cortex. By stimulating pairs of electrodes at a time and using sophisticated computer technology, they determined the relationship of phosphenes to each other and ultimately unscrambled the patient's particular phosphene map. In other words, each phosphene a patient saw was mapped on a television screen in relation to another, until an entire visual field was built up—a matter of a couple of hours. "This unscrambling," Dobelle said, "was a major problem. It is virtually impossible to do that in a short period of time without a computer."

Now that they knew the phosphene makeup of each patient's visual field, a matter of 64 electrodes and 64 phosphenes, the neuroscientists tried stimulating strategic electrodes (actually strategic phosphenes) in order to present patterns, including letters of the alphabet, on the phosphene map that had been theoretically worked out on the television screen, but which actually existed in each patient's brain. The patients saw the letters and confirmed them by drawing pictures of what they had seen (SN: 2/2/74, p. 68).

In these experiments, however, Dobelle and his co-workers used temporary electrodes. So they designed a chronic implant whose electrodes are placed in the visual cortex. Wires from the electrodes are routed through the bone at the back of the head, then between the scalp and bone, until they emerge through the skin behind and above the ear. There the wires terminate in a connector that is held inside a Pyrolite carbon pedestal.

They then performed the chronic electrode implant on Craig, a 33-year-old man who had been blind from gunshot for 10 years, and performed numerous experiments on him. Two of the experiments were particularly striking. In one, electrodes were connected to a television camera. The camera sent images to a computer that simplified them before they were carried as electrical impulses to Craig's brain via the wires in his scalp. In this way Craig was able to "see" a one-inch-wide white strip on a black background and to say whether it was horizontal or vertical.

In the second, more direct experiment, the electrodes in Craig's skull were connected to letters of the braille alphabet, a wire coming from each individual braille dot. (Braille letters were used instead of regular letters of the alphabet because 26 letters were too many for 64 phosphenes to present.) With this stimulation, Craig was able not only to "visualize" braille letters, but to "read" phrases and short sentences, such as "when the crow went into," and, "He had a cat and ball." In fact, he was able to read faster by this method than he was by tactile braille.

Dobelle and his team are the first to admit that numerous problems must be resolved before their techniques become practical visual prostheses for the blind. For instance, will there be much brain damage from continual stimulation? But they do believe that these problems will be eventually overcome and that they can design a miniature visual prosthesis that blind people can wear and use continually. In fact, they are already starting to design such an intricate system.

It would consist of a camera being fitted into the eye sockets of a blind person. The camera would transmit various levels of light, by electronic means, to a tiny computer built into an eyeglass frame, which the person would wear. The computer, like the large one used in the experiments, would translate this light into electric current, which would then be sent to the electrodes implanted in the person's visual cortex. Such a device would permit the wearer to perceive people and objects as well as to read. However, such artificial vision is still a few years away. □

Craig uses TV camera in front of him to see strips. Camera sends images to computer, which simplifies them before sending them to his brain via electrodes. Keyboard behind his head is used for other experiment, typing braille sentences he can read. Evans observes, Mladejovsky at controls.