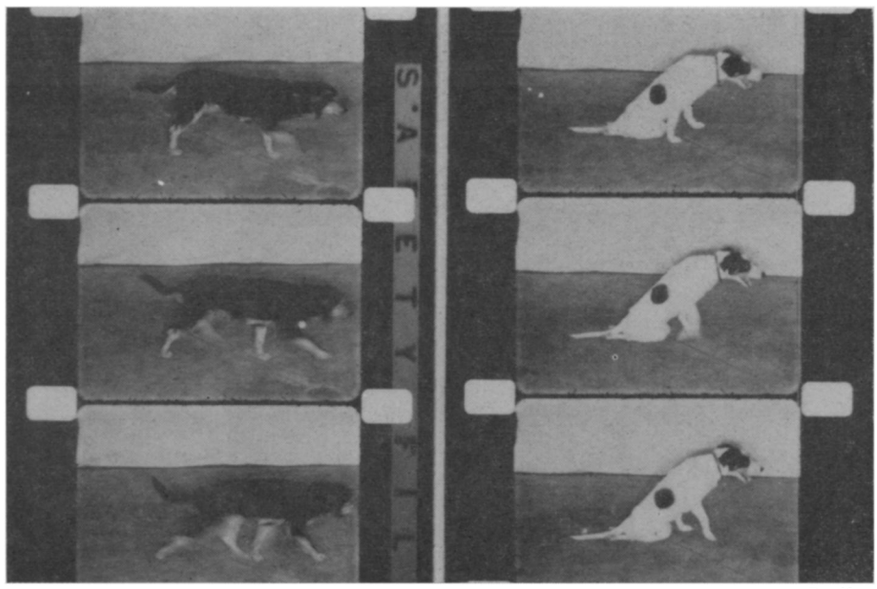

Dr. Kao

The dog at left moves after spinal surgery, but does he walk?

BRAIN TRANSPLANT

Not within sight

The ultimate is the brain transplant.

Should it ever become possible, which man would survive, the donor or the recipient?

The speculation, though intriguing, is somewhat off the track. Since consciousness and awareness of self reside in the central nervous system, the man surviving is the one with a brain. The real question is: What would happen to him—or to any conscious, perhaps comatose, mind—encased in a body that can't see, hear, feel or respond because his brain and the rest of the system don't mesh?

Because that is what a transplanted brain would be—isolated—without functional nerve connections to its foreign body.

There are any number of reasons why the brain, unlike kidneys or livers, could not make useful connections to a new body. The most obvious is that the brain is only half a nervous system—the other half is the peripheral system, including spinal cord and peripheral nerve fibers. Transplanting a brain means severing the system at the neck. One might as well cut a man in half.

So far as anyone can tell, and no one is giving it much serious thought, the two halves would not hook up again. Surgeons have never yet rejoined one man's spinal cord; even if they could join two foreign halves without an impossible allergic reaction, the connections probably would never produce nerve function.

A man's brain and his body have a long, intimate and incredibly complex relationship with each other. If each mind is unique, so probably is each instance of mind-body cooperation.

Animal brains have been kept alive for a limited number of days without their bodies. The main problem is to keep blood flowing throughout the brain. This is done either by hooking it up to a machine or attaching it to the neck of another animal. Researchers in both the Soviet Union and United States have done the experiment with dogs, but many scientists question its research utility. Others, particularly in Britain, won't do the work because they do not know what agony an isolated brain might experience.

Where research on vital organs looks to transplants and artificial devices, neurosurgery concentrates on finding an advance in nerve regeneration.

Peripheral fibers or axons leading to muscles and internal organs will regenerate readily if given a protective channel through which to grow.

Dr. James B. Campbell, a neurosurgeon at New York University who is well-known for his work in regenerating the peripheral motor axons, says of these fibers: "They are funny things. They have a relentless, a wonderful determination to grow." Dr. Campbell has restored motor function in patients with nerve grafts of two kinds.

In one case, the nerve, taken from a cadaver, is frozen, irradiated and

wrapped in a thin plastic shield. The dead, denatured transplant then acts simply as a channel for regeneration of the patient's own nerve. "It literally crawls down the channel," says Dr. Campbell.

For gaps longer than seven centimeters, a nerve from the patient's own body must be used. (The body can spare a sensory fiber without trouble.) Once transplanted to the injured area, the still-living nerve provides a channel and also appears to chemically aid regeneration.

But, so far no scientist has accomplished functional regeneration in the spinal cord to the satisfaction of the medical community.

Last November, a Toronto surgeon, Dr. Gordon Murray, made headlines and confused colleagues when he reportedly rejoined a man's spinal cord at the neck. The patient, a quadraplegic, supposedly regained some motor function after the operation, which involved severing and shortening the spine. It would have been the dramatic, long-awaited breakthrough, but the medical records at Toronto General Hospital show no report of any such operation. Apparently the operation was a common procedure for relieving pressure on the spinal cord. After investigating the case, the hospital sadly released a statement denying any evidence for a major advance in the treatment of paraplegia.

Like heart transplants, spinal regeneration inspires a good deal of scientific heat.

"It's heavily laden with emotion," says Dr. Larry Charles Fried, at the office of program analysis in the National Institute of Neurological Diseases and Blindness. "People get carried away. Some get overzealous. As in heart transplants, everyone is eager to be first."

But unlike heart transplants, which will either work or fail fatally, spinal regeneration is a very difficult thing to judge. In the last analysis, nerves are functional if the animal which has had its spine rejoined walks. Only trained observers watching closely can tell whether the animal is walking voluntarily, which involves nerve transmission from the brain, or moving reflexively, which may not require brain action.

Animals can stand and even move reflexively without any nerve regeneration, says Dr. Fried. Most investigators feel that reports of functional recovery in animals are actually a reflex type of recovery, he says.

This is the problem of persuasion facing Dr. Chun Ching Kao, a visiting scientist from Taiwan now at the Mayo Clinic in Minnesota.

While he was at Indiana University working with Dr. Leslie Freeman, di-

Science News Subscriber Service

Please include a Science News address label to insure prompt service whenever you write us about your subscription.

ATTACH LABEL HERE

MAIL TO: **Science News Subscription Dept.**
1719 N Street, N.W., Washington, D. C. 20036

CHANGE OF ADDRESS If you are moving, please let us know four weeks before changing your address. Place magazine address label in box above, print your new address below. If you have a question about your subscription, place your magazine address label in box above and clip this form to your letter.

TO SUBSCRIBE: **Mail this form with your payment and check**

☐ **New Subscription**
☐ **Renew My Present Subscription.**

— Check One —

☐ 1 year $6.50 ☐ 2 years $11.50 ☐ 3 years $16.50

— Check One —

☐ Check or money order herewith ☐ Bill Me

Name **Address**
(Please Print)

City **State** **Zip**

rector of surgical research there, Dr. Kao worked out an ingenious method for plugging brain material into a damaged spinal cord and, according to the claims, regenerating nerves with functional capacity.

The experiment has worked on five out of 36 dogs, says Dr. Kao. He was not, however, successful with either monkeys or cats.

It was necessary, says Dr. Kao, to take pieces of brain material from the animals—he took out small bits with nerve cells from the cerebellum and cerebral cortex—and to culture them for six days. The cultured brain material then worked somehow to stimulate spinal regeneration.

Dr. Kao also tried to culture brain material taken from humans in brain surgery, but the explant wouldn't grow. He believes, however, that a method of maintaining human cultures will be found. If all goes well medically, and that is now a very large question, Dr. Kao's technique would raise all kinds of legal problems, not to mention ethical ones. A paraplegic would have to undergo brain surgery that he did not need for an explant to plug his spine.

Transplanted material between two dogs doesn't work, says Dr. Kao. "If you put one dog's brain material into the spinal cord of another, the material dies and a scar forms. The cord will not regenerate." He tried this technique unsuccessfully on five animals using immunosuppressive agents that had no effect whatsoever.

Of the five successful cases, one dog walked very well for two to three months until it was sacrificed, says Dr. Kao. The other four were unsteady.

Patricia McBroom

THE LAW AND THE FLESH

Whose body is it?

By long-standing tradition originating in English common law, after death a man's body belongs to his heirs. Even if he wills his body to research or his heart to a transplant patient, his family can forbid it.

The need to resolve the legal tangle of body ownership, which has always been a concern to scientists using cadavers for research and teaching, takes on new urgency with major advances in transplant surgery in the last decade. These surgical advances also raise the need for a legal definition of death.

"It now seems that the social interest in transplantation justifies certain specific legislation regarding both a definition of death and authority to donate organs," Prof. David W. Louisell of the University of California School of Law at Berkeley says.

Laws governing organ donation, widely judged inadequate by scientists and lawyers alike, vary greatly from nation to nation and state to state.

England adopted a Human Tissue Act in 1961 allowing prior donation, but heirs remain at liberty to reverse the will. Since 1947, France has had a law permitting physicians to remove any organ immediately after death without consent of next of kin.

But most scientists doubt that the United States could have such a broad law for years. Dr. Carl E. Wasmuth of the Cleveland Clinic Foundation comments: "In the U.S. the sanctity of the human body is still the feeling of the people. This is going to be a matter of education for the public."

On the other hand, a recent Gallup poll revealed that 70 percent of persons questioned said they would gladly leave their bodies to medicine.

At the present time, prior organ donation is legal in 31 states in the U.S.; nevertheless, most physicians are hesitant to remove organs without specific permission from a dead man's relatives. California and Pennsylvania, for example, have laws that say if a man wills his body, physicians can remove organs without any further authority. "But, cautions Prof. Louisell, "These laws have never been tested in court and until they are, we're on shaky ground."

There are several movements afoot to clarify and standardize the laws governing disposition of dead bodies.

A Commission on the Ethical and Social Implications of Health Science Research and Development is proposed in bills pending in House and Senate.

The National Conference of Commissioners of Uniform State Laws is drafting a model law for willing organs before death. One idea is that organ donors could carry a card, similar to the one eye donors now carry, identifying themselves so that their organs could be removed by any authorized surgeon in any state at the time of death.

But such a proposal represents the ideal some lawyers and scientists don't believe will be realized at all soon. Even a modified advance in the legal situation would be valuable, they say. What they'd most like to see eliminated is the provision that virtually any near kin can nullify a donor's will. A man's widow, for example, has first authority