may resort to violence because of some brain damage. Some 85 percent of those persons appearing before a court for personal violence have appeared before, he says, and such statistics might possibly point toward an inherent tendency toward violence. Arthur Ward, chief of neurology at the University of Washington School of Medicine, contends that since about 15 percent of uncomplicated deliveries in the United States entail some kind of anatomical damage, which may or may not affect the brain, birth trauma might account for considerable violent behavior in the population. Getting hit on the head in sports could also do the trick, he stresses.

But unfortunately biologically triggered violence cannot be explained so simply. Ample evidence was also cited at the conference that central nervous system feedback—sensory input, emotions, memory, culture, environment—to crucial brain violence centers can strongly shape a basic biological susceptibility to violence. Delgado has found, for example, that stimulation of one area of a monkey's brain might induce different responses depending on memory or the situation. When electrodes prompted a male monkey to attack, he lit into another male monkey in the cage, not into his girl friend. When stimulated, another chimpanzee snarled but remained submissive in front of a more powerful opponent. Ervin cites a case of a woman who had tried to kill someone several times. In the laboratory the woman did not exhibit violence until she saw the chief nurse.

Relationships between epilepsy and violence are also being studied. According to Richard Masland, chief of neurology at the Columbia College of Physicians and Surgeons, only one to two percent of all epileptic seizures result in violence. Most seizures consist of loss of consciousness, rigidity of body, violent jerks and momentary loss of speech. But Delgado points out that when epilepsy leads to violence, it seems to originate in the temporal lobe—the seat of some other kinds of violence. And as B. J. Wilder, associate professor of neurological science at the University of Florida, says, applying certain chemicals—penicillin—or metals—cobalt—to particular areas of an animal brain has touched off epileptic seizures that have continued on and off for a few years. This evidence also suggests that epileptic violence is a biological disorder. But with epilepsy, as with some other kinds of biologically provoked violence, biology seems to be keenly influenced by nervous system inputs and feedbacks. Francis Forester, professor of neurology at the University of Wisconsin, has been following some epileptics who have seizures when they hear certain kinds of music.

Electrophysiology, microreadings of individual brain cells, computer compilation of data, tissue cultures and other biochemical advances are allowing a better diagnosis of biologically induced violence, and investigators are now trying to use the techniques for treating such disorders as well. Paul Crandall and Richard Watter of the department of neurology, University of Southern California, for example, have implanted sensors into the brains of epileptic patients. When the patients have an attack, brain activity is telemetered into the USC laboratory. This way the investigators hope to get a better idea of where the brain epileptic lesion is, so that they can operate on it more successfully. About 150 epileptics a year undergo brain surgery, but only about half are completely cured. Delgado, however, anticipates chemicals replacing surgery in the correction of biological violence in the near future. His group has successfully inserted small dialysis bags into animal brains and withdrawn chemicals through the bag at the time of brain stimulation. He foresees that chemicals might be inserted into strategic areas of the brain in a similar manner.

As might be expected, attention is also being directed toward the possibility of controlling nervous system inputs to brain violence centers. J. K. Penry, for example, is now developing telemetry to correlate epileptics' seizures, emotions and drug effects with temporal lobe activity. Forester has been trying to decondition the epileptics who experience seizures at hearing certain music. Alpha-wave autonomic control (SN: 11/6/71, p. 314) over seizures has been tried but has not worked so far.

Both, Penry of the National Institute of Neurological Diseases and Stroke, and Ward, caution, though, that new therapies for biological violence should not be applied to patients before it is known exactly what brain centers are being affected. "We know what nuclei we are stimulating with electrodes or drugs," Penry says, "but we do not know how far the stimulation spreads—which brain currents are open or closed. This is what is holding us up."

Some of the techniques under discussion are probably already technologically possible in humans (quieting a classroom of boisterous youngsters with remote electrical stimulation of the brain, for example). Ward cautions investigators to be especially careful not to apply radical electrical or chemical methods until they can confidently predict the behavioral consequences. And even if the consequences can be predicted, he and others—like their medical colleagues on related subjects (SN: 10/23/71, p. 275)—stress the necessity of seriously considering the ethics of such mind manipulation. □

Cancer compromise: NCI looks to future

After months of lobbying convolutions and legislator-scientist confrontations, the Senate and House agreed last week to a conference committee report on legislation to strengthen the national effort to lick cancer. The bill was expected to be signed by the President this week. It will take effect 60 days later.

The conference report reflects both the House and Senate bills (SN: 10/9/71, p. 243). It is a little closer to the House bill, however, in that the National Cancer Institute would stay intact, and within the National Institutes of Health family. Under the compromise, the President would appoint the NCI director (in the past the NCI director has been appointed by the director of NIH, with the approval of the Secretary of Health, Education and Welfare). The National Cancer Advisory Council, which gives out NCI grants, would be expanded from 15 to 18 persons, and would go under the name of the National Cancer Advisory Board. The board would also give out only some 60 percent of the grants, those over $35,000. The NCI director would channel the other 40 percent himself. The NCI would have a new three-man advisory panel, to be appointed by the President. What type of people would comprise the panel and how the panel would fit into the NCI administrative setup is not spelled out.

The House-Senate compromise also calls for the NCI to send its budget directly to the Office of Budget and Management with comments, but no changes, by the director of NIH. Although the bill emphasizes research over patient care, it calls for special funds for detecting oral, cervical and breast cancer, and for setting up 15 new centers for patient treatment as well as for research. Although money for cancer research in fiscal 1971 is set at $337 million, the compromise bill authorizes up to $1.6 billion over the next three years. The President will submit his budget for cancer research in January. It will then be up to Congress to decide whether the full $1.6 billion should be appropriated.

Supporters of this final legislation expect it to accelerate by several months the approval of grants of $35,000 and under; grant approval for larger grants would probably still take the usual six or seven months. The bill, supporters believe, would also ensure that money earmarked by Congress for cancer work would go to NCI and not end up in other NIH coffers.

Critics, however, view the legislation as not much different from the current NCI-NIH arrangement. The director of NIH, for example, could be appointed to the National Cancer Advisory Board

and exert power over NCI funds that way. But at least, critics admit, the legislation might have been worse—squelching what progress NCI had made in the past, and severing a reasonably workable relationship among NCI and the various National Institutes of Health.

What boost a refurbished and glorified NCI might give to cancer research is too early to tell. All the legislative controversy over cancer research during the past months, however, has prompted the NCI to bring together some of the top medical researchers in the United States, from various disciplines, to confer on what directions cancer research should take. The scientists have been meeting in closed conferences since the end of October; they will conclude in January. Their decisions could well have a greater impact on American cancer research than the cancer legislation per se. □

When the Pacific crustal plate reversed itself

Whalers and fishermen have known for years that there is a narrow belt straddling the equator where plankton and fish are especially abundant. The fertile zone, only about 100 to 200 miles wide, is caused by upwelling in the boundary zone where the oceanic currents from the Northern and Southern Hemispheres meet. The upwelling brings nutrient-rich deep waters to the surface.

The rich life in this narrow equatorial belt deposits vast quantities of lime and silica shell material on the sea floor, creating a thick layer of chalk (SN: 12/27/69, p. 590). As the Pacific Ocean floor moves northwestward sediments deposited at the equator become covered with increasing thicknesses of non-equatorial sediments—mostly a red clay.

Scientists on Leg 20 of the United States' Deep Sea Drilling Project this fall traced the movement of the Pacific crustal plate by drilling into this chalky layer. In results announced last week, they found that during the past 125 million years the Pacific sea floor has moved northwestward more than 2,000 miles. Parts of the Pacific that were once under the equator are now just south of the Aleutian Islands.

The general magnitude of this motion was not too much of a surprise; previous drilling had shown movement of 600 to 900 miles over the past 50 million years (SN: 10/23/71, p. 279). A more significant find was that between about 70 million and 55 million years ago, the northwestward motion of the Pacific crustal plate was reversed and the Pacific floor moved southward for a while before resuming its northwestward drift. Drilling at a point east of the Mariana Islands, the earth scientists, led by Bruce C. Heezen of Lamont-Doherty Geological Observatory and Ian D. MacGregor of the University of California at Davis, found a 70-million-year-old layer of chalk below another chalk layer only 50 million years old. The two layers were separated by a layer of red clay.

Though evidence of radical shifts in the direction of plate motion has been discovered elsewhere, says Heezen, this is the first definite indication of a complete reversal in plate motion. Magnetic anomaly patterns in the Pacific had given some clue. Some of these patterns, which normally parallel the direction of sea-floor spreading, run north-south and others run east-west. This indicates that at some time there was at least a 90-degree turn in the direction of plate motion. These anomalies are roughly the same age as the reversal in plate motion discovered by the Leg 20 scientists. Heezen also suggests that the reversal might have been related to the rupture between Australia and Antarctica, which occurred about 65 million years ago.

The scientists also measured the rate at which the Pacific crust is being thrust under the Asian continent at the deep-sea trenches lying along the western margin of the Pacific. By mapping the deposits of volcanic dust cast over the Pacific floor by Asiatic volcanoes and determining how rapidly the deposit moved toward Asia, they estimate that the Pacific crust has been consumed beneath Asia at a rate of about four inches per year over the past 10 million years.

In the course of the voyage, in which nine holes were drilled, two records were set. At a spot about 800 miles southeast of Tokyo the Glomar Challenger's drill bit descended through 20,321 feet of water, and then drilled through 1,237 feet of rock. This was the deepest drilling—both in water depth and rock penetration—yet accomplished. The samples brought up were the oldest yet found in the Pacific, more than 135 million years old. □

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Leg 20's MacGregor and Heezen.

Quasars, galaxies and superlight velocities

In the decade that quasars have been studied, their cosmological importance has frequently been stressed. Quasars look like stars but radiate energy at rates suitable to galaxies. Some of them appear to be among the most distant objects known. This combination of qualities ensures them a special place in the history and evolution of the cosmos, but as yet there is no general agreement what it is.

In the Dec. 1 ASTROPHYSICAL JOURNAL a theoretical model that links quasars, galaxies and radio galaxies in an evolutionary sequence is presented; possible physical links between some quasars and some galaxies are noted, and more evidence regarding the internal structure of quasars including motions that are apparently faster than light is recorded.

The theoretical model is by Alfonso Cavalieri of American Science and Engineering and Philip Morrison and Kent Wood of Massachusetts Institute of Technology. It is based on a suggestion that Morrison made some time ago that quasars, the nuclei of certain galaxies and pulsars might all be similar objects: condensed spinning magnetic bodies.

In the present work an evolutionary scheme for bodies of this sort is presented. At some point early in the history of the universe galactic cores with masses between 10^7 and 10^{10} that of the sun detach themselves from the more or less amorphous background. It is possible that some of these cores could form without being surrounded by normal galaxies. These galaxyless cores would collapse to form quasars. Quasars do most of their radiating in the visible and infrared portions of the spectrum, but in the course of their evolution to that state some of them could give rise to the radio galaxies—galaxies that are dark or nearly so in the visible, but radiate strongly in the radio range.

The model gives a mathematical expression for the total luminosity of the quasar population at different stages of its evolution. The farther away a quasar is, the earlier in its career did it emit the radiation we now record. Thus the history of quasars can be compiled by going to successively greater distances. When that is done, the total quasar