

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. □

## 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 Cavaliere 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



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Leg 20's MacGregor and Heezen.

## Cerebral atrophy in marijuana smokers

Marijuana may cause permanent brain damage, report four British doctors. In the Dec. 4 LANCET, they say the symptoms of mental illness seen in many chronic pot smokers may be due to organic rather than psychological reasons. Ten patients displaying these symptoms—headaches, loss of recent memory, poor concentration, depression, inefficiency, paranoid psychosis, hallucinations and superficiality—were tested and found to be suffering cerebral atrophy or irreversible brain deterioration.

A. M. G. Campbell, M. Evans, J. L. G. Thomson and M. J. Williams

used air encephalography to show that the lateral and third ventricles, or brain cavities, of the marijuana users were significantly larger than those in 13 controls of similar age.

This type of atrophy can be the result of a head injury, severe infection, congenital disease or old age. The average age of the patients was 22 years and their case histories showed no previous indication of brain damage. Therefore, the doctors conclude that marijuana use, the only thing the patients had in common, is the probable cause of the brain changes. Other drug use (usually amphetamines or LSD) was reported but not in any significant quantity.

“What is not certain is whether these changes are caused by the use

of cannabis,” says a LANCET editorial. Comparison with normal controls is not enough and LANCET suggests that controls showing the same mental symptoms without marijuana use would have been more appropriate. Alcoholism is also known to cause this type of damage but it is argued that the alcoholism is the effect rather than the cause. It may be the same in the case of marijuana. LANCET also points out that in another study 97 out of 100 patients showed the same ventricular enlargement and mental illness, but 71 of them used no drugs at all. LANCET therefore advises that it would be wise to avoid the conclusion implicit in this study until other possibilities have been examined.

brightnesses at different periods does not correspond well to the total luminosity given by the model, but the authors are not dismayed. The measurements were made at one wavelength, 2,500 angstroms, and how the brightnesses at this one wavelength relate to the total spectrum brightnesses given by the model have not been figured out yet.

There is also new observational evidence supporting earlier reports (SN: 5/29/71, p. 367) of apparent physical links between some quasars and some galaxies. E. M. Burbidge, G. R. Burbidge, P. M. Solomon and P. A. Strittmatter of the University of California at San Diego present statistical arguments to show that four quasars, 3C 268.4, 3C 275.1, 3C 309.1 and PHL 1226, are too near to four bright galaxies for the association to be chance. The circumstance raises the possibility that all quasars are associated with galaxies that are either their parents or their daughters (in the terms of Burbidge and collaborators) but have moved so far from them that the relation is no longer apparent.

This association of quasars and galaxies also raises the question of the quasar distance estimates and in so doing may raise some difficulties for the model presented by Morrison and collaborators. Traditionally the distances to quasars have been measured from the redshift of their light. Astronomers assumed that the redshift was due entirely to apparent velocity. The hypothesis of the expanding universe tells us that the fastest are the farthest. But in some of these cases the known distance of the associated galaxy does not correspond to the redshift of the quasar. It would indicate that at least some quasar redshifts are due to causes other than velocity and that the distance estimates have to be treated with caution.

Finally, attempts to elucidate the in-

ternal structure of quasars are going forward using the radio interferometer called Goldstack (that is, the Goldstone telescope in California and the Haystack telescope in Massachusetts). Among other things M. H. Cohen of the California Institute of Technology and six others report that the observations confirm earlier reports (SN: 4/24/71, p. 278) that the quasars 3C 279 and 3C 273 appear to consist of two objects that are separating from each other at speeds apparently greater than light. There are ways to explain this superlight velocity as an illusion, but they require so many constraints on the geometry and physics of the situation as to look artificial. The phenomenon could also be produced without motion by properly timed flashes along the body of an extended object in a manner similar to the running lights on a theater marquee. Beyond this, the present authors do not speculate. □

## Contract teaching fails

Contract teaching was expected to solve many problems in the education field because the teaching companies would be paid only for results. Giving the incentive to the teacher instead of to the student apparently is not working. A Rand Corp. study for HEW to be published this month finds that public school programs run by private business firms have produced no over-all gains. Five school districts were studied in detail. Gains in the five projects averaged about seven months growth for nine months instruction. This is about the usual unsatisfactory rate for children in poverty-area schools. Only one program—Gary, Ind. (SN: 10/9/71, p. 246)—posted gains above the normal rate. Rand did point out that contract teaching has helped to introduce new teaching methods. □

## The bombing of SLAC: A question of why?

Repairs were proceeding satisfactorily this week at the bomb-damaged Stanford Linear Accelerator Center. On Dec. 7 two bombs exploded in the klystron gallery of the accelerator. Damage was relatively minor: None of the klystrons, which supply the accelerator with the radiofrequency waves that power it, was damaged, and there was no injury to the accelerator itself, which stands in a tunnel below the klystron gallery. The financial loss was about \$45,000.

The accelerator was shut down at the time of the explosions. The director of the laboratory, Wolfgang Panofsky, sees no difficulty in achieving the originally scheduled turn-on date of Jan. 3. The FBI is investigating the incident. As of this week there was no word on possible suspects or motives.

The irony of the incident is that SLAC is a completely open laboratory. None of its work is classified; what it does is on the far boundaries of particle physics, a science without military applications.

The SLAC management has actively sought public understanding. It has invited the public and especially the students of Stanford University to come for tours and explanations of the laboratory. It has hired students as tour guides, hoping that first-hand experience would dispel any myths.

As a result of the explosions security is being tightened temporarily. There are more guards, especially a roving patrol along a two-mile length of the facility, and persons who enter the grounds at night are required to identify themselves. Whether these measures will become permanent remains to be seen. “It was such a nice atmosphere,” mourns a staff member. □