

# physical sciences

## NUCLEAR PHYSICS

### Abundance of cosmic ray quarks

There is still no direct evidence for existence of free quarks (SN: 2/17, p. 158), particles having one-third or two-thirds the charge of an electron.

An upper limit on quark flux has been set by several investigators, but the importance of a search beyond these limits is stressed in the Aug. 17 NATURE by Drs. Leona Marshall Libby and F. J. Thomas of the University of Colorado and the Rand Corp.

They set an upper limit on the density of naturally occurring quarks by a new method exploiting the fact that these non-observed particles, if they exist, could catalyze fission in pure heavy metals.

They suggest that cosmic ray quarks would lose energy by ionization in such a metal as uranium, be captured into orbit around its nucleus and cause the nucleus to fission. Since the quark is unchanged in this process, the cycle would be repeated.

Drs. Libby and Thomas suggest that a search through the some 300 tons of stockpiled heavy metals they assume have accumulated in the last 20 years, including uranium, plutonium and thorium, should show an upper limit for the cosmic ray flux of quarks of not more than a nine-billionth for each metal nucleus.

## MOLECULAR ASTRONOMY

### Hydroxyl discovered in infrared stars

Until now, there has been only one known observation of a possible link between hydroxyl molecules and infrared sources, suggested as regions where new stars are being born (SN: 8/17, p. 167).

That observation was of an hydroxyl source in the Orion Nebula, whose position, as measured by Drs. Ernst Raimond and Balduur Eliasson of California Institute of Technology, appeared to be in the immediate vicinity of a faint infrared object.

In the Aug. 23 SCIENCE, Drs. Alan H. Barrett and William J. Wilson of Massachusetts Institute of Technology report they have detected hydroxyl radicals in four infrared stars, using the 140-foot radio telescope at the National Radio Astronomical Observatory in Green Bank, W. Va.

The emission from one of them, known as NML Cygni, is the strongest radio line yet detected at 1612 megahertz. It comes from one of the brightest infrared objects in the sky, which is about 1,000 light years from earth.

The other three are also bright both in hydroxyl and infrared emissions. They are CIT-3, CIT-7 and NML Tauri.

## INTERSTELLAR ASTRONOMY

### Ice grains in interstellar space

The number of ice grains in interstellar space is less than 10 percent of what has been suggested in the past, telescopic and laboratory studies at the University of California in Berkeley show.

Far infrared spectra of two highly reddened giant stars, VI Cygni #12 and CIT-11, as well as the infrared

source NML Cygni, have shown no absorption band stronger than 10 percent of that previously predicted for 3.07 microns. This is the wavelength at which interstellar ice crystals have been predicted to vibrate.

This radiation was not detected in the above objects using the 120-inch telescope of Lick Observatory, nor was it found in laboratory studies of the vibrational band of ice at 20 degrees Kelvin.

Drs. R. F. Knacke, J. E. Gaustad and David D. Cudaback therefore conclude "interstellar grains contain very little ice," in a report submitted for publication in ASTROPHYSICAL JOURNAL (Letters).

## OPTICS

### Waveguide detector engineered by moths

Artificial waveguide detectors, used by German engineers during World War II to find Allied radar transmitters, are duplicated by natural selection by at least two species of moths.

Dr. Philip S. Callahan of the U.S. Department of Agriculture in Tifton, Ga., has found that the spines of two varieties of night-flying moths are the live equivalents of dielectric waveguide detectors, except that they function at visible rather than radio wavelengths.

The antenna spines of the cecropia moths are the only ones known to react to visible light. They serve as an excellent protective mechanism, keeping the moths from flying when there is light and predators are more frequent.

Artificial waveguide detectors, much larger than those of the moths, are constructed by making small tubes with materials of known physical properties. Those grown by the moths have not only the same shape, but also the same electrical and thermal characteristics as man-made detectors.

## GEOPHYSICS

### Gulf of California new—geologically speaking

The East Pacific Rise extends northward from the equatorial Pacific and disappears as a distinct feature near the mouth of the Gulf of California. From the north, the San Andreas fault trends down through California and disappears.

The Gulf of California is generally assumed to have originated from motion on one or both of these features at least 25 million years ago. Not so, say three scientists from Scripps Institution of Oceanography in La Jolla, Calif. Most of the motion of the gulf has occurred within the past four million years, they believe.

Drs. H. W. Menard, Roger L. Larson and S. M. Smith report in the Aug. 23 SCIENCE that the spreading rate at the mouth of the gulf is now six centimeters per year. They conclude that ocean floor spreading tore southern Baja California from mainland Mexico four million years ago and has subsequently rafted it 260 kilometers to the northwest.

This conclusion is based on variations in the earth's magnetism near the gulf's mouth, mapped by the Scripps team, and seismic profiles in the gulf by Cmdr. Edwin C. Buffington and his co-workers of the U.S. Navy Electronics Laboratory in San Diego. The independent studies led to the same conclusion.