

3C 273 (SN: 4/10/71, p. 245). Structure in the same quasars is now reported by another group: Dr. Marshall Cohen and graduate students George Purcell and David Schaffer of California Institute of Technology, Dr. David Jauncey of Cornell University and Drs. Barry Clark and Kenneth Kellerman of the National Radio Astronomy Observatory. Drs. W. Donaldson and H. Smith of the Jodrell Bank Observatory report internal structure in quasar 3C 147.

The original report by Dr. Knight and his colleagues indicated that 3C 279 most likely consisted of two equally bright components. Last week great excitement was generated at a symposium in Boston when it was reported that four months' watching shows that if there are indeed two components, they appear to be separating from each other at a velocity much greater than the speed of light. "If we blindly go ahead and assume [that quasar red shifts are reliable measures of distance]," says Dr. Shapiro, "then we get 10c" 10 times the speed of light.

Nobody wants to believe that any physical object is going faster than light. Some, like Dr. Geoffrey Burbidge of the University of California at San Diego, argue that the red shifts are not reliable guides: The quasars are much nearer than they appear to be and therefore the speed of separation is much less.

But, Dr. Shapiro counters, the recent work of Dr. James E. Gunn of Caltech (SN: 3/20/71, p. 193) associating a quasar with a group of galaxies convinces him that the red shifts are reliable distance indicators. It therefore becomes necessary to explain the speed as a geometric illusion.

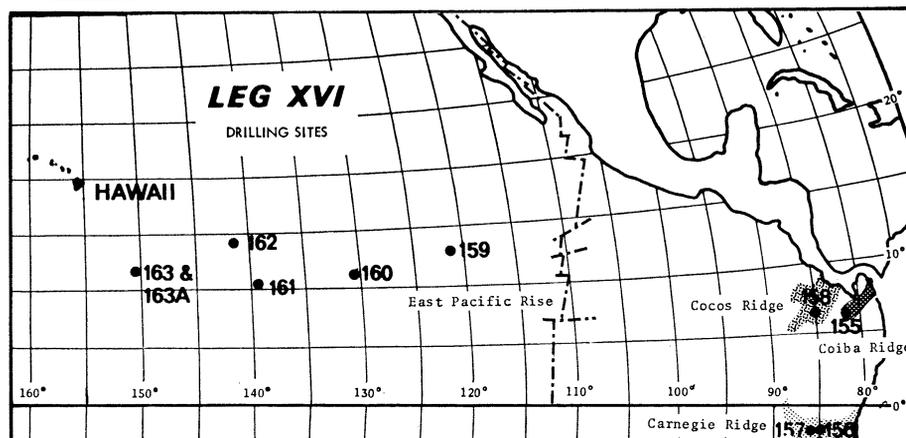
**One possibility** is that one object is moving toward us and the other away. This could give the impression of a relative velocity greater than the actual velocity of either. Another possibility arises from the nature of the observations, which are made by combining signals received at widely separated telescopes. This gives a one-dimensional view along the projection on the quasar of the baseline between the telescopes. Matter driven by some explosion in the quasar could be crossing the projection of the baseline nearly simultaneously at different points, giving the illusion in one dimension of rapid sideways motion.

The second explanation, expansion of a single object, is favored by Dr. Kellerman and his associates. For two components to appear equally bright, he says, the one moving away would have to be just that much brighter than the approaching one to compensate for the apparent dimming brought about by recession, an unlikely situation to happen at random. □

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## ZIPPERING-UP THE TRENCH

### How the Isthmus of Panama got there



E. Cherry Doyle

*Leg 16 finding: Panama was thrust up when ridge parts sealed a trench.*

The Isthmus of Panama is a peculiar feature. Not only is the connection of two continents by such a narrow tongue of land unique, but the Isthmus is also the only barrier to the worldwide circulation of water. Its creation out of oceanic material some 10 million years ago must have caused severe changes in the distribution of marine life and in local climates.

Scientists on Leg 16 of the National Science Foundation's Deep Sea Drilling Project, led by Drs. Tjeerd H. van Andel and G. Ross Heath of Oregon State University, believe they have found how this land bridge between North and South America was created.

The scientists had hypothesized that 10 million to 15 million years ago the trench that now extends along the western coast of North America as far south as Costa Rica extended southward across a deep water connection between the Caribbean and the Pacific. The Pacific crustal plate was sliding under the Caribbean. At the same time, there was an ocean ridge extending eastward from the present position of the Galapagos Islands. This ridge, the scientists believe, split lengthwise as a rift zone grew from its eastern end. The southern half of the ridge—the Carnegie Ridge—remained near the equator; the northern half broke into several pieces that drifted northward. As pieces of the ridge reached the trench they sealed it up from south to north. The jamming of crustal materials into the trench lifted the western edge of the Caribbean plate, forming the Isthmus of Panama.

**The researchers** drilled three holes: one on the stationary portion of the ridge at the equator, the other two on blocks thought to have drifted northward. At the bottom of all three holes the researchers found identical equatorial sediments. Equatorial waters are highly productive, producing unique

and easily identifiable sediments that consist entirely of the remains of microscopic plants and animals. This equatorial type of deposition could not have occurred at the present positions of the northern ridge segments, Dr. van Andel asserts; the ridges must have originally been located at the equator.

The northern holes, however, show gradual changes as the deposits become younger. The abundance of fossils decreased as the blocks passed through the less fertile waters north of the equator. Volcanic ash, clay and other materials of continental origin appeared in increasing quantities. The drift apparently began in the east. The western ridge, the Cocos, is just now running up against the continent.

**"The trench** is getting zippered-up from the southeast," Dr. van Andel says, and there is no reason why it won't continue. In another 10 million years, he predicts, the Cocos Ridge will seal the trench and lift Acapulco 1,000 feet in the air.

In an entirely separate study, the Leg 16 scientists drilled at five sites about midway between Hawaii and Central America. The discovery that metal deposits were forming in a rift zone in the Red Sea had led them to examine other rift zones, such as the East Pacific Rise, for further evidence of the nature and distribution of ore bodies. At one site between two fracture zones west of the East Pacific Rise, Dr. Heath reports, they found unusually high concentrations of metals.

South of Hawaii near the equator is one of the most biologically productive areas of the ocean. A zone of strong upwelling brings nutrients to the surface. The productivity of this area is greatly influenced by the climate of the rest of the world. During ice ages, for instance, ocean circulation becomes more intense and life is spread over a wider area. Cores from this part

of the ocean can therefore tell scientists much about the climatic history of the planet.

As with Leg 8 in the fall of 1969 (SN: 12/27/69, p. 590), the Leg 16 scientists hope to find a periodicity in the changes in the sediments that

would help predict future climate. Leg 16 ended March 30 and the data have not been fully analyzed, but, says Dr. Heath, "it looks promising. There are fluctuations in biological activity due to currents that appear to be predictable." □

#### CONFIDENTIALITY CLAUSE

### Autos, emission reports and the public

On Feb. 26, the Environmental Protection Agency's Administrator, William D. Ruckelshaus, asked 28 domestic and foreign automobile companies to report on their progress on emission controls and unconventional power sources. He set a deadline of April 2 so that the information would be available for public hearings on May 6 and 7 and for a report in June to Congress. The latter is required under the 1970 Clean Air Amendments. The purpose of the procedure is to gauge the companies' good faith in working to meet 1975 and 1976 emission goals set under the 1970 amendments. One key question posed by Ruckelshaus was how much money the companies were spending on research and development to meet the goals.

**Most of the reports** are now in. But according to EPA, most of the auto manufacturers, including Detroit's Big Four, invoked a provision of the 1970 amendments that allows them to ask that portions of the reports be kept confidential. The portions they do not want revealed: how much they are spending.

The provision of the act invoked states that confidentiality will be granted only "upon a showing satisfactory to the Administrator [that public revelation] would divulge methods or processes entitled to protection as trade secrets. . . ."

EPA is now reviewing the reports to determine if the money figures should be declassified, and officials hope there will be a decision before the May 6-7 hearings in Washington. But they admit they do not yet know whether EPA can make the decision unilaterally. "It will be up to our legal department," says Joseph Merenda, staff assistant in EPA's Bureau of Mobile Source Pollution Control.

**Some companies** (General Motors, for instance) have publicly released gross figures that they say represent amounts actually spent on emission control and unconventional propulsion research and development. But Merenda says the figures are less than definitive without a detailed breakdown. "The public is not willing," he said this week, "to take such claims on faith from anyone." And environmentalists say the figures mean little

except when placed in the perspective of what the dollar need actually is to achieve the required technologies. The environmentalists also say public revelation of amounts spent for annual style changes and advertising would provide a good index of the companies' priorities.

But Dr. Fred W. Bowditch of GM said this week: "We are applying all we know how to apply." Environmentalists' arguments about annual style changes and advertising are invalid, he says, because GM's emission control effort is already getting all the money it can use. Detailed figures cannot be released for "competitive" reasons, he says.

Apart from this, the auto manufacturers' reports show some apparent significant progress toward meeting the emission goals. Ford, for instance, says it is "moderately optimistic" that the 1975 standards for carbon monoxide and hydrocarbon emissions can be met but less optimistic about the 1976 nitrogen oxide goals. And Ford displays moderate enthusiasm for a 120-mile-range electric automobile powered by sodium-sulfur batteries for urban use.

**GM revealed** in its report the development of a prototype system for flashing fuel into vapor before it enters the cylinder, using a "stove" or heat exchanger to convey exhaust heat to the fuel (unburned liquid fuel being a major source of emissions). Combined with an air pump, exhaust gas recirculation and a catalytic converter, the system is "impressive," says GM. Possible levels of emissions: 0.2 gram per mile of hydrocarbons, 4 grams of carbon monoxide and 0.6 gram of nitrogen oxides. This is well within the 1975 standards for hydrocarbons and CO. The 1976 NO<sub>x</sub> standards do not yet exist. But the GM system approaches the expected goal of a 90 percent reduction from 1970 levels.

Most of the manufacturers reporting indicate they will rely on catalytic converters as a major part of their emission control systems, and they add that lead-free fuel will be necessary for success of the converters. Ford says a 91-octane gasoline without lead will be necessary, and that even a tankful of leaded gasoline could poison catalysts. □

#### HIGH AMOUNTS

### Mercury in the air

Scientists have known for some time that at least part of the mercury found in fish probably has its source in air pollution from incinerators and power plants (SN: 1/2/71, p. 7).

A team of scientists at Washington University's Center for the Biology of Natural Systems in St. Louis has pinned down the extent of this source. Using an airborne spectrometer, the scientists conclude that the amount of airborne mercury probably far exceeds that which enters waterways directly.

**The air downwind** of 12 power plants and city incinerators was measured for mercury content. Then, using a formula for sulfur oxide emissions, the group calculated the estimated total amounts of mercury released from the plants. The 12 plants alone released an estimated 21,470 pounds of mercury each year, contrasted with an estimated 14,600 pounds by the 50 major chemical plants in the nation that release mercury into water.

Mercury in the city incinerators has several sources, including paper treated with sodium hydroxide from chlorine-alkali plants, hospital wastes and gauze from dental offices. Mercury from the power plants is associated with coal.

The scientists said the mercury posed little danger as an air pollutant, but that it undoubtedly contributes to mercury pollution in waterways after it is precipitated in rain and is biologically altered. □

#### GEOPHYSICS PRIZE

### Paleomagnetists honored

The geophysicists' equivalent of the Nobel Prize—the Vetlesen Prize—has been awarded to Drs. S. Keith Runcorn of the University of Newcastle-upon-Tyne in England, Allan Cox of Stanford University and Richard R. Doell of the U.S. Geological Survey for their work on paleomagnetism (SN: 4/10/71, p. 251).

**Dr. Runcorn** pioneered in the use of remanent magnetism in rocks to determine past positions of the magnetic poles and to reconstruct the movements of continents. Drs. Cox and Doell demonstrated that the earth's magnetic field reverses its polarity. The pattern of strips of normal and reversed polarity on the ocean floor has been one of the strongest confirmations for continental drift.

The Vetlesen Prize was established in 1959 by the G. Unger Vetlesen Foundation to honor leaders in geophysics. The prize is administered by Columbia University.