

Research Notes

Earthquake Records

More of the earth's surface was permanently distorted by the great Alaskan earthquake of March 27, 1964, than has been documented for any known earthquake, and the vertical extent of the faulting that triggered it was at least ten times greater than reported for any other quake.

This is revealed by Frank Press, director of the Caltech Seismological Laboratory, and David Jackson, Caltech senior, in an analysis of the land displacements reported by the U.S. Geological Survey and the U.S. Coast and Geodetic Survey. Some areas were uplifted as high as 50 feet, while others subsided as much as 7 feet.

The primary fault activity, which extended horizontally for some 500 miles, extended down 60 to 120 miles into the earth and came to within 10 miles of the surface.

For the 69-day period after the main shock, there were 12,000 aftershocks of magnitude 3.5 or more. The main shock and these aftershocks released the energy equivalent of a total of 100 underground nuclear explosions of 100 megatons each. The total is equal to 500,000 times the energy of the Hiroshima atom bomb.

As an indication of how far away the earthquake left its mark, it permanently compressed rock a measurable, although microscopic, amount some 4,000 miles away in the Hawaiian Islands. The compression was measured by strain gauges installed by Caltech in the islands.

Screaming Flames

A "screaming" flame produces up to 50 times more smog-creating oxides of nitrogen than a quiet, steady flame, according to Bruce Sage, professor of chemical engineering.

The phenomenon of the screaming, or roaring, flame has caused problems in industrial boilers for years. It also has been the cause of rocket-engine failures and is a problem in air pollution. The phenomenon produces oxides of nitrogen that trigger the formation of undesirable atmospheric compounds, including eye irritants. Also, the vibrations can result in serious damage to the metal and brick walls of combustion chambers such as boilers.

The noisy flame is caused by oscillatory combustion. In this kind of burning, the combustion is uneven and occurs in surges of high frequencies —

commonly between 500 and 4,000 cycles per second. It becomes audible as the combustion frequencies reach those of sound waves.

Dr. Sage has been investigating oscillatory combustion for nearly ten years. The phenomenon was discovered in rockets in 1940 and occurs over a wide range of combustion conditions, including those found in automobile engines. Dr. Sage, aided by G. N. Richter and R. C. Seagrave, assistant professors of chemical engineering, and with the support of the U.S. Public Health Service, has been studying the factors in combustion that lead to the formation of oxides of nitrogen.

The fact that roaring flames produce more oxides of nitrogen was discovered by Dr. Sage and his colleagues in the course of recent studies of flames in an experimental combustion chamber in Caltech's chemical engineering laboratories. Oxides of nitrogen were found to form during periods of rapidly changing temperature. These changes are introduced by local perturbations in pressure.

The Hunting of the Quark

Murray Gell-Mann, professor of theoretical physics, explained last month how he happened to give the name "quarks" to the subatomic particles whose existence he first proposed in 1961.

In James Joyce's *Finnegan's Wake*, it seems there is a napping bartender who keeps being awakened by a striking clock, at which point he calls out, "Three quarks for Mr. Mark."

Dr. Gell-Mann's interpretation is that "quarks" is a combination of "quarts" (a word all too familiar to the bartender) and "hark" (which the man might naturally say when he was awakened by a striking clock).

Since it is Dr. Gell-Mann's theory that all the known particles today are manifestations of just three particles which will never be found, since they are actually nothing more than mathematical concepts — why, what better name for these particles than "quarks."

This esoteric information, revealed before the Joint Congressional Committee on Atomic Energy (which was hearing testimony to justify the AEC's proposed \$6 billion program for high energy physics research), brought a surprising tribute from the Los Angeles *Times* national science correspondent. He called Dr. Gell-Mann "something of a nuclear Mort Sahl."