the Sears and Roebuck catalog. In a sense it was there waiting in the supernova remnant. According to a quite independent theory, when a star explodes as a supernova, it leaves behind this huge cloud of glowing gas, the supernova remnant and its own core, crushed into a neutron star. So in a sense the neutron star is the obvious candidate.

To justify the proposal that a vibration of a neutron star, a neutron starquake, could flick off 10^{44} ergs in gamma rays Ramaty kept telling a press conference that it is a "small amount" (compared to the 10^{46} to 10^{51} erg that such a vibration would have available). This provoked Evans to intervene: "Reuven keeps saying 10^{44} is small. It's enormous. 10^{44} ergs in a tenth of a second is 10^{45} ergs per second. That exceeds the luminosity of the whole Milky Way galaxy."

Another argument for the neutron star comes from studies of the spectrum of the gamma ray burst by the Russian observer E.P. Mazets. Mazets found a sharp enhancement, a spectral line, that is, at 400 kilo-electron-volts. The only thing likely to cause a gamma ray line in that range is the annihilation of electrons and positrons. The annihilation line is normally found at 511 kilo-electron-volts. If the difference is taken to be a redshift, it has to be a redshift due to the gravitational field of the source. There is no cosmological redshift between us and the LMC. The redshift gives the ratio of mass to radius of the source. Picking a neutron star of one solar mass (a plausible figure) the radius comes to 10 kilometers (also plausible).

The whole hypothetical sequence goes like this: Something happens in the interior of the neutron star. "I cannot be precise about what that is," says Ramaty. A vibration propagates outward to the surface carrying energy. The vibration shakes the star's magnetosphere, an atmosphere composed of electrically charged particles bound in magnetic fields. The vibrating magnetosphere accelerates the particles, and that produces the gamma rays, both the annihilation line and the continuous part of the spectrum.

There is a plus. The vibrating mass of the star generates gravitational waves. These carry off a sizable part of the energy. This damps the vibration, rending the phenomenon transient. The damping time that theory calculates for a neutron star that would produce the observed redshift in the gamma ray line (0.25) is 0.15 seconds. That compares well with the length of the main outburst pulse.

So Ramaty remarks, "We have for the second time indirect evidence for gravitational waves." He proposes that a good confirmation of this theory would be the detection of a burst of gravitational waves coincident with a gamma ray burst. For the moment that's beyond the capability of gravity wave detectors. Maybe when there's a stronger burst or more sensitive detectors. □

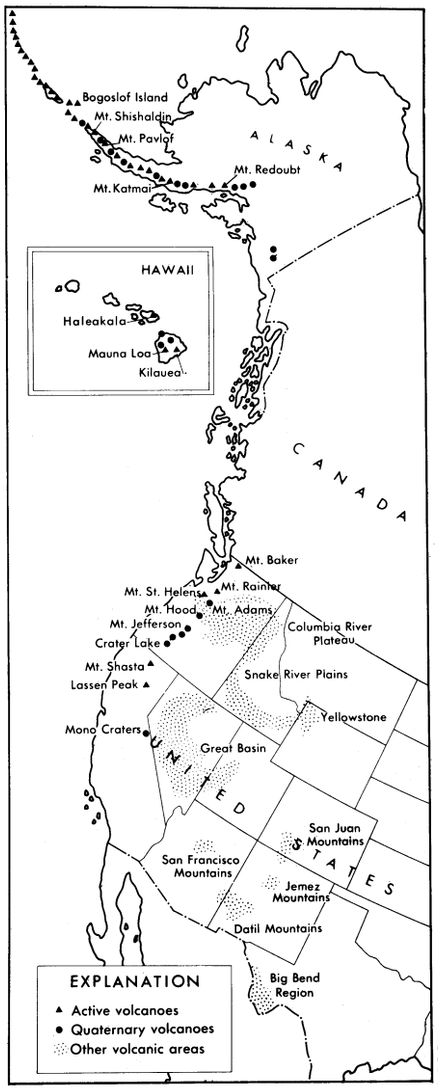
The life and times of Mt. St. Helens

The story of Mt. St. Helens is truly beginning to resemble a soap opera: With nearly theatrical timing, the volcano smolders, fumes and spits, always threatening, but never quite building to a climax. With each episode it promises its geological viewers, "Wait one more day."

The latest crisis in the life of the only erupting volcano in the continental United States is a bulge on its northern flank. Recently taken aerial photographs show that the mountain "underwent large bodily displacements" since the first eruption March 27 (SN: 4/5/80, p. 213). By April 30, the USGS determined that a one-half-square-mile area on the north slope below the volcano's crater had risen at least 80 feet since August 1979. Certain points within the region appear to have bulged considerably more: A pinnacle on the north rim of the now 2,000-foot-wide crater measures about 250 feet higher than it did before the first eruption, according to the USGS. From April 24 to 28, the swelling increased "at an impressive rate" by as much as 20 ft. in the Goat Rocks area at the 7,500-foot level of the 9,677-foot mountain. The bulge "represents the most serious potential hazard yet posed by the volcano" due to the threat of avalanches of rock, ice and mud.

Just what the swelling means is unclear. The movement of magma may be forcing the rock outward, says USGS volcanologist Robert I. Tilling, or gravitational forces may be causing a "slumping" that appears as a bulge in the aerial photographs. Tiltmeters, designed to measure the volcano's swelling or inflation, have been in place at lower levels, but until recently did not show a consistent trend of inflation or deflation, Tilling says. The most recent tilt measurements show "some tilt, not much, but at least compatible with the [photographically detected] bulge." Observers are waiting for precise measurements before making more definite statements. Mappers are redrawing contours of the area, Tilling says, and targets for precise horizontal and vertical measurements are being chosen. "Qualitatively we know something is happening to the north flank. Now we're waiting for something quantitative to tell us what, where and how much."

High in the sky, atmospheric chemists are also getting a quantitative picture of Mt. St. Helens. Richard D. Cadle of the National Center for Atmospheric Research in Boulder, Colo., directed a series of sampling flights through the thick of some of the volcano's most spectacular explosions. Flying in a specially equipped Beechcraft Queen Air, Cadle and coworkers obtained "superb samples" on April 7 and 8 when "we got in such thick ash we had trouble seeing out the windshield in order to land." In a week's total of five plume-crossing flights, the scientists analyzed the gas content of the eruptions; measured the size, weight and composition of the particles; sampled the water in the cloud to determine its origin; and took time-lapse films of the eruptions.



Washington State's Mt. St. Helens is one of the "Ring of Fire" volcanoes that encircle the Pacific Ocean. Such volcanoes occur at the junction of two tectonic plates.

Though much analysis remains, Cadle says his results suggest that the volcano probably will not have a long-term effect on weather or climate. Major volcanic eruptions such as Krakatoa in 1883 can fling volcanic particles into the stratosphere, which scatter solar radiation and produce cooler global temperatures. In order to produce such effects a volcano must kick out very fine ash particles and large amounts of sulfur compounds, says Cadle, but Mt. St. Helens meets neither requirement. "Our results suggest even if the explosions did reach the stratosphere — which they did not — one would not expect an effect on weather because the particles are so large they fall out immediately and not enough sulfur is present."

Cadle's preliminary results also confirm that the volcano is not producing new magma. Volcanic eruptions are generally of two types: phreatic, in which ground water explodes into steam and forces old rock and ash from the crater, and magmatic, in which fresh lava is released. Recently, however, scientists began to suspect that ground water may have a larger role in magmatic explosions than previously thought, Cadle says. By analyzing such factors as the origin of the water in the eruption cloud and how the water has reacted beneath the surface with certain compounds, Cadle hopes to learn more about the chemistry of the volcano's plumbing. "Since we can't dig away at a volcano like an anthill or something, all we have is circumstantial evidence that ground water is playing a role." Mt. St. Helens, he says, may provide the phreatic extreme in the spectrum of underground volcanic chemistry.

As befits a sultry soap opera star, Mt. St. Helens's recent behavior has been at best contradictory. Despite the apparently foreboding swelling, the volcano has ceased to spew out angry, ash-filled clouds and has settled down to more sedate, near constant steaming. Harmonic tremors, which are long-lasting, rhythmic shakings that herald the movement of magma (SN: 4/12/80, p. 229), have not been recorded since April 12. The daily number of earthquakes has decreased, but the proportion that are larger than Richter magnitude 4.0 has increased. All in all, says a USGS spokesman, "We don't know what it means."

But they like it: As far as science is concerned, the Mt. St. Helens saga is a hit. As many as a dozen scientists are still tuned in to the volcano round the clock, says Tilling, though the viewing is starting to take a toll on the USGS volcano budget. (A request for supplemental funding is in the works.) "This particular eruption is the first in the lower 48 states to be studied with modern instruments and with a staff of people experienced with volcanoes and ready to go," says Tilling. "Even if we don't see magmatic material, we have been able to study the hydrothermal processes, what is driving the eruptions, the natural seismicity, the nature of the fluids. It is a unique opportunity to study the reawakening of a strato-volcano [made of alternating layers of lava and ash]."

In order to make those studies a little easier, 35,000 acres of the Gifford Pinchot National Forest surrounding the volcano have been declared a "geological area" by the Forest Service. The designation allows the Forest Service to take steps to protect the area from encroachment and destruction, says a spokeswoman.

Will Washington State find happiness with Mt. St. Helens? Will the USGS figure out the meaning of the bulge? Will harmonic tremors ever return? Will the volcano ever erupt magma and quit fooling around? And will this story ever end? Stay tuned.□

High skin-cancer rate at government lab

The incidence rate for malignant melanoma — a virulent and sometimes lethal form of skin cancer — is nearly five times higher for white male employees of Lawrence Livermore Laboratory than for either the general population or for individuals living in the communities where the affected employees live. What's responsible for the increase is unknown.

A study done by Donald Austin and colleagues at the State of California's Department of Health Services in Oakland focused on LLL workers after a local hospital noted what seemed to be an abnormally high occurrence of the rare cancer among LLL employees. "Since the nonwhite population tends to have practically no melanoma," only the white population was examined, explains Mildred Snyder, one of Austin's colleagues. And to control for two factors that have been linked with the disease — a higher incidence in sunny regions and in high socio-economic groups — the study population was matched for age, sex and race against a control group of individuals living in the same counties (Alameda and Contra Costa) as the employees studied.

The finding, Snyder says, is that "the rate of melanoma occurrence was five times higher [actually around 4.75] in the employee group than in the general population." Alternate geographic breakdowns "all came out the same," she adds. And since just two of the 19 cancers found among LLL workers involved women, the elevated risk has been established only for men. At a rate per 100,000, that translates to 57 cases among the employees versus 12 cases among the controls.

"We're planning additional work," Snyder says, "to see if we can pinpoint the hazard in the environment or what in the employee group is different in some way." The epidemiologists will look for things affected individuals had in common such as occupation, work location, previous work history or lifestyle.

Because about half of LLL's research programs involve nuclear weapons design or development, the California researchers add a disclaimer to their findings: "Malignant melanoma has never been associated with any type of radiation other than ultraviolet radiation. In well studied populations having received radiation from medical-, nuclear-fission or radioisotope sources, increased malignant melanoma risk has not been reported." Any other statement "would be conjecture."

But hints that other agents might act synergistically with UV light to promote the cancer have led to studies such as one exploring a possible link between melanoma and oral contraceptives. This study is headed by a group at the University of California at Los Angeles. And a five-year study of Los Angeles County residents by Thomas Mack at the University of Southern California will try to answer perplexing questions such as why persons who work in the sun have a low risk of melanoma; why doctors, lawyers and bankers are at high risk; and why persons born in California are at higher risk than those born elsewhere and now living in California. □

Estrogen therapy and breast cancer

Drugs originally purported to keep women "feminine forever" have in recent years been charged with causing some serious damage. Estrogens, which are administered to relieve uncomfortable symptoms of menopause, appear to be linked with cancer of the uterine lining (SN: 1/3/76, p. 9). Now a study by University of California scientists indicates that long-term estrogen treatment of postmenopausal women also increases the risk of breast cancer.

Women from two retirement communities near Los Angeles were the subject of the study. A group of 131 patients with breast cancer was matched with 262 control subjects of the same age, class, race and marital status.

A 2.5-fold higher than normal risk of breast cancer was calculated for those women using high doses of estrogen, the equivalent of 1.25 mg daily for at least three years. "We were surprised to find that this strong effect appears limited to women with intact ovaries," Ronald K. Ross and colleagues report in the April 25 JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION. The increase is substantial, biologically credible and consistent with findings of a 1976 National Cancer Institute study (SN: 2/5/77, p. 90), they say. However, they report a risk below what they expected for lower level use of estrogens.

From their data, Ross and co-workers estimate that a woman undergoing menopause at age 50 who receives 1.25 mg replacement estrogen therapy daily for three years increases her probability of getting breast cancer by age 75 from 6 percent to 12 percent.

"These are sizable increases and carry with them sizable differences in mortality," Ross and colleagues say. "The benefits of estrogen therapy at this dosage level would need to be extremely great to warrant such risk."

In an accompanying editorial, Paul Meier and Richard L. Landau of the University of Chicago criticize the California findings. They point out that a similar 1977 study found no excess risk. In addition they say the high amount of estrogens that