

## Search for safety valves

The time when earthquakes can be predicted with reasonable accuracy may eventually come (SN: 2/20/71, p. 131). But prediction would be only a partial solution to the threat these upheavals present to populated and developed regions. The ideal solution would be to control or prevent them.

The possibility that earthquakes might be mitigated first suggested itself to seismologists when the filling of Lake Mead was accompanied by numerous local tremors. Quakes have similarly accompanied the injection of water under high pressure to drive out remaining oil at the Rangely oil field in northwestern Colorado.

Studies at Rangely, conducted by scientists at the National Center for Earthquake Research in Menlo Park, Calif., to test theories about earthquake modification, were described this week at the annual meeting of the American Geophysical Union in Washington. The experiments have an eventual goal of learning how stored-up strains in the earth may be relieved slowly.

Since 1969 earthquakes in the Rangely vicinity have been precisely located by a network of 14 stations that telemeter data to Menlo Park. Principal seismic activity occurs at depths of between one and four kilometers along a vertical fault that cuts across the field. Epicenters are concentrated on the southern margin of the field. The fault motion, the scientists report, appears to be right-lateral strike-slip. This means the two sides of the fault move horizontally with respect to one another, and to an observer standing on one side of the fault the other side would appear to be moved to the right.

Dr. James D. Byerlee studied the mechanical behavior of Weber sandstone, the type of rock in which the Rangely earthquakes occur, to determine its behavior as a function of confining pressure and water pore pressure. The laboratory experiments show that sudden stick-slip motion can occur during sliding both on fault surfaces and on surfaces cut by a saw, but that Weber sandstone is much more stable than other rock types. Most of the movement observed between two surfaces was by stable sliding, rather than the stick-slip motion that produces violent tremors. "This suggests that fault creep [gradual movement] may be an important mechanism at the Rangely oil field."

Another NCER scientist, James H. Dieterich, investigated computer modeling of earthquake stimulation by fluid injection. Two- and three-dimensional models have been developed to describe ground deformations associated

with earthquakes on an existing fault. Friction values from laboratory experiments were inserted into the models. When subjected to a uniform rate of tectonic loading, the model generates a sequence of earthquakes that vary in magnitude and occur at different locations on the fault. For the simulated earthquakes, drops in stress, variations of magnitude with rupture length and other parameters were in good agreement with field observations for real earthquakes.

Dieterich simulated earthquakes caused by fluid injections at Rangely by allowing friction to vary with time and location on the fault as a function of changes in fluid pressure. At a constant rate of injection, the model shows that earthquakes become less frequent with time but increase in magnitude.

Four injection wells straddle the seismically active zone and pumps have been installed at the wells. Beginning last Nov. 10, fluid was withdrawn from the region through these four wells. Pressures in adjacent observation wells, according to Drs. C. B. Raleigh, J. H. Healy, J. P. Bohn of NCER and J. D. Bredehoeft of the U.S. Geological Survey's Water Resources Division, had dropped by as much as 800 pounds per square inch by Jan. 15 of this year.

Before backflowing began, there were two centers of earthquake activity in the vicinity of the four wells, one located at a distance from them and the other directly beneath. When water was withdrawn through the wells, earthquake activity beneath them was reduced significantly.

The researchers hypothesize that reduction in fluid pressure in the reservoir would curtail earthquake occurrence because of an increase in the effective normal stress on the fault surfaces. They will test this hypothesis by reinjecting fluid to determine if earthquake activity again increases with rising pore pressure. They hope that continued experiments will identify an important safety valve for earthquakes triggered by fluid injections and even for quakes along such dangerous faults as the San Andreas in California. □

## HODGKIN'S DISEASE

### Pushing for a total cure

Some form of cancer will attack one of every four persons in the United States sometime during his life. Such statistics have made finding a cure for cancer a major goal of the 1970's. In December the Yarborough panel (SN: 12/19/70, p. 459) proposed the creation of a National Cancer Authority and an all-out attack on the disease. In his subsequent State of the Union Message President Nixon took up the call by announcing that he would ask Con-

gress for an extra \$100 million in fiscal 1972 to fund a bolstered effort to find a cure for cancer (SN: 1/30/71, p. 80).

The advances made in cancer research during the past 40 years (SN: 1/2/71, p. 12) indicate that now would be a good time for this extra Governmental boost. Cancer research is in full swing and is making considerable headway in certain areas. The added impetus should produce results.

However, there are many forms of the disease and a variety of treatments. Knowing exactly where to apply the impetus is crucial. With some forms of cancer one answer might be the coordinated, big-team approach, in contrast to having hundreds of independent researchers, each pursuing his own path.

A team approach to the cure of Hodgkin's disease is achieving success in 75 percent of the cases treated in some large medical centers. This disease is a form of cancer that attacks the body's lymphatic system. It usually begins in the neck and spreads throughout the body in four stages. Ten years ago it was considered an incurable and fatal disease. Now patients treated in the early stages may expect a 90 percent chance of a five-year cure, and for those making it to five years, a 95 percent chance of total cure.

The team approach that has been achieving this high rate of success was explained in detail by a panel of physicians speaking at an American Cancer Research seminar for science writers last week in Carefree, Ariz.

The first step in treating the disease involves proper diagnosis of the exact stage it is in. "Until recently, staging was based on inadequate information," says Dr. Henry Rappaport, pathologist at the University of Chicago. Two new diagnostic techniques have changed this: lymphangiography, which enables the physician to see whether lymph nodes deep in the body are diseased, and surgical exploration of the abdomen, which permits a direct look at the diseased organs as well as a laboratory study of them and any others that might be affected.

Once the exact stage of the disease is known, the proper treatment can be applied. In the first and second stages radiation therapy is most effective. In the third stage radiation and chemotherapy can be used. In the fourth stage radiation cannot be used because of the risk of destroying vital tissues surrounding the diseased areas. Therefore, chemotherapy alone is used.

These treatments, however, have not always been as effective as they are today. Dr. Henry Kaplan, a pioneer in radiation therapy from Stanford University, has helped to develop megavolt radiation therapy for Hodgkin's disease.

Using powerful, precise radiation from a linear accelerator or a large cobalt machine he is able to deliver tumor-killing doses of radiation deep into the body with little or no harm to the skin. Unfortunately, a lack of properly trained radiotherapists limits this treatment to a few large medical centers.

**Advances** in chemotherapy have also added to the success of the Hodgkin's disease treatments. Formerly a single drug was used to destroy a tumor. The drug did the job but often it was not complete, and the tumor would return. Dr. Vincent T. DeVita Jr., head of the solid tumor branch of the National Cancer Institute, has found a way of getting around this limitation. Using a combination of four anticancer drugs, he has had an 81 percent disappearance of tumors in 43 patients treated. Seventy-seven percent of the patients who responded were still alive after five years, and half of them were completely free of the disease.

The skillful coordination of these recent advances, the panel reported, has produced results that indicate the fight against this particular form of cancer is moving in the right direction. □

#### UNEMPLOYED ENGINEERS

### Jobless funds for 14 cities

Each successful assault and subsequent cut in spending for defense, space and other heavy industry projects has displaced thousands of engineers and scientists. The count of jobless is currently 75,000 to 100,000, and it is expected to increase. The result has been a flurry of bills and programs from Congress and the Administration.

Last week the Labor Department announced details of President Nixon's own plan, called the Technology Mobilization and Reemployment Program. The program allocates \$42 million (or about \$420 per jobless individual). Of this amount, \$25 million would be used to retrain some 10,000 persons in job areas where there is a strong prospect for employment; \$10 million for relocation grants to persons who find jobs and have to move; \$5 million in grants for 20,000 persons to explore job opportunities outside of their home areas, and \$2 million for research on conversion studies.

**The money** will be divided among the 14 areas that have been hardest hit: Atlanta, Boston, Cape Kennedy, Dallas, Huntsville (Ala.), Los Angeles, Nassau County (N.Y.), Orange County (Calif.), Philadelphia, San Diego, San Jose, Seattle, St. Louis and Wichita. The services will be administered on a first-come first-serve basis: Registration at the state employment agencies in the areas will begin April 19. A Labor Department announcement de-

fining the eligibility requirements for the money was expected this week.

In addition to a House bill sponsored by Rep. John W. Davis (D-Ga.) and Rep. Robert N. Giaimo (D-Conn.) that would provide \$450 million for research into the problem of converting defense and aerospace workers to other activities (SN: 2/20/71, p. 128), three bills have been introduced in the Senate. Sen. Edward M. Kennedy (D-Mass.) introduced in January a bill providing \$500 million over a three-year period for retraining of the unemployed. The money would be used by the National Science Foundation to establish community conversion corporations. Last month he introduced another bill that would authorize low interest, long-term conversion loans in amounts up to 60 percent of the unemployed's former salary or \$12,000 a year.

Sen. George S. McGovern's bill would establish a National Commission on Peacetime Transition to protect workers in defense and space industries and encourage new enterprises in both the private and public sectors. According to a McGovern aide, the bill would require that military, space and Atomic Energy Commission contractors deposit in reserve 12.5 percent of their profits from Government contracts (before taxes). This money would be used by the new commission to pay benefits to workers whose work weeks have been shortened due to spending cuts or whose jobs have been eliminated or downgraded.

Recently released preliminary results of a questionnaire sent by the Battelle Memorial Institute to aerospace workers laid off from 1968 to 1970 show that of 2,000 respondents only 31 percent have found permanent jobs; 32 percent have found temporary jobs, and 32 percent are still unemployed. Five percent have left the working force.

**On the average**, the respondent was out of work for 31 weeks. Of those who found permanent jobs, only 18 percent returned to the aerospace industry. Of those who found jobs outside the aerospace industry, only 12 percent said that their new jobs were highly related to their skills and 50 percent said their new jobs were not at all related to their aerospace experience. Thirty-one percent of those finding jobs outside the industry said they would not return to an aerospace job. Only 16 percent said they would.

In addition to the human and economic problems of unemployment, the massive shifts constitute an irretrievable national loss, says Dr. George M. Low, Acting Administrator for the National Aeronautics and Space Administration. "We are losing much of [our] aerospace capability. . . ."

#### THE DRUG SCENE

### Dr. Jekyll and Mr. Cocaine

The worst bummer of all time was recorded by Robert Louis Stevenson. It seems that the good Dr. Jekyll tripped out on a mysterious powder and ended up as the nefarious Mr. Hyde. This was a strange case indeed, because it is possible that the author, R.L.S., may have been on a pretty heavy trip himself.

Saul Bellow, one of America's leading fiction writers, states that, "You may find illumination anywhere," and in the past, various literary geniuses have taken inspiration from psychoactive drugs. Coleridge, Poe and Baudelaire, in particular, did some of their most creative writing while under the influence of the poppy. Now, speculates Dr. Myron G. Schultz in the April 5 JOURNAL of the AMERICAN MEDICAL ASSOCIATION, there is a possibility that R.L.S. may have written "The Strange Case of Dr. Jekyll and Mr. Hyde" with the help of a hallucinogen—cocaine.

Cocaine is the active alkaloid of coca. It was used by the Incas to attain beatitude, and was given to the Peruvians by the Spanish in exchange for their labor.

**The drug itself** was first isolated in 1859 and came to prominence for its therapeutic qualities in 1884. Medical papers of the day touted it as a "miracle drug" for the cure of gonorrhea, morning sickness, seasickness, hay fever, opium addiction, sore nipples, whooping cough, asthma, syphilis and the common head cold. The September 1885 LANCET noted this.

Stevenson, who had suffered from "catarrhal consumption" since early childhood, was living in Bournemouth, England, at this time. His physician, Thomas Bodley Scott, was unsuccessfully treating the respiratory condition with morphine. It is quite possible that Scott may have followed the recent suggestion of LANCET and given his patient cocaine.

This would account, Schultz contends, for the demoniacal, pace at which the bedridden Stevenson wrote and then completely rewrote the novel (60,000 words in six days), and for the novel's imaginative preoccupation with good and evil. Cocaine does give the user an unusual capacity for work, and has the mind-altering ability to "develop everything that is degrading and ignoble in human nature."

Dr. Schultz's speculations cannot be verified, but if they are true, we can now number Stevenson among the spaced-out literary figures of the past and the psychedelic lyricists of the present. We can only speculate what R.L.S. would have done on LSD. □