

aims prevent it from being regarded as a continuation of Vela.

The proposed program has five main parts: (i) geological and geophysical field studies; (ii) instrumentation of seismic zones; (iii) research on the physical basis of earthquakes; (iv) research in earthquake engineering; and (v) a "miscellaneous projects" category which includes an item of \$10 million for research in earthquake analysis and prediction.

A total of \$74.4 million, or more than half the estimated total cost of \$137 million, would go into the instrumentation of seismic zones. The object, according to Press, would be to measure "all aspects of the physical environment in the vicinity of earthquakes, looking for an empirical predictive pattern."

In the report, the rationale for instrumentation is as follows:

"This program is directed primarily at monitoring with the greatest achievable sensitivity all possible indicators foretelling the occurrence of earthquakes. It represents an empirical approach in the absence of a confirmed theory for the mechanism of earthquakes. On the other hand, all phenomena reported [by reputable scientists] to have preceded earthquakes will be checked. The pre-earthquake activity predicted by the main theories of the earthquake mechanism will be examined. The level of stress will be monitored in seismic zones against the eventuality that the stress history is pertinent to the occurrence of an earthquake. Strain and tilt fields will be observed in a continuous fashion in case creep acceleration prior to fracture is significant. Changes in the local magnetic, electric, and gravitational fields may be related to changes in the stress or the physical state of rock, both of which may precede a major shock. The statistics of strain release by extremely small shocks (energy release corresponding to a few pounds of TNT) may also indicate changes in physical state. Experiments in mines and laboratories which also suggest changes in the occurrence of micro-earthquakes prior to fracture will be expanded to explore their pertinence to actual earthquakes. The program is designed to maximize the possibility that the zones being monitored are also the zones within which earthquakes will occur. The resulting data will be of fundamental importance to the earth sciences, bearing as they do on de-

### NSF To Coordinate Solar Study

The Federal Council on Science and Technology has designated the National Science Foundation as the federal coordinating agency for U.S. observations of the total solar eclipse in South America, 12 November 1966. American scientists, whether or not they are members of a federal agency, are invited to notify the coordinator, Robert Fleischer, of their plans, preferably by 1 January. It is hoped that scientists' requests for assistance from South American governments and institutions will be made through Fleischer, to insure their consistency with each other and with the plans of South American scientists. Additional information is available from Fleischer, Program Director, Solar Terrestrial Research Program, NSF, 1800 G St., NW, Washington, D.C. 20550.

formation, mountain building, continental drift, and other dynamic processes within the earth."

Fault zones in California and Alaska would be instrumented, and where practicable the instruments would be linked to computers. The hope will be to "trap" an earthquake big enough so that the data collected will throw light on the question of the possibility of prediction.

The committee urges close cooperation with Japanese scientists who have launched their own 10-year program of intensive empirical studies in a country which provides a rich ground for earthquake research. In Japan, instruments have recorded changes in the advance of quakes which some scientists have suggested may be "premonitory events." But Press says that, although strains or tilts may have occurred before some earthquakes, this is not evidence that earthquakes always follow such occurrences.

In the proposed program about \$12 million would be earmarked for geological and geophysical field studies in quake-prone areas. Research on the physical basis of earthquakes, with attention to such fields as rock mechanics, would get some \$15 million over

10 years. The miscellaneous-projects category is allotted \$16 million, with \$1 million a year going to support research in analysis and prediction of earthquakes.

Research in earthquake engineering is ticketed for an allotment of \$19.6 million over the 10 years. The effort would be carried on in five categories: strong-motion seismology, soil mechanics and foundation engineering, structural dynamics, design techniques, and economic studies.

Implementation of the engineering portion of the program is strongly urged by the committee, although this effort falls somewhat outside the province of a group commissioned to make recommendations on earthquake prediction. Chief products of this program would be "seismic zoning," for areas vulnerable to earthquakes and tidal waves, and design standards which could be incorporated into building codes. Press's comment was, "whether or not earthquakes are predictable, the major contribution of science and technology to the earthquake problem may well come from the engineering program."

Prospects for acceptance of the program in its pristine form are difficult to predict. No matter how high the prestige of the panel members, the proposal does not yet have specific backing in Congress or in the operating agencies. The report, therefore, can be likened to the proverbial arrow shot into the air.

Only when the reactions of the agencies concerned are in—the Army Engineers, the Geological Survey, the Coast and Geodetic Survey (which operates the tidal wave warning system), the new Environmental Science Services Administration, and the National Science Foundation—and the process of bargaining proceeds will the prospects become clearer.

In this case, the cooperation of the states most directly affected, California and Alaska, will be required. And the attitude of Congress and of administration budget makers will ultimately be decisive. Not only is the level of funding for earthquake research sure to be debated, but division of funds between prediction research and engineering is also likely to be scrutinized.

Federal investment in Project Vela Uniform is declining, and the tentative price tag of \$137 million on the 10-year earthquake research program would roughly equal the amount spent