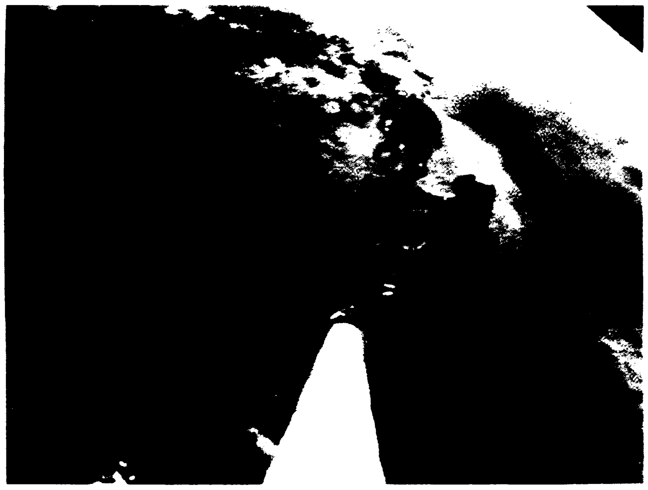

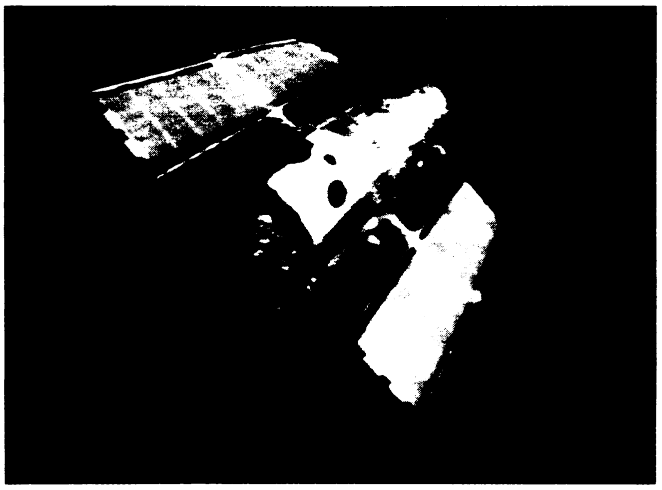

Left: Astronauts on the shuttle's robot arm cover Hubble's old magnetometers. Beneath the cloud cover lies the continent of Australia. Right: A repaired Hubble moments after its release by the arm.

Hubble's main mirror. But after they added a coprocessor to improve the memory of Hubble's flight computer, ground controllers were dismayed to find that the computer intermittently radioed spurious signals. Engineers later that day traced the problem to faulty communications rather than a hardware flaw.

Leckrone notes that several initial tasks, such as calibrating the new gyroscopes and determining whether any of the scientific instruments were jostled out of alignment during the mission, must be completed in the next couple of weeks. Only after that can scientists determine the success of the optical repairs. Next week, ground controllers will begin a two-week process of ridding Hubble of contaminating vapor that might otherwise settle on the new WFPC's electronic detectors once they are cooled.

Engineers will then begin aligning Hubble's secondary mirror to aim light precisely into the camera. Around that time, technicians will also deploy a mechanical arm inside COSTAR that holds corrective mirrors. This should enable Hubble's Faint Object Camera to see more clearly.

After finding the optimum focus for both cameras, scientists will perform the ultimate test some six weeks from now: They will take several images of crowded star fields and faint galaxies to find out whether the repair mission has paid off with a sharper view of the heavens.

– R. Cowen

Electrical clues precede some tremors

Battling the skepticism of their colleagues, some geoscientists are investigating the controversial idea that faults release electromagnetic signals prior to generating large earthquakes. Researchers last week reported hints that such electrical bursts have preceded several recent quakes, raising the possibility that this phenomenon might finally be drawing serious attention.

Claims of electrical precursors of earthquakes are nothing new. But experts have found many past reports of such dubious quality that they have shied away from this research. In previous studies, workers typically failed to demonstrate that prequake electrical signals were not caused by subway trains, atmospheric phenomena, or myriad other sources of electrical noise in the environment.

Some Greek researchers in recent years have claimed success in predicting earthquakes by observing voltage changes in the ground. Although most seismologists within Greece and elsewhere have dismissed such findings, the reports stirred the interest of Seiya Uyeda, a seismologist who splits his time between Tokai University in Shimizu, Japan, and Texas A&M University in College Station. Uyeda convinced colleagues in Japan to set up an experimental observation network along the western coast of that country to test the Greek techniques.

At a meeting of the American Geophysical Union in San Francisco last week, Uyeda reported that this network had indeed detected unusual changes in Earth's voltage in the weeks preceding four strong quakes that hit Japan between 1991 and 1993. Uyeda says his team must do more work to determine whether such electrical changes come from a human source. "We're not sure of anything. It may be something, or it may be nothing," he notes.

As a foreign associate of the National Academy of Sciences and an established scientist, Uyeda may succeed where others have failed in promoting research into electromagnetic changes associated with earthquakes.

Hiroo Kanamori, a seismologist at the California Institute of Technology in Pasadena, says he finds Uyeda's work interesting. "My feeling is that regardless of whether this has value as a prediction tool, they may be looking at a very important physical process in the crust."

Antony Fraser-Smith of Stanford University in Palo Alto, Calif., has also been attempting to catch signals coming before quakes. Working with instruments that detect very-low-frequency radio waves, Fraser-Smith normally studies the magnetic properties of Earth's atmosphere. He got into the earthquake business by chance after one of his machines detected an unusual magnetic disturbance before the Loma Prieta earthquake in October 1989.

He has since set up five of these instruments at key sites along the San Andreas fault, waiting to see whether similar magnetic signals precede another quake. Two of the instruments are located at Parkfield, Calif., where seismologists expect a magnitude 6 earthquake to occur soon. Fraser-Smith reported last week that the Parkfield sensors did not detect any magnetic peculiarities before a much smaller quake, measuring magnitude 4.8, hit the town last month.

Past observations of electrical precursors have attracted little attention, in part because the scientists who made them did not describe a physical mechanism that could have caused such signals. Stanford's Simon L. Klemperer and an Israeli colleague have devised a theoretical model that could explain what Fraser-Smith observed in 1989. They suggest that movement of the earth before a quake causes tiny water-filled pores in the rock to connect, thus enabling an electrical current to flow.

– R. Monastersky