science news
OF THE WEEK

'Something very weird' in Cygnus X-3

On the night of Sept. 2 radio astronomers in Canada and the United States were getting ready to do joint observations of the binary star Algol. Astronomers at the Algonquin radio observatory of Canada's National Research Council had been watching Algol for several nights and had seen two interesting flares. The weather was too bad to search for new radio sources, so Philip C. Gregory decided to check on a source already known for radio emissions as well as X-rays—Cygnus X-3 in the constellation Cygnus of our Milky Way galaxy. What he saw he could hardly believe.

The average radio level for Cygnus X-3 is about 0.1 flux units. What his instruments detected was 22 flux units —220 times greater. "I thought something had gone wrong with the receiver," Gregory told SCIENCE NEWS, "and I kept turning the sensitivity down." After an hour he was convinced it was real. He called Robert Hjellming of the U.S. National Radio Astronomy Observatory at Greenbank, W. Va., who is participating in the joint observations. "Would you believe 22 flux units for Cygnus X-3?" he asked. Hjellming called back in 30 minutes verifying the outburst. Working with Gregory that night were E. R. Seaquist and P. P. Kronberg of the University of Toronto and Z. A. Hughes, Andrew Woodsworth, M. R. Viner and D. S. Retallack of Queens University, Toronto.

"Only the night before," says Hjellming, "Cygnus X-3 had dropped to 0.01 flux units." (The lowest it had ever been was 0.03.) Thus, the increase over the night before was even more spectacular. Astronomers have seen increases in radio sources by a factor of two or three over periods of a typical month. "We are sitting right now on 20 days of unpublished data about Cygnus X-3," says Hjellming, "but we have never seen anything like this increase before."

By Sunday morning six observatories were in on the investigation and scientists in charge of telescopes in space had been alerted. Observations were made over the entire radio spectrum from 1.9 centimeters to 21 centimeters wavelengths. According to Hjellming, the level of radio output was 22 flux units at 2.8 centimeters and 20 flux units at 3.7 centimeters on Sept. 2 and 3. On Sept. 3 and 4 it dropped off dramatically to 12 flux units. By Tuesday, Sept. 5, it had dropped to 3 flux units at 2.8 centimeters.

Brightness temperatures as high as 10 million degrees K. seem necessary to explain the radio emissions, Gregory says. "In an event as abrupt over such a short time and at such high temperatures," he adds, "we would expect to see some increase in the visual." But preliminary reports from Mt. Palomar Observatory are that the astronomers there saw nothing obvious in the visual range of the spectrum.

"This is a very strange object," says Gregory.

Since rocket observations in 1967, scientists have known they were dealing with a peculiar source in Cygnus X-3. Last year the X-ray satellite Uhuru verified that it was an X-ray source. Then in June of this year it was dis-

Magnetic changes: Clue to quake precursor?

It now seems fairly clear that last November's controversial Cannikin nuclear test produced none of the dire consequences predicted by the test's opponents (see p. 170). In fact, the test has had at least one very beneficial result: It has enabled scientists to confirm the existence of a phenomenon that may eventually be applied to earthquake prediction.

Two National Oceanic and Atmospheric Administration geophysicists, W. P. Hasbrouck and J. H. Allen, announced this week that Cannikin apparently produced permanent changes in the magnetic field over the island of Amchitka. The discovery suggests that changes in underground stresses are reflected in measurable changes in the earth's magnetic field.

Laboratory experiments have shown that when magnetic rocks are subjected to pressure, their magnetic properties change. This phenomenon, called the piezomagnetic effect, has been discussed as a possible means of predicting earthquakes: Changes in stress around a fault may be detected by magnetic sensors. But as Hasbrouck points out, what happens in the laboratory and what happens in "real life" in the field are often two different matters. Actual measurements of magnetic field changes associated with changes in stress in the earth's crust have been rare. Cannikin offered an ideal opportunity to test the piezomagnetic effect in the field: The rocks on Amchitka are magnetic, and the exact position and time of a large source of stress change (the explosion) were known. The NOAA scientists made magnetic surveys before and after the test and continuously monitored magnetic field intensity at four locations. The Cannikin magnetic surveys demonstrated that the piezomagnetic effect does occur in nature.

Within 30 seconds after the explosion, a magnetic sensor three kilometers southeast of ground zero detected a nine-gamma increase in the intensity of the magnetic field. (A gamma is the unit used to express magnetic field intensity. The intensity of the earth's total field is about 50,000 gammas.) Within an hour and a half after detonation, the field intensity decreased by about two gammas, leveling off at seven gammas above pre-explosion intensity. The researchers continued to monitor the magnetic field for another eight days. The seven-gamma increase persisted. The two believe the intensity increase represents a permanent change in the magnetic field. Hasbrouck notes that Russian geophysicists have reported similar increases in magnetic field intensity accompanying their atomic tests, but the field always fell back to normal within 24 hours after the test.

Hasbrouck and Allen propose two possible causes for the magnetic intensification. Either the compressive stress generated by the explosion produced a change in the magnetism of nearby magnetic rocks by squeezing them, or subterranean stresses produced by the test have not been relieved.

Magnetic measurements on a fault north of Cannikin revealed a magnetic anomaly that is apparently controlled by the fault. The anomaly occurs around a portion of the fault about 1.6 kilometers northeast of the covered to be a radio source as well. "It is a compact, powerful source that behaves very erratically," says Riccardo Giacconi, a principal investigator on Uhuru. It is a binary star system, and Uhuru astronomers have been trying to establish if its X-ray variations are periodical.

Both Gregory and Hjellming speculate that Cygnus X-3 could be a black hole, although they do not understand why it would be giving out radio energy. The black-hole theory would account for the high temperatures, however, since as mass from another star falls into the black hole, energy would be released. If the outburst were a nova or a supernova, astronomers would expect to see some optical brightening.

Evidence indicates that the source is in front of the Cygnus rift—a dust-cloud in the constellation Cygnus. From the abruptness of the increases, the size of the source must be less than one light-day in width. The Uhuru astronomers should be able to nail down an upper limit of the size more precisely.

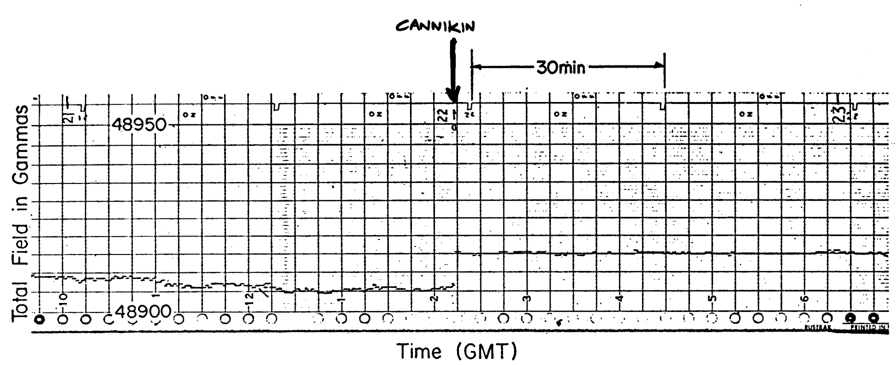
Because Cygnus X-3 is a strong X-ray source also, scientists expect to find a dramatic increase in the X-ray emissions coinciding with the radio. "If the X-ray and radio sources are independent," says Hjellming, "it would be even more inexplicable. It should be one of the strongest X-ray sources in the sky about now."

But Giacconi is not so sure. "We really haven't established if the X-ray and radio sources of Cygnus X-3 are the same." When Cygnus X-1, for example, increased in radio emissions, it dropped in X-ray energy, he noted. But Giacconi says that six days before the radio outburst, Uhuru recorded an increase in X-ray counts from Cygnus X-3 from 150 (the normal count) to 300 counts per second, the highest ever seen from that source. "But that is not an increase of the magnitude seen in the radio," Giacconi notes. The Uhuru data from the Sept. 2 outburst have not been analyzed. "If the increase in the X-ray turns out to be as large as the increase in the radio, it will have blasted our detectors," concludes Giacconi. They will know by the end of this week.

On Tuesday of this week, Chi-Chao Wu of the University of Wisconsin had in hand the raw data from OAO 2's ultraviolet observations of the source during the outburst. "The data are not reduced completely yet," says Wu, "but we do see a substantial increase in counts in one wavelength of the ultraviolet." There were no significant increases detected yet in other wavelengths.

Later this week, the new ultraviolet and X-ray telescopes of Copernicus (SN: 9/2/72, p. 156) were to look at the Cygnus X-3 mystery.

"Something very weird is going on here," says Giacconi. All agree, however, that more study and observations are needed to find out just what that something is. □



NOAA

Jump in magnetic intensity after Cannikin confirms geopiezomagnetic effect.

Cannikin epicenter. Post-Cannikin measurements across the fault showed a "dip" in magnetic intensity running parallel to the fault. There were increases of as much as 13 gammas in the magnetic field on the Cannikin side of the fault and decreases of 11 gammas on the far side of the fault. This change of a total of 24 gammas across the fault, says Hasbrouck, "may not seem like much compared to the 50,000-gamma intensity of the earth's field, but it is exciting to me. The most we expected was a change of half a gamma to two gammas." These magnetic changes also appear to be permanent. The NOAA scientists interpret them as signs of an increase in compression in the crust on the Cannikin side of the fault and an increase in tension on the other side. Magnetic dip, they suggest, may be the result of opening of the fault.

The next step in the investigation will be to quantify the piezomagnetic effect—to determine how much stress produces a given magnetic change—and to study it at other locations. Says Hasbrouck: "It looks promising, but we have a long way to go in a far-out field like this."

Psychologists: In the shadow of Diamond Head

The 80th annual meeting of the American Psychological Association was held this week in Honolulu, Hawaii, where the dominant mood was one of vacation. The almost 6,000 persons who attended were more likely to meet and greet on the beach at Waikiki than at a symposium. Many were more interested in taking home a good tan than a pile of research papers. But all was not pineapple and poi for the psychologists. New research was presented and old concerns were voiced.

For instance, the week prior to the APA meeting, the Association of Humanistic Psychologists met in Honolulu. Their meeting coincided with President Nixon's meeting with Japan's Prime Minister Kakuei Tanaka. For many of the AHP members, Nixon's presence was good enough reason to organize an antiwar rally and to take a stand against the war in Southeast Asia.

Carl R. Rogers, pioneer in encounter group therapy and director of the Center for Studies of the Person at La Jolla, Calif., was keynote speaker at the AHP meeting. In reference to the war, he contended conflict can be avoided by using the group approach. The leaders—not the representatives—of two antagonistic groups will almost certainly reach an understanding, Rogers said, if they meet in an atmosphere of openness and honesty.

Concerns other than the war were aired at the APA's open forum or town hall meetings. Women and blacks asked why so little has been done by the APA to upgrade their status. Others called for more effective psychological training, laws against corporal punishment in schools and a reform of marijuana laws. But the tone of the arguments raised at the town hall meeting was subdued compared with previous years. Some psychologists even speculated that the prohibitive expense of traveling to Hawaii kept the less affluent but more vociferous and radical members away.

Along the same lines, Jack Sawyer of Harvard University said the artificial surroundings of the resort city and the feeling of tourism at the meeting detracted from what should be an atmosphere of social and intellectual ferment. He accused the APA convention planners of contributing to, instead of striving against, racism and commercial exploitation of the Hawaiian Islands. Rogers, who was at the APA meeting to receive the organization's first Distinguished Professional Contribution's Award, also took a few pot shots at the organization he once headed. In an invited address he said psychology is "slipping backward as a