Working groups focused on the topics of message formats, means of communications, and the communications protocols required for the use of such means across national boundaries. An impressive demonstration of computer-to-computer linkages showed the establishment of links from Ottawa to computers in Australia, Finland, West Germany, New Zealand, Norway, Sweden, the UK and the USA.

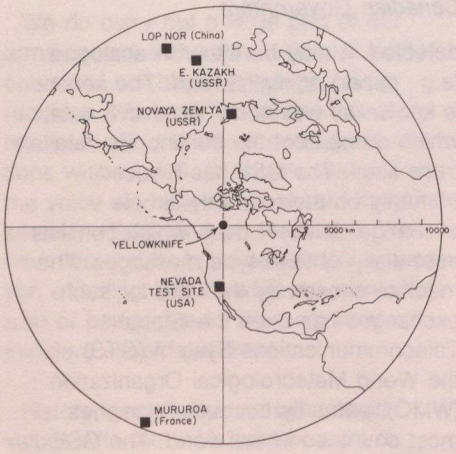
General agreement was reached on the format for waveform messages; several outstanding problems relating to the use of packet-switched networks were resolved; and the internationally approved protocol for computer linkage was strongly recommended. The results of the workshop will be presented as a Canadian working paper at the next meeting of the GSE in March 1987. It is expected that the workshop's conclusions will be accepted within the GSE, thereby accelerating its work.

Upgrading the Yellowknife Seismic Array

The following article is based on a report prepared by the Department of Energy, Mines and Resources.

The seismic array located just west of Yellowknife, NWT, is being completely modernized. A major impetus for this large-scale project is the recognition by the Canadian Government of the importance of contributing to the development of a global seismic network which could be used to assist in verifying an eventual comprehensive test ban. The upgrading of the Yellowknife seismic array will cost nearly $4 million and is expected to be completed early in 1989. The modernization of the array will be carried out by the Geophysics Division of the Geological Survey of Canada, Department of Energy, Mines and Resources, which has operated the facility for almost 25 years.

The Yellowknife array was installed in 1963 and, aside from the addition in 1974 of analogue radio telemetry between the outstations and the control centre and automatic computer processing, has remained essentially unchanged. Most seismic observatories consist of seismometers at a single site, but the array has 18 outstations, each equipped with a seismometer, spread out at intervals of 2.5 km along two lines 20 km in length, oriented north-south and east-west. The array control centre, located outside the Yellowknife airport, receives data from all these instruments by radio. Using a computer, the direction and distance of a seismic source, whether explosion or earthquake, can be determined from the sequence in which signals from the source arrive at the individual seismometers. In addition, by adding up the output of all the instruments after an appropriate time delay (a process called beamforming), smaller signals can be detected by the array than would be possible from a single seismometer, since the uncorrelated background noise tends to cancel out while the correlated signals reinforce each other.



The Yellowknife seismograph array is within 10 000 km of all principal underground testing sites.

Yellowknife was chosen as the site of the array for several reasons: it is far from oceans, which are a major source of background noise; the rock beneath it is unusually uniform; and its remoteness minimizes the most important secondary source of noise, namely human activity in the form of traffic, trains and industrial machinery. The array has proven very sensitive and detects many thousands of earthquakes (and several tens of underground nuclear explosions) each year. The data produced by the array have been widely used by researchers in Canada, the US and Europe in continuing efforts to devise methods to detect smaller and smaller events and to characterize them accurately as either earthquakes or explosions — both essential prerequisites for a verifiable ban on nuclear testing.

Over the years, the array equipment has become somewhat antiquated. The data from the array accumulate on tape at the Yellowknife control centre and are sent to Ottawa at intervals of about two weeks. This delay would not be acceptable in a (test ban) treaty environment. The modernization therefore includes replacement of the existing seismometers and the addition of a four-element array (with a spacing of about 10 km) of new "broad band" seismometers. Data from these sites will be relayed by digital radio telemetry to a new control centre, from which the data will be sent by a dedicated satellite link in "real time" to Ottawa. Since the project was funded in July 1986, new equipment has been ordered, tunnel vaults about 15 metres long have been blasted into cliff faces for the broad-band sites, detailed design documents for both hardware and software have been completed, and work has begun on many of the high-technology components of the system.