CTBT regime and those of past arms control agreements, many of which depend largely upon a single method of verification — often on-site inspection — for compliance monitoring, is that a CTBT will have the opportunity to make use of the multi-layered approach to provide verification of compliance on a global, as well as a regional, basis. Speaking in the CD on August 5, Canadian representative Paul Dubois promised continued Canadian support for exploring a variety of verification methods for a CTBT: "Operating synergistically, such a package of methods can provide the most cost-effective approach to CTBT verification in the long run."

Clearly, much remains to be done in the identification and development of a package of technologies that can form an effective verification regime for a comprehensive test ban treaty. That is one of the major challenges facing the Conference on Disarmament as it attempts to move quickly to complete negotiations on this important issue. ■

Non-Seismic Technologies in Support of a Test Ban

A variety of non-seismic verification methodologies are being discussed in the CD with respect to a CTBT. These are preliminary discussions and no definitive conclusions have yet been reached. As a contribution to this process, Canada tabled on May 26 a paper entitled "Non-Seismic Technologies in Support of a Nuclear Test Ban." The paper addressed four such technologies:

- overhead surveillance from satellites and aircraft;
- chemical detection during on-site inspections;
- three-dimensional electrical resistivity measurements at a suspected test site; and
- surveillance of radioactive debris in the atmosphere and atmospheric tracer modelling.

The tabling of this report was followed in June by presentations to the CD's *Ad Hoc* Committee on a Nuclear Test Ban by two Canadian experts: Mr. Jeffrey Tracey of EAITC's Verification Research Unit, who discussed overhead surveillance using commercially available sources, and Dr. John Davies of Barringer Instruments Ltd., who spoke on chemical detection at the site of a suspected test.

This report and these presentations represent the results of on-going cooperation among the Canadian government, the private sector and academia with respect to CTBT verification. Among the contributors to this year's program were Intera Technologies of Calgary, Barringer Instruments of Toronto, Premier Geophysics of Vancouver and the Atmospheric Environment Service of Environment Canada.

The International Seismic Monitoring System

The following article was prepared by Mr. Peter Basham of the Geological Survey of Canada, who is a Canadian representative on the Group of Scientific Experts.

In 1976, the Conference on Disarmament formed the "*Ad Hoc* Group of Scientific Experts to Consider International Co-operative Measures to Detect and Identify Seismic Events," commonly called the Group of Scientific Experts or GSE. Since that date, the GSE has been engaged in defining the technical specifications for a global system of seismic data exchange that would assist all participating countries in their national verification requirements for a comprehensive test ban treaty. Now that the CTBT negotiations will finally begin, and it is clear that seismic data exchange will form the most important part of the monitoring system, what kind of system has the GSE devised?

What is the ISMS?

The concept of the International Seismic Monitoring System (ISMS), the now generally accepted term for this system, has not changed fundamentally since it was studied by the group of experts that met in Geneva in July 1958 "to study the methods of detecting violations of a possible agreement on the suspension of nuclear tests." The most difficult testing environment in which to detect nuclear tests is underground, where most testing has been conducted since the Partial Test Ban Treaty of 1963 banned testing in the atmosphere, under water and in outer space. Underground nuclear explosions do, however, produce seismic waves that can be detected by seismographs, instruments that are commonly established in local, national and global networks to detect, locate and study earthquakes that occur naturally in the earth, and that in many countries pose significant risk to human developments.

Networks of seismographs will detect seismic events (explosions and earthquakes) down to a certain threshold size, depending on the numbers and sensitivities of the seismograph stations. One of the decisions to be made by the CTBT negotiators is the level of this threshold, recognizing that as the detection threshold is pushed down, the number of seismograph stations must increase and the costs can be pushed up accordingly.

Detecting a "seismic event" is one thing; identifying the event as either an earthquake or an explosion is another. Large underground explosions are relatively easy to identify as such, but as the events get smaller, earthquakes and explosions tend to appear more and more alike in their seismic signatures. In the GSE concept for an ISMS, the responsibility for the identification of suspected violations of the treaty — that is, for deciding that a seismic event is indeed an explosion — is left to national efforts by parties to the treaty. The ability to do this, based on seismological research on underground explosions and earthquakes over the years, will also have a bearing on the desired detection threshold that negotiators will discuss.

The ISMS can therefore be viewed as a system composed of three main parts:

1) a global network of seismograph stations meeting minimum specifications, operated and maintained to agreed standards, and contributing their seismic data;
2) an International Data Centre (IDC) that receives data from these stations, proc-