vides aberration-free transverse deflections. The deflectors are powered from permanent-magnet focused klystrons capable of delivering 20 MW in pulses of 5 microseconds when triggered at the repetition rate of the alternating gradient synchrotron. The operating frequency of the rf source is 2.865 GHz, generated by a phase-locked source with quartz stability. For good particle separation, the amplitude and phase of the deflecting rf fields must be held constant to a high degree of accuracy, and to achieve this, many servo loops are incorporated in the equipment. Nevertheless, Brookhaven people say, the operation proved to be simple and reliable.

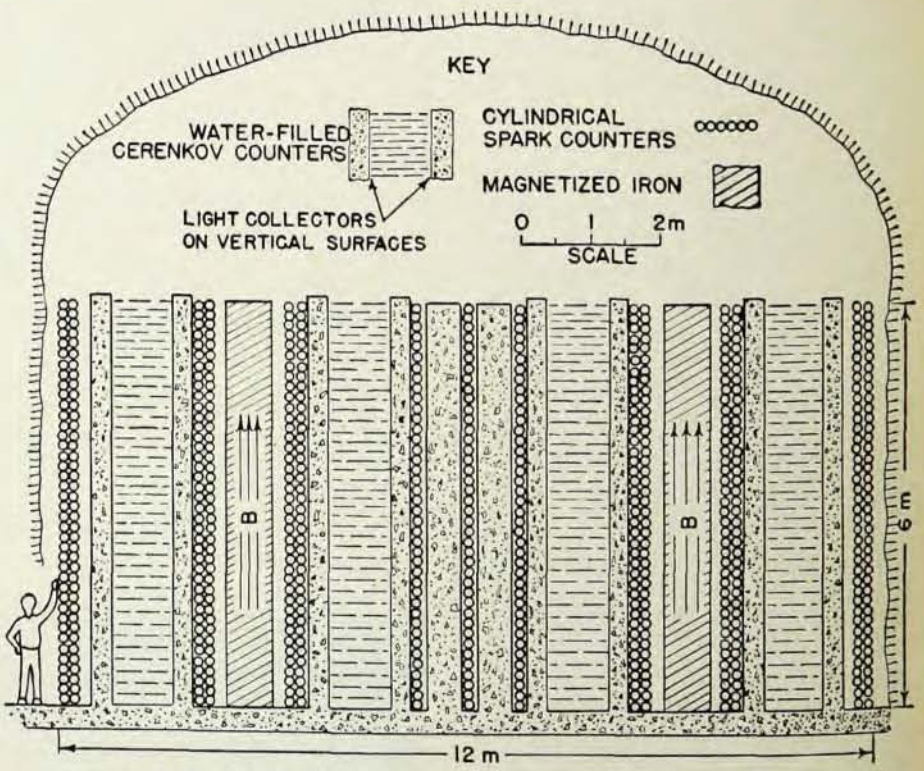
The separator was designed and developed by Harold Hahn and Henry Halama of the BNL Accelerator Department. The beam design was carried out by Horst Foelsche of BNL and Jack Sandweiss and Joseph Lach of Yale.

It's a spark, it's a pop, it's a neutrino

An underground cosmic-ray neutrinos detector is expected to start operation sometime this summer in a mine near the University of Utah. The installation, an array of counters 6 × 12 × 10 meters, will actually count muons produced by interaction of neutrinos with the surrounding rock. The setup is biassed to favor muons coming from below the horizon so as to screen out muons from cosmic or other terrestrial sources. It will be used for investigations in neutrino astronomy.

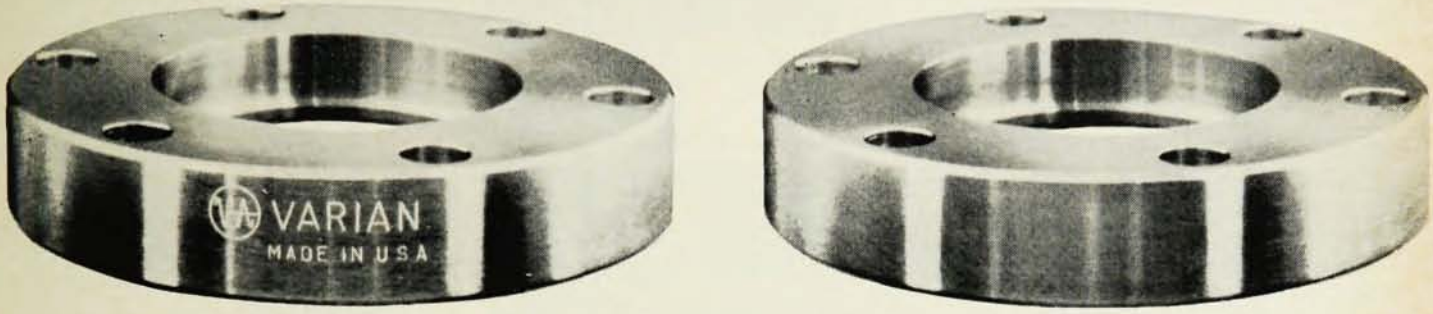
At the heart of the device is a series of four water-filled Cerenkov counters with directional properties. These are 1 × 6 × 10 meter tanks, two of whose vertical surfaces are lined with 113 light collectors each. The light collectors gather Cerenkov light produced by muons travelling transversely. The light collectors then trigger specially designed cylindrical spark counters.

The spark counters resemble giant Geiger tubes 15 cm in diameter and 10 meters long and have very thin (about 0.03 cm diameter) wires running along their axes. Fillings of 50 cm of argon and 25 cm of ethylene insure that the discharges, when the



NEUTRINO TELESCOPE arrangement at University of Utah

These flanges are made to meet ultra high vacuum specifications. Both are made from 304 stainless steel. They are interchangeable.



Yet, the one on the left is better. Why?

It's a Varian ConFlat® Flange. Completely leakproof, bakeable to 500°C, brazeable to 920°C, (which is, after all, what you're looking for in a flange).

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devices are triggered, are sharply localized corona spikes instead of sheaths running the length of the wires as in conventional Geiger tubes. Actual detection of the sparks is done acoustically by microphones placed inside the tubes. Acoustical ranging allows the location of the sparks along the 10-meter wires to be determined with a precision of ±3 mm, and the system is capable of recording several sparks on each wire at the same time. By recording pulses from opposite sides of each tank separately, the sense of motion of the muons can be determined.

Between each pair of tanks and their associated counters are arrays of magnetized iron plates, 6 meters high, 1¼ meters wide and about ¾ of a meter thick. Adjacent plates are joined to form a continuous magnetic circuit, and each plate will be wound with coils yielding a magnetic field of about 16 000 gauss. This arrangement will measure the energy of muons between 2 and 100 GeV. A measurement of the secondary muon energy spectrum is believed to be essential to the understanding of muon interactions above 10 GeV.

The whole assembly will be located underground at about 1500 meters water equivalent, where the expected flux of background muons through its aperture is expected to be still as large as 10^6 per year. However, the designers claim that the sense of travel of a high-energy secondary from a neutrino interaction can be unambiguously determined (in the most favorable case by four Cerenkov measurements and three time-of-flight measurements), and therefore upward-going muons should furnish a background-free signal despite the shallow depth. Neutrinos interacting within the chamber should also be easy to identify, they say. The counting rate of the wanted (sub-horizontal) muons is expected to be about 25 per year.

Members of the Utah physics department who are engaged in the work are J. W. Keuffel, H. E. Bergeson, and R. O. Stenerson. They are assisted by about eight graduate students and about 30 undergraduates. The project is supported by grants totalling $910 000 from the National Science Foundation. □