

---

## An integrated approach to science teaching

Leading science educators from 63 countries have been meeting this past week at the University of Maryland in a conference that organizers say may bring about a revolution in science teaching. The theme of the conference is how to prepare teachers in disparate parts of the world to implement the new "integrated" science courses.

Integrated science teaching involves material presented without the usual breakdown into disciplines, such as physics and chemistry. The concept caught on at a similar conference, held five years ago in Bulgaria, and the 215 delegates meeting in Maryland heard papers based on the experience gained since then, proposing ways of broadening the appeal of integrated science programs.

The conference chairman, physicist Albert Baez, said integrated science teaching is gaining new popularity in developing countries. There, he said, students who do not go on to high school can be exposed to a wide variety of scientific knowledge through an integrated course, and schools will not have to hire separate teachers for each science subject.

The first step toward implementation of such programs is teacher training—or more often, retraining. The problem then arises, Australian educator Gregor Ramsey told the conference, that most teachers "do not believe they need further training." Ramsey proposed some fundamental changes in teacher preparation to combat this nonchalant attitude. Instead of the traditional, for-

mal training Ramsey would like to see more practical experience offered to the prospective teacher, including a period of internship followed by a period of team teaching.

Harold Foecke of UNESCO said that lack of proper teacher preparation may be the major constraint in implementing integrated science courses throughout the world. Another speaker said teacher preparation should concentrate on guided study groups and open discussion; rather than on the traditional lecture system.

While most speakers sounded optimistic about the chances of bringing about curriculum reform in their various countries, John Goodlad, the eminent science educator at the University of California at Los Angeles, added a note of caution. Too often, he said, curriculum revisions are not accompanied by the proper change of "culture" within the school. Teachers who try to change the established climate often feel isolated and threatened. Unless they are engaged in dialogue with other teachers beyond their school, and given peer support, curriculum reform, he said, will amount to little more than "wheel spinning."

The conference was jointly sponsored by the University of Maryland, the U.S. National Commission for UNESCO and the International Council of Scientific Unions, with funding from several private firms. The teachers also visited American schools and were treated to a folk music concert by Albert Baez's famous daughter, Joan.

---

## Turning off tunamen's porpoise transmitters

Just as seabirds circling overhead can be a sign of whales below, so porpoises frolicking on the ocean surface can sometimes mean that schools of tuna are cruising beneath them, an observation that has long been of use to commercial fishermen in tracking the schools throughout their wanderings.

A few weeks ago, the American Tuna Boat Association revealed that some of its members had been attaching radio transmitters to porpoises as an indirect way of following the tuna. The transmitters broadcast a beeping signal whenever their antennas are above the surface, often with a range of as much as 15 miles.

The Marine Mammals Protection Act makes it unlawful for anyone to catch or harass porpoises for commercial purposes. Even though the radio-

equipped porpoises might have been taken inadvertently, rather than for the express purpose of fitting the equipment, and although the transmitters were being held in place only by straps, suction cups or other non-surgical means, the spirit of the act as administered by the National Oceanic and Atmospheric Administration is that they should have been let go unencumbered. "What had been an incidental catch of a porpoise," says a NOAA official, "became a deliberate catch."

The agency objected, and it reports that the tuna industry "took steps to conform immediately." Nonetheless, NOAA published a special amendment to the regulations by which it carries out the act, devoted especially to prohibiting transmitters on porpoises, an issue which the agency says was "not clear," in contrast to some conservation groups who feel that the tuna fishermen were just hoping that they had found a loophole. □

## Long baseline sizes up two small radio objects

To get high resolution of radio sources astronomers have to go literally to the ends of the earth. Nowadays they do it with increasing frequency, making use of a technique called very long baseline interferometry (VLBI).

VLBI consists of combining recordings made simultaneously at widely separated radio telescopes. This gives a signal that can discern finer detail in the source than any single telescope could. From Massachusetts Institute of Technology comes a report of a Soviet-American cooperation that has achieved, they say, the finest resolution yet. It may also represent a limit on radio astronomical "seeing."

The collaboration used the Haystack telescope in Westford, Mass., and a telescope at the Crimean Astrophysical Observatory in Simeiz, U.S.S.R. Fifteen astronomers were in the group, of whom the senior members were Bernard F. Burke of MIT, Leonid I. Matveyenko of the Institute for Space Research in Moscow, Ivan G. Moiseev of the Crimean Astrophysical Observatory, Steven H. Knowles of the Naval Research Laboratory and James M. Moran of the Smithsonian Astrophysical Observatory.

The objects of their observation were two so-called celestial masers, clouds of water vapor that give off maser-like emissions, designated W3 and W49. It is believed that these masers represent stars in the process of formation: They are collapsing under their own gravitation, and the maser emission is a way of getting rid of excess energy that would otherwise heat them up and prevent collapse.

The Massachusetts-Crimea observation, with a baseline of 6,000 miles, gave a resolution of 0.0002 of a second of arc. This was sufficient to show that the W3 maser is slightly smaller than our solar system, the W49 one about the same size. This is what one would expect for a cloud condensing into a star. In W49, says Burke, "we concluded we were partly resolving the brightest sources" within the cloud.

Burke suggests that the results with their resolution of 0.0002 second may place a limit on the possibilities of radio astronomical seeing. Just as the earth's atmosphere affects the light of stars and causes twinkling, so the interstellar matter affects radio signals and causes radio sources to twinkle. The farther out in the galaxy you go, the more of this matter you encounter. Burke points out that W49 is on the other side of the galaxy, 14 kiloparsecs (about 45 million light-years) away, and the observed resolution of 0.0002 second "puts a pretty good upper limit on what [detail] you can see." □