The Handicapped and Science: Moving into the Mainstream

May was a big month for the handicapped. The White House Conference on Handicapped Individuals in Washington, D.C., and the belated issuance of the regulations implementing the Rehabilitation Act of 1973 signaled the political coming of age of the handicapped movement.

Both events will affect education. The White House Conference had unquestionable symbolic value, but the practical implications of the guidelines have made it the subject of a long, bitter, behind-the scenes struggle. The Rehabilitation Act, which became law only after Congress overrode a second Nixon veto, stipulates that no handicapped person shall for reasons of his handicap be excluded from programs receiving federal funds. It was pointedly ignored during David Mathews' tenure as Secretary of Health, Education, and Welfare (HEW), even though he was under court order to implement the law. His successor, Joseph A. Califano, Jr., under intense pressure from an increasingly militant handicapped lobby, finally capitulated and issued the regulations after the handicapped staged nationwide demonstrations and even picketed Califano's home.

The guidelines require that programs supported in whole or in part by federal funds must be open to all handicapped within 60 days, and all structural changes to make facilities accessible to them must be made within 3 years (*Science*, 24 December 1976).

In the past, many handicapped children did not attend school at all and others were relegated to special institutions for the handicapped. The handicapped population aged 3 to 21 is estimated at approximately 7.8 million, or about 12 percent of the children in that age group,* but no one is certain how many handicapped children are educable and this makes planning difficult.

The main impact on the education process is likely to come from the law's mandate that handicapped children must be "mainstreamed," that is, they are not to be segregated in schools but are to be educated with the nonhandicapped in regular classrooms to the maximum extent possible. While the lawyers are scurrying about trying to determine exactly what the guidelines mean and the budgetmakers are worrying about money, many schools have already begun to mainstream handicapped children. HEW estimates that the cost of implementing the law will be $2.4 billion a year, but others speculate that costs could reach $10 billion a year or more.

Historically, the exclusion of many handicapped children from public schools has resulted in inferior education for them, and there is strong evidence that this is particularly true in science. Little, if any, preparation has been made for the teaching of science to handicapped children, and science educators are concerned about this. Some informed observers say that mainstreaming will be a "disaster" unless teachers are prepared and given more classroom assistance. Special curricula and materials must also be designed and supplied for handicapped students.

A survey conducted by the AAAS Project on the Handicapped in Science in 1975 and another survey done in 1976 by Science for the Handicapped, a new group associated with the National Science Teachers Association, confirm that most handicapped students in public and private schools simply have not been exposed to science teaching.

Handicapped children have often been erroneously thought to be mentally deficient, and science was considered too difficult for them. Other rationalizations were that the handicapped were not interested in science or that they might damage laboratory equipment or pose safety hazards because they were not able to manipulate materials well.

Another cause of the exclusion of handicapped children from science instruction has been the lack of training in science of special education teachers. Even in some instances where an attempt at mainstreaming has been made, handicapped students are still shunted off to itinerant special education teachers during the regular science lessons.

Why the special concern about educating handicapped children in science? According to the AAAS Project on the Handicapped, there are virtually no professional scientists who have been handicapped since birth or early childhood. Most students handicapped from an early age have been barred from pursuing scientific careers, because, without an introduction to science vocabulary and to development of concepts and problem-solving in elementary schools, the student is unable to continue to higher levels.

Educators believe that all children should learn science because science is, in a sense, the way that one deals with his environment—and life. This need is especially acute for the handicapped child.

A fundamental problem is still that little is being done in an organized and planned way with science teaching for the handicapped. The AAAS Project on the Handicapped in Science, one of the few groups actively promoting science for the handicapped, has been compelled to start virtually from scratch in a search for individual teachers who have successfully taught science to handicapped children so that their experience can be emulated.

Despite a generally bleak picture, some individual science teachers and classes are achieving promising results. One of the notable—some observers say unique—exceptions is the small, mainstreamed, multidisciplinary program conducted by the American University in Washington, D.C., for handicapped children between the ages of 5 and 11. It had been developed by chemistry professor Doris E. Hadary (see box). She is said to be one of the few scientists who have systematically reviewed all of the major science curricula being used today in order to develop a curriculum for the handicapped. The Hadary program is a highly regarded model because it combines a number of elements viewed as essential to the success of any program for the handicapped: training teachers in methods of teaching laboratory science to the deaf, blind, and emotionally disturbed; adapting laboratory science and art materials for parallel use; developing and implementing a 6-year science and art curriculum in a mainstream setting; and testing and evaluating the program.

The American University group, funded by the Grant Foundation of New York, has from the beginning cooperated closely with a program for adapting science materials for the blind, directed by Herbert D. Thier, at the Lawrence Hall of Science at Berkeley.

Hadary has solid credentials both in

*The legal definition of handicapped individuals includes those who are mentally retarded, hard of hearing, deaf, speech-impaired, visually handicapped, seriously emotionally disturbed, orthopedically impaired, and those with learning disabilities not caused by environment, culture, and economic disadvantage. The new HEW definition has been extended to include drug addicts and alcoholics.

science and science education. She taught high school biology and chemistry while completing her doctorate in biochemistry at the University of Wisconsin and is the recipient of five major national awards for excellence in science teaching. Hadary still teaches college chemistry along with the methods course. She was active in the science curriculum reform movement of the 1960's, serving on the original team for the Science Curriculum Improvement Study (SCIS) directed by Robert Karplus at Berkeley.

The adaptations made by Hadary and her colleagues emphasize the use of

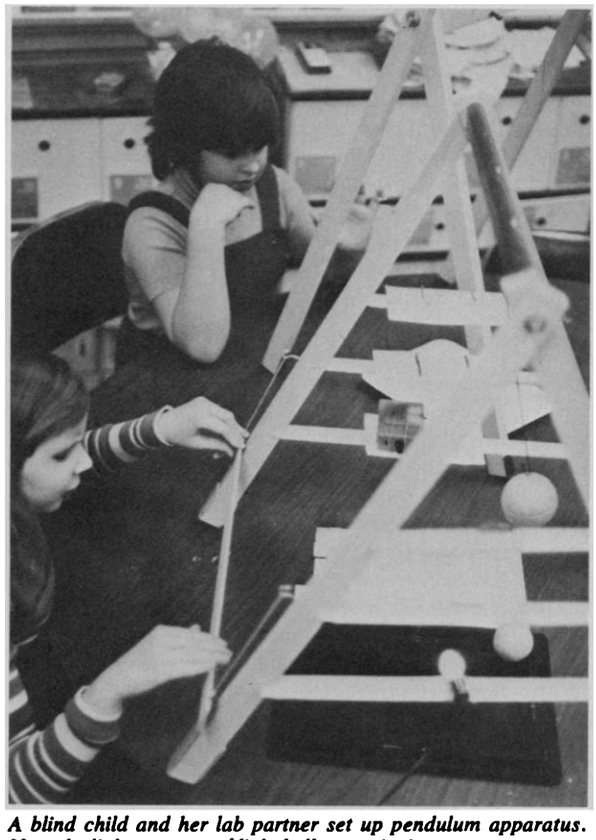
Lab Classroom: Breaking the Communication Barrier

Blind, deaf, and emotionally disturbed children are bused into the Horace Mann School in the District of Columbia three afternoons a week from several nearby school districts for "mainstreamed" science and art classes. The handicapped children are taught along with regular elementary school children.

The director of this innovative program, Doris E. Hadary of the American University (AU), commandeered two classrooms from the Mann School after outgrowing a make-shift lab in an abandoned AU green house. The light, high-ceilinged classrooms of the 45-year-old Mann Building provide a setting of calmness and order.

The hands-on science approach and the laboratory, in particular, are said to provide a good atmosphere for dealing with the problems of communication that almost all handicapped children have.

Experts feel that this communication disability dominates the life of most handicapped individuals, and, according to a paper presented at the White House Conference on Handicapped Individuals by John Gliedman and William Roth (drawn from their forthcoming book prepared for the Carnegie Council on Children), the problem arises from the negative way that the able-bodied perceive the disabled.



A blind child and her lab partner set up pendulum apparatus. Note the light sensor and light bulb opposite it.

In the Mann lab-classroom there is a feeling of harmony and camaraderie as graduate student and master science teacher Robert Haushalter talks to the science class. One experiment focuses on factors that affect the swinging of a pendulum—the length of string, and so forth. Bob, as the children call him, speaks slowly and clearly to the 16 nine-year-olds that are clustered about him. Turning so that all students can see his face, Bob, totally prepared, displays a handprinted card which asks, "What is happening?" He produces other appropriate written questions for the benefit of Mike, a deaf boy seated in front of him and next to a blind girl. In all, there are five handicapped children in the group.

The children, working in pairs, perform the experiments, then meet again with the teacher to discuss results and make further observations. It is at this point that Mike, the deaf boy, makes a dramatic discovery. Mike has not been able to hear the beeping sound of a light sensor which is being used for the benefit of the blind girl. The sensor gives a steady auditory signal in response to the light of a stationary bulb placed opposite it. When the pendulum swings through, it cuts the light wave, momentarily interrupting the beeping of the sensor and causing a change in the volume and pitch, which is the signal to the blind girl.

Mike can't hear this, but he has been handling the light sensor out of curiosity. Suddenly he realizes what the light sensor is doing by feeling the vibration of the sensor. He moves it around the light bulb, points it toward the sunlight streaming in through the large windows of the classroom, then back again to the light bulb, and feels the changes in vibration caused by the signal changes of the sensor. The class stands around Mike, totally engrossed with his experimentation and discovery. There has not been one sound or movement throughout this "breakthrough." Everyone is proud of Mike.

Mike's discovery illustrates the learning theory behind the program—to find out for oneself through exploration, and inventiveness, and really to understand what is happening. To do this one must understand the apparatus with which one is working. That's what Mike did. The good teacher tries to activate the child's curiosity and to observe intently so that if something unexpected does occur the necessary explanations can be offered. Experiments are done so that students have the chance to develop scientific thinking and skills, not to get the "right" answer.

A bonus of the American University program has been the breaking down of communication barriers between disabled and able-bodied students, says Hadary. The regular classroom teachers at the Mann School couldn't agree more. "The mainstreamed science and art classes have become the high point of the day for many of the regular school children." says one teacher. According to Hadary, "After working together, the 'normal' child sees the handicapped as 'normal' and then they act as one human being to another."—E.W.

hearing and touch for the visually impaired and the use of sight and touch for the deaf. For the deaf student, for example, vibrations of strings and tuning forks are demonstrated in water waves and sand movement.

The results from evaluative tests given this spring in the mainstream classes are just being run through the computer at Berkeley. According to Hadary, who is an admittedly biased but certainly experienced observer, "My gut feeling is that the results are positive."

Those most active in science education for the handicapped are enthusiastic about the American University program and believe it is a way to educate the handicapped successfully in science. There is general agreement, however, that the already overburdened classroom teacher must be adequately trained to do the job and that school systems, many of which are now facing severe budget constraints, must find the resources to pay for the supporting staff and services that handicapped children require.

—EFTHALIA WALSH

Endangered Species: Review of Law Triggered by Tellico Impasse

To condense the evolution of life on Earth . . . suppose the whole history of the planet is contained within a single year. The conditions suitable for life do not develop until late June. The oldest known fossils are living creatures around mid-October, and life is abundant . . . by the end of that month. In mid-December, dinosaurs and other reptiles dominate the scene. Mammals . . . appear in large numbers only a little before Christmas. On New Year's Eve, at about five minutes to midnight, man emerges. . . . The period since 1600 A.D., when man-induced extinction began to increase rapidly, amounts to three seconds, and the quarter century just begun, when the disappearance of species may be on the scale of all the mass extinctions of the past put together, will take another sixth of a second–a twinkling of an eye in evolutionary time.–NORMAN MYERS, in *Natural Resources Defense Council Newsletter*

The Endangered Species Act of 1973, designed as it were to extend that twinkling by a millisecond or two, seems a pathetic instrument indeed to slow the rushing forces of species extinction. But judging from some of the rumblings in Congress, one might think it was intended to cast humankind back to the dark ages. The Tennessee delegation in particular is abuzz over the prospect that the Tennessee Valley Authority's almost-complete Tellico Dam will end up not as a focal point for new industrial development but as a vast, silent concrete monument to the tiny inhabitant of the Little Tennessee River known as the snail darter.

Last January, a federal appeals court ordered work on the dam halted, saying that it would destroy the only known habitat of the 3-inch snail-eating fish and, therefore, it was in violation of the Endangered Species Act.

The TVA, with $103 million sunk into the project, is predictably unwilling to let the matter rest. So, environmentalists and many others now fear that the Tellico controversy will trigger a congressional reassessment that could culminate in a drastic weakening of section 7, the most potent segment of the act, which prohibits federal agencies from jeopardizing endangered species or habitats that have been designated as "critical." Specifically, this section says projects carried out by federal departments and agencies must not "jeopardize the continued existence of . . . endangered species and threatened species or result in the destruction or modification of habitat of such species which is determined . . . to be critical."

Section 7, with its unqualified admonition, has proved to be a remarkably powerful, and therefore controversial, component of the Endangered Species Act. Since the act's passage, there have been many hundreds of consultations between federal construction and land management agencies and the Department of the Interior's U.S. Fish and Wildlife Service, where the Office of Endangered Species (OES) is located. In the vast majority of cases it has been determined that no endangered species are jeopardized. Indeed, in fewer than 100 projects has it been necessary to make alterations in the plans to accommodate the law. And, despite the fact that the only way to compel an agency to abide by section 7 is to bring a case to court, there have thus far been only three lawsuits. One was over Missouri's proposed $100 million Meramec Park dam, in which the Sierra Club sued in order to save the Indiana bat and an endangered pearly mussel. (The court ruled in favor of the dam on the grounds there was insufficient evidence to do otherwise, but the project is in trouble now for other reasons.) Another suit, brought by the National Wildlife Federation, claimed the habitat of the Mississippi sandhill crane would be ruined by completion of Interstate Highway I-10. The court ordered modifications in the route. The last suit was Tellico.

Most of the serious conflicts between public works projects and endangered species appear to be posed by dams, which tend to be all-or-nothing affairs, not amenable to much modification or relocation, and extraordinarily disruptive of ecosystems both aquatic and terrestial. Dams are also big money and therefore intensely political projects. The only other project about which a suit is imminently threatened is another dam—the Columbia Dam on Tennessee's Duck River, whose construction threatens some endangered snails (the Environmental Defense Fund has served notice to the TVA that it intends to move on this one).

The Tellico case is unusual in that it is an example of agency noncooperation—"the bad faith example that proves the rule," according to Tellico plaintiff Zygmunt Plater. The TVA has known about the snail darter since 1973 when it was discovered by a TVA zoologist. (It was officially put on the endangered species list in 1975.) The agency has expressed willingness to do anything to mitigate the situation—including relocating the darter to another river—except stop construction. Apparently it was confident it would win in a court confrontation, and indeed the first court ruling on the case last year was in TVA's favor. The appeals court, however, was not about to read equivocation into the act where it did not exist. The TVA was gambling that the advanced stage of the project would render it immune from tampering. But the court said: "Whether a dam is 50 percent or 90 percent completed is irrelevant in calculating the social and scientific costs attributable to the disappearance