AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
150 YEARS • 1848-1998

THE BLACK RIBBON

ILLUSTRATION: ALLAN M. BURCH

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The Boston area is rich in summer science programs for high school and college students. A few years ago I told one group of high school students how we map the universe and showed them how we know what we know. The students readily appreciated the enormous patterns we have discovered in the distribution of galaxies like the Milky Way—thousands of galaxies mark these patterns which extend for hundreds of millions of light years. They naturally asked many of the questions we are trying to answer: Are the vast dark regions (voids) we see empty or are they full of mysterious dark matter? How did the pattern with sheets full of galaxies surrounding voids originate? Toward the end of the intense question period, a young woman raised her hand and asked two questions: First she wanted to know whether the universe has a center. Without pause she continued, "Why should society spend money on the work you do?" I asked her why she wanted the answer to her first question. Without hesitation she replied, "I'm curious. I want to understand. I replied, "Well, how much are you willing to pay?" Enthusiastic applause exploded around me as I went on to explain that scientists preserve and extend society's sense of wonder. I felt good about my answer, but the question has continued to nag me and I have thought about how scientists could both interest and benefit a broader segment of the population.

The differences between the population of physical scientists and the population of the United States—or of the world—are not subtle. Few physical scientists come from families living at or below the poverty line, few are people of color, and most are male. Many of us ask why so few young people are attracted to science. At least in part, people are attracted to subjects where they can identify at a basic level with the people who do it. The extraordinary aesthetic of the natural world is not obvious to someone who never leaves the inner city. Appreciation of the elegance and power of physical law is an acquired taste.

We scientists have the great privilege of spending our lives following our curiosity. We work hard for that privilege and society as a whole reaps tremendous benefits from our efforts, but perhaps by reflecting on the elements of fortune that may have contributed to our success we can understand how to enable more young people to appreciate and to participate in the advancement of science.

The United States is a leader across a broad range of scientific disciplines. Our technological prowess is part of our greatness as a nation. Sadly, among the rich industrialized nations we also lead by a substantial margin in the rate of poverty among children. One-fifth of American children—14.5 million—live at or below the official poverty line now; one-third will experience poverty at some time during their childhood.*† For comparison, the rates of childhood poverty in Germany and France are about one-third of ours.* The U.S. government poverty line is a mere $16,000 per year for a family of four. During the last two decades the rate of poverty among children has increased; a child is about twice as likely to be poor as an adult 18 to 64 years old.*†

The effects of childhood poverty are well documented. They include increased risk for stunted growth, anemia, asthma, repeated years of school at the same grade level, lower test scores, and in the longer run, lower wages. Every educated person recognizes the importance of highly trained, skilled, inspiring teachers in an inviting, safe school environment for surmounting the obstacle of poverty. Today the gap between rich and poor schools is widening. It is almost as though we have two public school systems in the United States—one for the rich, another for the poor. The 1997 Department of Education report devoted an entire section to this critical issue of "high- and low-poverty" public schools.‡

Education in mathematics and in the physical sciences seems to be particularly sensitive to the wealth of the school. The largest differences in teacher preparation between rich and poor schools are in mathematics, chemistry, and physics.‡ Although some might hope that educational materials available over the Internet could alleviate the imbalance, the opposite is more likely to be the case. Internet access in the poorest schools is much more limited than in richer school districts. A family living at the poverty level is unlikely to be able to afford a computer at home. Even with a computer, access to the Internet is another significant expense. A child might borrow a book from a public library; but it is not possible to take a computer home. The increasing importance of computer skills in educational settings and in the job market accentuates the gap between the rich and the poor. The general problem of underachievement in school is certainly not limited to the poorest children but does fall disproportionately on them. The Nation-

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**Wasting America's Future* (Children's Defense Fund, 1994). †*The State of America's Children: Yearbook 1998* (Children's Defense Fund, 1998), available at http://childrensdefense.org/. ‡*Report on the Condition of Education, 1997* (U.S. Department of Education, 1997), available at www.ed.gov/. §*Years of Promise: A Comprehensive Learning Strategy for America's Children* and *Starting Points: Meeting the Needs of Our Youngest Children* (Carnegie Corporation of New York, 1996), available at www.carnegie.org/.

I thank my friends for their sensitive and incisive comments on this essay.

JEFF GREENBERG/VISUALS UNLIMITED

al Assessment for Educational Progress statistics for 1994 show that 82% of *all* fourth graders could not meet the mathematics standards; 75% of them could not meet the fourth-grade reading standards. Broad public and professional concern about the entire student population reflects the increasingly sophisticated demands of life as we approach the 21st century.

Government agencies, at the state and federal level, along with many scientific organizations (including the AAAS), have invested in and devised innovative programs for teacher training. They have also invented novel curricula that have met with some success in encouraging curiosity about and achievement in mathematics and science. Enough is now known about childhood learning and development that the Carnegie Foundation optimistically comments: "With the right combination of challenge and support from parents, educators, and the community, virtually every child, by the end of the fourth grade, can be reading, writing, and doing math and science at levels now achieved by only a few."[§]

Understanding and involvement are solid first steps toward the improvement of opportunities for all of our children. At the same time, cuts in federal support for fundamental needs erode the prospects for progress. In 1996, Congress made the deepest cutbacks in the history of food assistance programs. These cutbacks halted the 20-year growth of the Supplemental Food Program for Women, Infants, and Children (WIC). WIC is one of the most effective federal food distribution programs because it provides vouchers for specific nourishing food items for the mother and child. Two-thirds of the 6-year-long, $20-billion cut in the food stamp program will diminish the quality and quantity of food available for families with children. Prolonged undernutrition is a known cause of health and learning problems. Before these cuts, the number of children going to bed hungry was already shameful.

A healthy child born to a poor family is as curious as one born into better circumstances. Curiosity and the will to explore are delicate treasures in every human being; they can be quenched by constant concern about basic needs. These pressures undermine the confidence and sense of security necessary to ask questions. They replace the drive to find answers with hopelessness. If we want young people to appreciate the excitement and beauty of the life of the mind, we must first ensure that they have lives worth living.

A substantial decrease in the poverty rate among children is a fundamental part of a healthy economy. Failure to resolve this problem makes technological expansion more difficult and further endangers support of basic science itself. The most tragic aspect of this problem is the waste of our greatest resource, our young people. The future of the country and of all creative disciplines depends on them. Hunger, inadequate medical care, poor housing, and inferior schools are enemies of the sense of wonder. It is easier and less expensive in the long run to prevent a loss of imagination by providing adequate nutrition, housing, medical care, and schooling than it is to try to restore that loss.

Successful youth enrichment programs prove that the nation's save-now-pay-later attitude toward children and education lacks wisdom. In 1995, I had dinner with a high school senior selected for one of the special New York City–wide science programs. She told me her life story and her hopes. Never able to afford a book of her own, she devoured books she borrowed for her long daily subway commute. She told me about children she knew—also living their lives below the poverty line—who would thrive on rich, challenging programs but were lost for lack of funds. She wore a black ribbon to mourn cuts in the city education budget announced that day. As I got up to leave, she unpinned the ribbon from her dress and attached it to my briefcase. It's still there.

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ILLUSTRATION: TERESE WINSLOW