# U.S. Science education reforms: is astronomy being overlooked?

By D.B. Hoff

Department of Physics, Luther College, Decorah, IA, USA

## 1. Recent history of science education reform in the USA

In 1981, in response to growing concerns that the United States was falling behind the rest of the world educationally, the federal Secretary of Education created a national commission on excellence in education. This commission was charged with gathering data about the status of U.S. education compared to the rest of the developed world and to define the problems which would have to be faced to successfully pursue the course of excellence in education.

In 1983 this commission issued its report, *A Nation at Risk*, (Secretary of Education, 1983). The release of this book produced a flurry of activity by schools, political entities and professional groups representing various educational disciplines. These groups included, the National Council of Teachers of Mathematics, the National Governors Association and the National Science Teachers Association and others. By 1989, the American Association for the Advancement of Science (AAAS), a major American organization representing a broad spectrum of the sciences, produced its own call for an improved educational climate for science and engineering. Their book, *Science for All Americans*, attempted to produce a comprehensive expression of the scientific community as to what constitutes literacy in science, mathematics and technology (Rutherford and Ahlgren, 1990). The release of this report, coming from a credible, broad-based and nationally recognized organization of scientists and engineers produced a great deal of interest in the American press and calls came for developing strategies for action.

Following the publication of *Science for All Americans*, with financial support from a number of public and private agencies and foundations, the AAAS followed up this broad call to action by establishing a large task group of teachers, administrators, scientists and science educators charged with establishing benchmarks by which literate students in the 21st century would be judged. The task group was collectively called Project 2061. They realized that achieving improved science literacy would to be a slow process. The year 2061, marking the year of the return of Halley's Comet, was chosen as the project name to denote the long time likely required to acquire uniform science literacy in the U.S. The many participants in the benchmark planning process were divided into discipline teams and four years later, in 1993, produced *Benchmarks for Science Literacy* (AAAS, 1993). This volume listed the benchmarks for the various sciences for children from kindergarten through grade 12. More about the general benchmarks and those specific to astronomy will be given below.

Other action was brewing on the reform movement as well. The prestigious National Research Council, chartered by the United States Congress in 1863, got into the act. Starting in 1991 this council began planning for the development of a document that would, not only examine science education as defined narrowly by science content, but would develop standards by which one could judge not only children's understanding of science content, but also set the standards for the professional development of teachers, for science teaching itself, for assessment of learning and for the entire science education system from kindergarten through graduate school–and beyond. Their document

National Science Education Standards was released just this year (National Research Council, 1996).

## 2. Astronomy content in the reform documents.

We now come to the question in the title of this talk. In the United States reform movement in science education has astronomy been overlooked? Certainly as one examines the astronomy content of the NRC standards document , you would have to agree with Jay Pasachoff who wrote a clear indictment on the lack of astronomy subjects and content in the last issue of the *American Astronomical Society's Newsletter* (Pasachoff, 1996). Let us quickly look at the NRC list in its entirety. As Pasachoff notes, there is no astronomy outside the solar system listed for grades 5-8. That nuclear energy is the driving force within stars is not present, and it is a major leap to go from the solar system to the origin of the universe. (I have copies of these standards if anyone is interested.)

But what about the AAAS document, *Benchmarks for Science Literacy*? Here the bench- marks for astronomy content is found in Chapter 4, "The Physical Setting". This section is further divided into sub-sections on the universe and one on the earth. These sections cover ten pages and are much more extensive than the standards found in the NRC book. For example by the eighth grade, students following a curriculum based on the AAAS benchmarks would have an introduction to the world of stars and that nuclear processes are the driving force in stars. Also the link between the stellar world and the origin of the universe is much smoother than in the NRC work. (The AAAS list of topics is too extensive to put on transparencies, but I have extracted the benchmarks themselves from the book and have a number of copies to distribute to anyone interested.)

## 3. Why does it appear that astronomy has been overlooked in the NRC document?

Typically, astronomy has not been a major topic in American science curricula. While astronomy as a subject did appear in American high school curricula in the late 1800's, it had virtually disappeared after the beginning of this century, not to reappear until after the beginning of the Space Age. This disappearance can be traced to an educational reform movement designed to standardize the high school curriculum. I shall not trace the reasons for that drive to reform, but will only note that in 1893, the so-called "Committee of Ten"produced recommendations for what course work a high school student should have completed prior to admission to college. These recommendations grew out of recommendations from a number of task forces from a variety of disciplines, including the sciences. While the committee was referred to as "The Committee of Ten", there were really a number of conferences held that reported back to the main committee. The main committee's final report recommended coursework in both physics and chemistry, but not astronomy. If offered at all at the high school level, the report further stated, astronomy need only be a 12-week elective course.

The denigration of astronomy as a subject in schools a century ago may have a modern counterpart. There were no astronomers on the committee charged with developing recommendations for "Physics, Astronomy, and Chemistry"at the beginning of this century. (In fact, at their first meeting, this group renamed itself the sub-committee for "Physics, Chemistry , and Astronomy", moving astronomy to a third, and minor role.) In today's reform, an examination of the names listed in the "Working Group on Science Content Standards"for the *National Science Education Standards* shows a similar lack of involvment from the astronomical community. In the appendix of the book listing

contributors we find the names of biologists, chemists, geologists and physicists but no astronomers. I have no way of telling if this was the result of lack of interest on the part of astronomers or an oversight by the planning committees, but nonetheless none were on the science content standard's group.

It may be more than mere speculation that the reason astronomy appears to be treated more fairly in the AAAS work is that in the equivalent contributor listing in the AAAS document there are two astrophysicts listed, along with biologists, chemists, geologists, meteorologists and physicists.

## 4. What will be the effect on astronomy education as a result of the current reform movement?

In answer to that question, it is probably too early to tell. First, change comes slowly in education. Second, direction for science education in the U.S. is highly decentralized. Education in the U.S. is under the direction of the individual states. Under the U.S. Constitution, any function of government not specifically spelled out as being the function of the federal government is reserved to the states. Education is therefore described as a "state's right". This means that there really are 50 different loci for educational leadership in the U.S. In fact, it is more complex than that, as there is a great deal of local control within the states themselves. There are approximately 16,800 separate school districts in the U.S., each with a fair degree of autonomy in constructing and choosing curriculum materials. It is true that some states are producing educational frameworks, based on the reform documents, that are to be used by local districts as they construct their own science curricula. Add to that, the U.S. has no centralized, uniform testing in the sciences. Some textbook publishing companies are tailoring their products to conform to the AAAS benchmarks and likely will pay lip service to the NRC documents as well but it remains to be seen whether these products will have a major impact on student achievement.

What about curriculum development or dissemination projects funded by the federal government? Are they incorporating topics that reflect the guidance of the reform documents? The American Astronomical Society is conducting a very agressive teacher resource agent program whose purpose is to disseminate materials that have been developed with National Science Foundation funds. This program currently has about 220 teacher-agents located in nearly all of the United States whose function it is to conduct workshops for other teachers sharing materials developed by federally funded projects. This program is selecting those topics for the appropriate grade level that best reflect the guidance of the reform movements. But this is *post facto* as most of the curriculum development projects themselves do not appear to have paid much attention to the work of the AAAS, in spite of the fact that it has been out in final form for three years.

## REFERENCES

AAAS, 1993, *Benchmarks for Science Literacy*, New York, Oxford University Press, New York.

NATIONAL RESEARCH COUNCIL, 1996, *National Science Education Standards*, National Academy Press, Washington D.C.

PASACHOFF, J. M., 1996, "Astronomy and the New National Science Education Standards: Some Disturbing News and an Opportunity", *AAS Newsletter* (80), June.

RUTHERFORD, F.J. & AHLGREN, A., 1990, *Science for All Americans*, Oxford University Press, New York.

SECRETARY OF EDUCATION, 1983, *A Nation at Risk*, U.S. Government Printing Office, Washington, DC.