

such a foundation and the level of support it has been provided amount to something of a miracle. Or maybe the wonder is that the NSF survived five years of congressional wrangling and another five or so of precarious budgets and then finally took root—a phenomenon that might be counted a miracle at least in terms of the theory of continuous creation.

The problem with either of these notions is that during this same period every major industrial nation has acquired an organization of some kind with the responsibility for supporting basic research. All these countries, moreover, devote about the same proportion of national resources, measured in relation to gross national product, as the United States does to basic research. The reason, in each case, is the same: the fear that by failing to support some basic research the country will jeopardize the future strength of its economic and military capacities. If the American achievement is a miracle, even on a minor scale, it seems to occur with remarkable frequency and at rather predictable orders of magnitude elsewhere as well. The really interesting question about the NSF, which this comparative perspective suggests, is how it differs in structure and function from its counterparts in Britain, France, Germany, Canada, and elsewhere. Now that there is such a wealth of comparable experience against which to measure our own, there can be no convincing justification for continuing to examine the American case as though it were still *sui generis*.

Even from a more parochial domestic perspective, it is impossible to appreciate the impact of the NSF on science and higher education, for better and for worse, without paying much more attention than Lomask does to the ways in which the Foundation provides its support. In discussing the origins of the decision to adopt the grant rather than the contract as the primary instrumentality, Lomask correctly notes that this decision was made by Waterman and his aides, who themselves had come from the Office of Naval Research, where contracts were used exclusively, because their studies and inquiries showed that the grant, with its greater freedom and flexibility, was more appropriate. He fails to point out, however, the important precedent established by the private foundations, which had been the principal supporters of science before the federal government assumed this responsibility. Without this precedent, it is questionable whether any of the federal agencies supporting research would have

been able to avoid the use of contracts, since these were standard in all types of procurement involving nongovernmental agencies.

More important, by adopting the project grant, coupled with peer review, the NSF was able to channel the bulk of the support it received into the laboratories where—in the opinion of the best-qualified specialists in each field—it would yield the best results. In other words, the technique has enabled the scientific community to support the researchers it has judged best qualified even though the funds have been appropriated by a representative system well known for “pork barrel” politics—or, to put the case in its best light, for a concern with equitable distribution among regions, institutions, and qualified individuals. So sacred is the project principle in this country that even when institutional grants have been tried out, they have generally been “formula” grants tied to the degree of project support. Except for the effort in the 1960’s to create new “centers of excellence” and for certain of the fellowship programs, notably the National Defense Education Act, which was formulated by Congress, the project system based on peer review has been the preferred mode of support.

Much has already been written about the consequences of this system for science and for the university system. It remains debatable, however, whether the Foundation is not too much committed to this system both for its own political good and for the good of the research universities. In a period in which the universities must adjust to diminishing levels of support both for research and for education, it is open to question whether exclusive emphasis on the project system does not provide too much autonomy to the individual researcher and too little leverage for the university administration to consolidate and trim existing activities and open up new ones. It is even questionable whether, in view of the pressures the universities are now under not only to cope with overextensions induced by government support but also to endure the burdensome costs and interference with academic freedom due to the vogue for “accountability,” their degree of dependency upon the NSF and other government agencies is as healthy and as welcome as it was once almost universally considered.

No history of the NSF that so neglects its impact on its principal institutional clients can be considered even minimally adequate. A serious historical effort would also have to inquire into the links between the project system and the

American attachment to the liberal ethos, with its traditional emphasis on equality of opportunity and the more recent shift to a stress on equality of results. It would also have to discuss both the remarkable benefits of peer review and the criticisms that have been made of its real and imagined weaknesses.

None of these subjects is explored at all adequately in this account. In fairness to the author, it should be stressed that he was evidently commissioned to compose the sort of tale he has in fact told—an “informal” history blending “selected” important information with lighter material in an account that a wide variety of readers would find palatable. This he has certainly done, and done well, by the usual standards of such work, and it would be churlish to criticize him for not writing another, more serious kind of historical study. The Foundation, however, is not beyond criticism for soliciting this kind of scrutiny when it could have defined the need differently. Miracle or not, the NSF is one of this country’s most important instruments of self-government. As such, from time to time, it deserves and should encourage searching examination of its structure and function. Periodic check-ups of this sort are at least as valuable as a birthday greeting, however well deserved.

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Curricula and Political Conflict

Science Textbook Controversies and the Politics of Equal Time. DOROTHY NELKIN. MIT Press, Cambridge, Mass., 1977. xii, 174 pp. \$12.50.

Aristotle, Copernicus, Galileo, Lamarck, and Lysenko were all individuals whose scientific theories were branded acceptable or heretical according to ideological circumstances. Dorothy Nelkin has written a book that reminds us that examples of such politicization need not be drawn from another culture or another era. More than a century has passed since the publication of the *Origin of Species*, and 50 years have elapsed since Clarence Darrow defended Darwin’s views against a literal interpretation of the Bible in the famous trial of John Scopes. Nevertheless, the theory of evolution is still not universally accepted in this country. Evolution has come to be a *sine qua non* of modern science; yet public school teachers are not

everywhere free to explain its features. Indeed, as Nelkin makes dramatically clear, in sections of the United States highly organized and politically influential organizations continue to succeed in their efforts to promote the instruction of a counter-explanation, the biblical explanation of creation.

Schools are widely held to be one of society's most powerful engines for the transmission of values from one generation to the next. Napoleon is credited with observing, "As long as children are not taught whether they ought to be a Republican or a Monarchist, Catholic or irreligious, the State will not form a Nation." But whose values should the schools transmit? In the United States public schools are supposed to reflect the values of citizens, parents, and taxpayers in local school districts and states. In some regions, primarily the Deep South and Far West, these constituencies perceive the theory of evolution as hostile to religious values to which they are intensely committed. In effect, for such opponents, evolutionary theory is a counter-religion. They even have a name for it, "secular humanism." If the First Amendment constitutionally prohibits teaching their religion, then why should the public schools be permitted to promote inimical views of another sect? In their opinion, if biological evolution is to be taught, then their religious beliefs are due equal time in the classroom and equal space in textbooks.

In a series of interesting short chapters, Dorothy Nelkin traces the cultural receptivity to the theory of evolution. Darwin's *Origin of Species* was published in 1859 and, despite its dramatic implication for those adhering to a strict interpretation of *Genesis*, met with surprising social acceptance during the next half-century. Much of the industrial expansion and economic imperialism of the late 19th and early 20th centuries was justified under the banner of "survival of the fittest." Julian Huxley is portrayed as describing the "evolutionary vision" as a "naturalistic religion," and the late C. H. Waddington viewed evolution as providing "a secure basis for ethics." In 1895, the National Education Association, the largest professional organization of public school educators in the United States, openly advocated a secondary school zoology curriculum grounded in evolutionary theory. By 1920, according to Nelkin, evolution was explained widely in high school and college textbooks.

However, in the 1920's the seeds of dispute began to grow. "Fundamentalist" interpretation of Protestant doctrine un-

derwent a substantial revitalization, and its adherents strongly criticized evolution as being anti-God. Between 1921 and 1929 antievolution legislation was introduced in 37 states. The high point of resistance during the decade came with the Scopes trial in Dayton, Tennessee. Scopes was defended by the colorful lawyer Clarence Darrow, whose incisive cross-examination made the Bible's defender, William Jennings Bryan, appear foolish to the scientifically sophisticated. Yet Darrow lost the case, and it was not until 1968 that the U.S. Supreme Court struck down the Tennessee statute prohibiting the teaching of evolution.

The current wave of opposition to public school teaching of evolutionary theory began in the late 1960's. Soviet space successes gave rise to a widespread inclination toward more rigorous instruction in science. The National Science Foundation injected a substantial measure of organizational and financial support into the development of new science curricula. With NSF assistance, extensive revisions were undertaken in high school physics, mathematics, chemistry, and biology courses. The new biology series strongly stressed evolution, the stochastic nature of genetic transmission, and the caprice of environmentally advantageous mutations. For those who adhered literally to the biblical master plan, all this "science" was a bitter pill to swallow.

The condition for creationists was exacerbated by expansion of NSF support into the social sciences. "Man: A Course of Study" (MACOS) is a curriculum module stressing, among other concepts, human cultural adaptation to environmental conditions. The fact that groups such as Eskimos have from time to time sanctioned infanticide in order to limit the population to a size the environment could support is seen by social scientists as a demonstration of man's majestic ability to cope with his surroundings. As seen by some religious fundamentalists, this example is an unjustified relativist attack on value absolutes such as the sanctity of life and the prohibition against killing. Not only did the new biology curriculum promote evolution and the new social studies course endorse cultural relativism, these purposes were accomplished with the overt support of the federal government. Over a hundred million dollars in tax revenues had been spent by NSF for development of these heresies. Wrongdoing of such significance and of such magnitude surely deserved to be countered.

Dorothy Nelkin illustrates the fundamentalists' counterattack by a case de-

scription of the political struggle in California to dilute coverage of evolution in that state's science textbooks. The creationists mounted a sufficient campaign, primarily through their spokesmen sitting as gubernatorially appointed members of the state board of education, to delay statewide adoption of a textbook series until equal weight was accorded the antievolution point of view. The final version of the textbook in dispute concentrated on evolutionary theory, but the board of education succumbed to creationists' demands and sent a memorandum to all school districts reminding teachers that "whenever human origins were discussed, alternative theories should be presented."

What accounts for the sustained resistance to evolutionary theory over the last 50 years? Nelkin suggests one major and one minor hypothesis. Her primary explanation is of a psychosocial nature. For many Americans, not only does science conflict with religion, modern science and its handmaiden technology have failed to provide the spiritual, and perhaps material, fulfillment promised in the American dream. Despite space age inventions, electronic marvels, and chemical wizardry, problems such as crime, environmental pollution, and economic instability persist. From such conditions, antievolutionists infer that science has misled and that the key to reduced alienation and heightened well-being is a return to yesterday's values of truth and moral certainty.

To be sure there have always existed pockets of resistance to science in this nation. In Nelkin's view, however, modern Americans are increasingly ambivalent about science. She cites as evidence public opinion poll results that reveal 89 percent of the U.S. population believing science to be necessary for a high standard of living while simultaneously 76 percent are worried about excessive concentration upon science and 72 percent believe we are becoming too dependent upon science. For Nelkin, the antievolution movement directed at the public schools is a backlash against science.

Nelkin acknowledges that objections to evolution may also be partially explained by growing centralization of school decision-making authority. The book does not deal with the phenomenon in detail, but the last 50 years, coinciding with the science textbook controversy, have witnessed one of the most remarkable governmental transformations in our nation's history. At the beginning of the 1920's, there existed more than 120,000 school districts in the United States. At that time, each elected school

board member represented approximately 250 constituents. Citizens exerted substantial control over school policies by regular and personal contact with these officials. In response to arguments made on grounds of efficiency by professional school administrators, the number of districts has been so reduced that today there exist fewer than 17,000 districts. Each school board member, on the average, now speaks for approximately 3000 constituents. The opportunity for local citizens to exert control over schools has suffered as a result. The condition is exacerbated by the growing tendency to elevate educational policy decisions to the state level and to permit teachers to engage in collective bargaining. Not only are there fewer school boards, they have less authority. Into the power vacuum have stepped professional educators. From the fundamentalists' perspective, the educational professionals have abused this power by promoting a sectarian doctrine, "secular humanism."

Ironically, the very processes that have placed the large majority of Americans at a greater distance from school decision-making permit a determined minority to have disproportionate influence. The concentration of school decisions in the hands of fewer officials, often at the state level, as in statewide adoption of textbooks, enables highly organized groups, no matter how small, to exert great leverage. Their energies can be concentrated upon a single target, the state board of education or the state legislature. If they had to try their case in hundreds of school districts, the slender numbers and resources of the creationists would be swamped by the larger majority who support evolution, either actively or by being willing to leave professional educators and academics to teach as they see fit.

Nelkin's book, though somewhat abbreviated in parts, is by any measure readable and by most measures accurate. In the absence of clear empirical evidence regarding the teaching of evolution in high schools it may be, however, that she has overdrawn the case. Without question, antievolutionists continue to succeed in their efforts to provoke political conflict. Those of us who work closely with public schools, however, continue to be impressed by the distance between policy-making bodies and the classroom. Most school board members at both the local and the state level know, even if they cannot afford to say it loudly, that their decisions are only loosely coupled to the organizational dynamics of schools and the activities that take place in classrooms. Public school

policy-makers have too few sanctions, either positive or negative, at their command to influence teachers widely. Consequently, it may be that several generations of science teachers, having been steeped in evolutionary theory by their college teachers, are now instructing in the Darwinian vein with little concern for the political efforts of creationists. Moreover, courts exhibit increasing reluctance to grant creationists equal textbook space. The courts have found such tactics to be in violation of the First Amendment's prohibitions against the establishment of religion.

Regardless of the extent to which Nelkin makes the case that evolution is being neglected in the classroom, she conveys a larger message. As is clear from the controversies that swirl around such undertakings as nuclear energy projects, science is now an integral part of public policy decisions, and we will henceforth be observing the degree to which science and democracy can coexist. If science is increasingly a concern of public policy, then science instruction in public schools will increasingly be politicized. School politics reflects social controversies as surely as species originate by natural selection, and for that reminder we can be grateful to Nelkin.

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The Upward Path

Scientific Elite. Nobel Laureates in the United States. HARRIET ZUCKERMAN. Free Press (Macmillan), New York, and Collier Macmillan, London, 1977. xvi, 336 pp. \$14.95.

American Nobel laureates in science (persons who did their prizewinning work in the United States) tend to come from professional or business families, to go to elite schools, to be recognized early, to work under leaders in their fields, to publish more and to work harder than their unprized contemporaries, to receive their prize in early middle age and to have their lives changed by it. None of this, as Zuckerman says, is very surprising. "Ascent into the ultra-elite [of prizewinners] follows an almost commonplace script." Her contribution is to quantify it.

Here are some of her numbers. Eighty-two percent of the 61 laureates educated in the United States came from professional or business families as against 90 percent of Supreme Court jus-

tices and 48 percent of holders of doctorates in science. Eighty-five percent of the laureates got their Ph.D.'s at one of 13 institutions; 52 percent worked under prizewinners past or future. They earned their doctorates 4.7 years earlier than the average scientist, published more than four times as many papers, did their prizewinning work at an average age of 39 and received their prizes 12 or 13 years later. The prize made them public figures, lured some into punditry (a number here would be intriguing), ended collaborations prematurely (joint winners still working together at the time of the award continued together another 5.4 years, single winners and their prime collaborators parted after 3.6 years), and reduced by 35 percent the productivity of those who had not previously enjoyed the attentions of the public.

Some interesting points emerge. The elevated age at which the prizewinning work is accomplished suggests that science is not, as it is often said to be, a game for late adolescents. The age has not changed much over time: in the case of physics, 36.7, 33.9, and 37.0 for prizes awarded during the years 1901-25, 1926-50, and 1951-72, respectively. Another point concerns recognition before the prize. Citations in the professional literature to work by laureates-to-be just before their awards averaged 222 a year as against 6.1 for the common scientist. Seventy-eight percent of winners were members of the National Academy of Sciences when they were called to Stockholm. As Zuckerman observes, the Nobel prize does not go to unknowns. A third point is collaborative research. In the years 1901-25, 41 percent of the prizes were awarded for work done in collaboration; in 1926-50, 65 percent; in 1951-72, 79 percent. Here, as in much else, the laureates led the masses. During the same three periods, the percentages of published papers with multiple authors were 25, 51, and 71.

The world is no doubt richer for these numbers. It could have been still richer. Francis Galton found that great Victorian scientists had small heads. How does the matter stand with American Nobelists? Are they longer or shorter than the average scientist? Have they fewer children, more wives, odder hobbies, stranger pets? Zuckerman's line of inquiry does not run to such questions; she seems to take not biological or personal characteristics but early and continued access to "advantages"—excellent instruction, elite institutions, all the necessary resources—as the chief determinant of scientists of prizewinning quality. She wonders whether other scientists, if