邓炎昌主编

AMERICAN SOCIETY AND CULTURE

Volume 2

现代美国社会与文化

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American Society and Culture

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（第二卷）

北京外国语学院美国学中心　邓炎昌 主编

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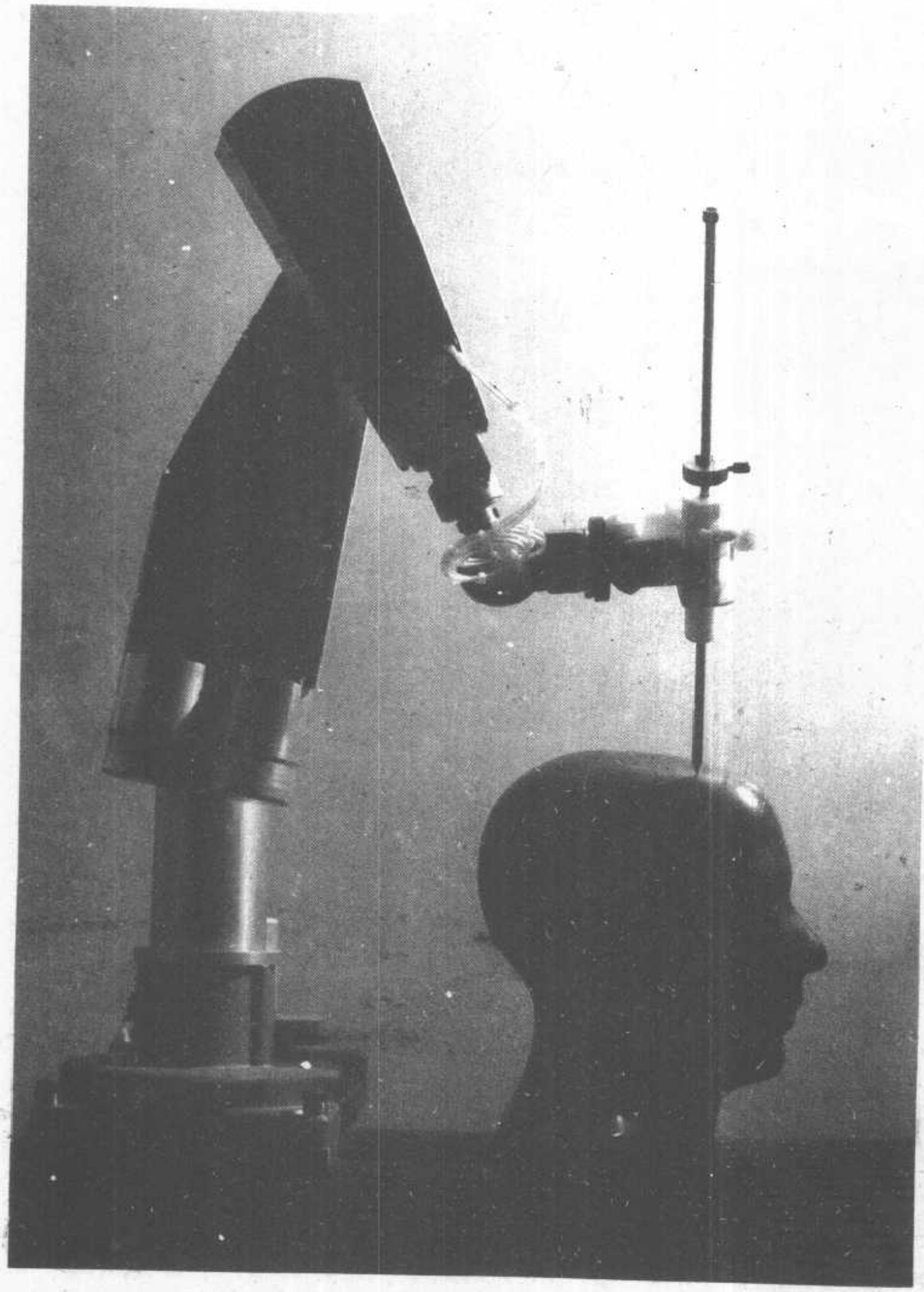

Science & Technology

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Science, Technology and Society

科学、技术与社会

美国是一个科学与技术高度发达的国家。美国的经验证明,科学技术与社会是紧密相关的。社会的发展离不开科学技术的进步;反过来,科技研究的课题、发展方向与速度也受各种社会力量的制约。高度发达的科技可以大大促进生产力的发展,提高全民族的物质文化生活水平。但是,如果没有系统有效的社会控制,它也能给社会乃至整个人类带来不可估量的损失和难以度测的严重后果。

在这里,我们选了四篇文章来介绍美国科学与技术的情况。

America's Scientific Institutions (美国的科研机构) 介绍了美国闻名世界的三大科研机构:国家人体健康研究院 (NIH),贝尔实验室(Bell Labs),以及加州理工学院(CIT)。分别介绍了它们创立的经过,人员的构成,工作指导思想以及科研的特色。

The Social Control of Science and Technology (科技的社会控制) 分析了科技与社会的关系。文章指出,科学与技术方面的发明创造,如果缺少系统有效的控制,有可能给人类社会带来三个严重的后果: 造成生态环境的破坏,研究方向背离人类的根本利益以及削弱建立在普通百姓对事物了解与控制基础上的民主制度。然而,任何企图对科技进行有效控制的努力又会引起不同价值观念的冲突,引起一系列新的问题。文章最后的结论是:当今科技发展如此迅速,已远远超过社会加以控制的能力。因此,当前人类社会面临的挑战是如何保证科技发展的方向有益于全人类。

The Poisoning of Michigan (密执安州的污染),详细记述了密执安州一家化学公司剧毒化学品被误用作牲畜饲料以后,给人、畜以至整个生态环境带来的严重后果。

Computer Crime (计算机犯罪)从另一个方面表明科技发展给人类造成的令人困惑的问题。电脑无疑是人类智慧的结晶,它给人类文明的建设提供了威力巨大的武器,但使人类始料不及的是,它同时也成了各种犯罪分子手中可怕的工具。文章描述了一群青年人无意中接触到一家大医院的电脑储存库后加以删改,最后造成严重后果的情况。文章指出的尖锐问题是:如果一群孩子只是出于好奇尚且造成了如此严重的后果,那末,如果一群蓄意破坏的成年人,又将会导致什么灾难呢?

43. AMERICA'S SCIENTIFIC INSTITUTIONS

Near the end of a five-day tour of highly automated, hightech Japanese factories, the American visitor was overwhelmed and feeling a little inferior. Watching a string of gleaming stereo sets move down an assembly line, he turned to the plant manager and said, "Gosh, even your industrial design is better than ours."

"Ah, yes," replied the manager, "but America has treasures that Japan can never hope to possess."

"You mean our mineral wealth and bountiful farms?"

"Ah, no. I was referring to Caltech[1] and M.I.T.[2]"

America's scientific institutions — its technological universities and government laboratories — are the envy of the world, producing ideas, devices and medicines that have made the U.S. prosperous, improved the lives of people around the globe and profoundly affected their perception of the world and the universe. This tremendous creativity is reflected in the technical reports that are published in scientific journals throughout the world. Fully 35% of them come from scientists doing their research at American institutions.

Yet American dominance in science can no longer be taken for granted. Many recent U.S. achievements and awards stem in large measure from generous research grants of the past, and any weakening of government and industry commitment to support of basic research could in the next few decades cost the nation its scientific leadership. Some slipping is already evident. In high-energy physics, where Americans once reigned supreme, Western Europe now spends roughly twice as much money as the U.S. Result: the major high-energy physics discoveries of the past few years have been made not by Americans but by Europeans.

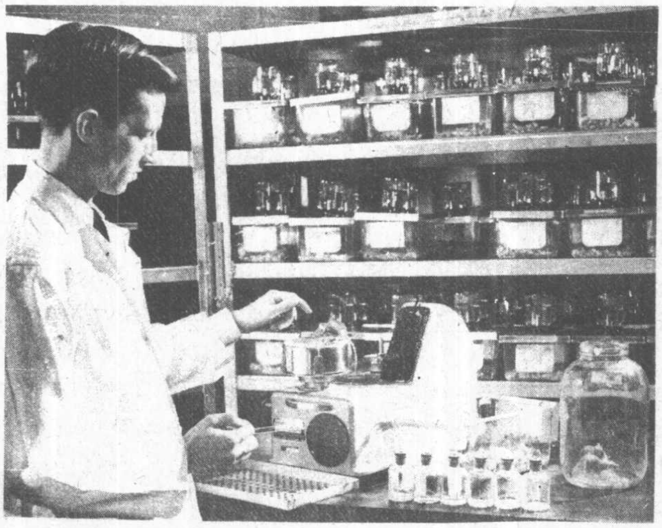
Even so, money alone cannot guarantee scientific supremacy. It must be accompanied by freedom of inquiry, an intellectually stimulating environment and continuous recruitment of the best minds. That combination has been achieved in many U.S. institutions — educational, governmental and industrial — but perhaps nowhere more successfully than at the National Institutes of Health, Bell Laboratories and Caltech. A brief look at each:

The National Institutes of Health: Indulging the Unusual

The brick buildings dotting the campus-like setting in Bethesda, Md., are honeycombs of laboratories. Everywhere, the air is filled with the hum of voices discoursing on subjects ranging from vitamin supplements to viral vaccines, in the words of Author-Physician Lewis Thomas, "one of the nation's great treasures." In an era of disillusionment with Government bureaucracy, he observes, "This is standing proof that at least once in a while, Government possesses the capacity to do something unique, imaginative, useful and altogether right."

A technician tests a new drug in cancer research at The National Cancer Institute.

National Institutes of Health



In the past few decades, the letters NIH have become almost as familiar to Americans as FBI[3] or IRS[4]. The federal research center has been a leading force in the U.S. and around the world for the study of cancer and heart disease, the development of vaccines and treatments for infectious illness (most recently AIDS) and the investigation of mental illness. Its scientists are at the forefront of research in such fundamental mysteries as gene regulation, the workings of the immune system and the structure of complex organic molecules. Says an author of two books on the NIH: "There is no other biomedical institution that has its scope." Or its influence. The NIH has undertaken the responsibility for the training of one-third of the nation's biomedical researchers; it has sponsored the work of two-thirds of those U.S. scientists who have won Nobel Prizes for Physiology or Medicine since 1945. It is clearly a major factor in America's primacy in medical research.

Despite its status as a Government lab, the NIH has traditionally allowed its researchers extraordinary freedom in making unusual, obscure and sometimes seemingly fruitless explorations. In the 1930s, for instance, two researchers at the NIH set about exploring the seemingly unimportant problem of mottled teeth. Their quest confirmed the cause — excessive exposure to fluorine. But it also revealed that fluorine, in lesser quantities, can safely prevent tooth decay. The result, after a decade of study: fluoridation of drinking water and a remarkable nationwide drop in dental cavities.

In the '50s, the NIH was equally indulgent of a brilliant but eccentric pediatrician named Carleton Gajdusek, who went off on what appeared to be a wild-goose chase[5] through the highlands of Papua New Guinea. He was investigating kuru, a strange and fatal disease that had struck the remote Fore tribe. Kuru was first dismissed as something irrelevant to the rest of the world. Gajdusek, who later won a Nobel Prize, proved it to be the first example of human infection with a slow virus. Such viruses among the tiniest and slowest-acting infectious agents yet discovered, have now been identified as the cause of several ailments of the nerve system, and are a leading suspect in Alzheimer's disease.

Like many illustrious American inventions, the NIH has its roots in the immigrant experience. Says NIH Director James Wyngaarden, "We trace our origins to a one-room, one-researcher lab on Staten Island" established in 1887 to combat the waves of cholera, typhus and other diseases that came with each immigrant ship. In the 1930s the Hygienic Laboratory was renamed the National Institute of Health; it moved to more spacious quarters in Bethesda and created the National Cancer Institute (NCI), the first of what is now a dozen specialized centers.

The NIH today is, without question, the single largest sponsor of biomedical research in the country. In 1984 it supplied more than a third of the $11.5 billion spent on such research. About 70% of the NIH research budget goes to scientists working at universities and labs around the country. The rest goes to researchers at the institutes in NIH, which specialize in everything from child health to aging, from environmental hazards to eye disease. The Bethesda campus also includes a 540-bed hospital, where the lessons of the lab are applied to patients. Doctors there are presently investigating experimental drugs for AIDS and new treatments for cancer, including the use of natural substances.

But allocations to the NIH have been leveling off since 1968, and next year may decline for the first time ever, from $5.2 billion to $4.9 billion, if the Administration's proposed budget is approved. The NIH would then be able to fund only 27.4% of the grants it considers worthy of support, down from 37% in 1984 and 52% in 1979. Austerity is also threatening the NIH's most valuable resource: its staff, which is increasingly being lured by the higher salaries offered in industry and academy. Still, the creative atmosphere at Bethesda and the freedom to take intellectual risks attract many of medicine's best and brightest. Says NCI Chief Vincent De Vita, when asked why he stays on despite more attractive money offers: "This is the most exciting place in the world to work."

Bell Laboratories: A Critical Mass

The computer room in Bell Laboratories' six-story brick quarters in Murray Hall, N.J., is strewn with a head of toy sheep, an assortment of plastic ducks and a glass beaker that contains a Madagascar cockroach. Walking along one of the facility's narrow, green corridors, Mathematician Ronald Graham effortlessly juggles six spinning white balls. Some days the balls are black. Since its founding on New Year's Day 1925, Bell Labs — AT&T[6]'s peerless research and development arm — has been bubbling with creative unorthodoxy. "To work here," says one researcher, "you have to let your hair down and be a free spirit[7]."

You also have to be brilliant. Of the 20,000 people employed by Bell Labs in 19 facilities spread throughout the nation, 2,769 are Ph.D.s. "The brainpower around here is enormous," says a physicist referring to the Murray Hill branch, where a force of 3,200 does much of Bell's basic research. "This is like a university with a faculty of 500 physicists. If all of us took off and went to different universities, we wouldn't have the same impact." But together, the physicists and other Murray Hillers form what another physicist calls a "critical mass."

The ensuing chain reaction has changed modern society. Over the span of 60 years, Bell Labs has generated 21,000 patents, more than one for each of the institution's working days. More than mere inventions, the patents cover breakthroughs that have launched entire industries — developments such as the transistor, the solar cell and satellite TV. Meanwhile, scientists at Bell have taken seven Nobel prizes and, in the process, inspired some legends.

In an event that came to be called the "well-known accident," Clinton Davisson and his colleague Lester Germer in 1925 accidentally stumbled on experimental proof of a crucial aspect of quantum theory. Davisson noticed that a stream of electrons beamed at a crystal of pure nickel was diffracted, a phenomenon that is characteristic of light waves. Electrons had been thought to exist only as subatomic particles until, just a few years before Davisson's observation, the newly developing quantum theory suggested that electrons could behave as both particles and waves. Here was proof, and it won Davisson a Nobel in 1973.

In 1936 a young M.I.T. graduate named William Shockley joined the labs, where he and his colleagues John Bardeen and Walter Brattain developed the transistor, an electrical device that could perform the duty of a bulky vacuum tube more reliably, with less energy and in a considerably smaller space. The solid-state integrated circuits and chips that evolved from the transistor are the essential ingredients of today's electronic products, from computers to digital watches to spacecraft television cameras. In 1956 the three scientists were awarded Bell Labs'second Nobel Prize for Physics.

Arno Penzias, now the labs'vice president in charge of research, was a radio astronomer hired in 1961 to work on satellite communication. While he and his colleague Robert Wilson were researching radio radio frequencies in the Milky Way, they found they could not subdue a bothersome hissing sound that their huge antenna picked up, no matter where in the sky it was pointed. They took the antenna apart but the hiss persisted. Penzias and Wilson finally reached a dramatic conclusion (for which they shared the 1978 Nobel Prize for Physics): the noise was the dying remnant of the fierce radiation produced some 15 billion years ago by the Big Bang[8] that created the universe.

The new generation at Bell is equally brilliant — and unorthodox. Physicist David Tank, for example, keeps his experimental subjects in an aquarium where they are fed seaweed; they are sea slugs, which have simple nervous systems and large nerve cells that are easy to study. "What we want to know is this," says a researcher, "if the animal learns something, what circuits charge?" Computer Scientist Stephen Levison is creating an airline-reservation system that responds to voice commands. "I want to make a reservation, please," Levison says into a microphone. Responds the computer "Please wait." Says one researcher: "This is still one of the few places you can devote 100% of your time to basic research without being interrupted to teach classes or fight for funds."

California Institute of Technology: Formality Is Taboo

People driving by the pleasant campus in Pasadena, Calif., barely notice the low-rise buildings, the casually dressed students strolling across lawns or sitting on benches with their noses buried in books. To all appearances it could be any one of hundreds of small vocational colleges. In fact, that is how it began life in 1891, with the name of Throop University.

The California Institute of Technology (as it was renamed in 1920) has come a long way since then. Other small universities have a Nobel prize winner or two among their faculty and alumni; Caltech boasts 20, including Physicist Richard Feynman, who helped formulate the theory of quantum electrodynamics, and Neuroscientist Roger Sperry, whose experiments revealed functional differences in the left and right hemispheres of the human brain.

Other universities take credit for a handful of major discoveries; Caltech's would fill a book. It was there that Seismologist Charles Richter devised the standard scale for measuring the intensity of earthquakes; that Astronomer Maarten Schmidt discovered the nature of quasars; that Physicist John Schwarz developed the "superstring" theory that may achieve Einstein's goal of linking the universe's four basic forces; that scientists made the longest biologically active protein ever chemically synthesized. Caltech administers NASA[9]'s nearby Jet Propulsion Laboratory, which designed, built and guided many of the nation's unmanned spacecraft, including *Explorer I*, the first U. S. satellite, and the *Voyager* that flew by the planet Uranus. These and a host of other achievements have sprung from an institution that is small in comparison with major universities; Caltech has only 273 professors and fewer than 1,000 each of graduate and undergraduate students.

Caltech's rise to prominence came in the 1920s under the direction of three eminent scholars: Chemist Arthur Noyes, who was imported from M. I. T., Physicist and Nobel Laureate Robert Millikan, from the University of Chicago, and Astronomer George Ellery Hale of California's Mount Wilson Observatory. Using their prestige to lure both brains and financing, primarily from the East, the trio built a superlative faculty and outstanding facilities that in turn attracted some of the nation's best students; almost one-third of last year's entering freshmen ranked first in their high school graduating classes.

Adding to Caltech's appeal is the permissive, informal atmosphere that pervades the campus. Says Caltech's President: "Select the very best people, give them the very best facilities and stand aside." He does just that, giving his professors a voice in choosing which students should be admitted, who should be hired and which research projects should be funded. "We don't have a lot of deans running around," says a chemistry professor. "The scientists run this place." As a result, Caltech scientists can test a theory in the time that other universities take merely to consider it.

Formality is taboo. The president, Dr. Goldberger, is called by his first name "Murph" by faculty and students alike. Professors lecture in jeans and open-collared shirts, shorts and sandals. They encourage questions and expect challenges. One professor has been known to wear a horse's head while lecturing. Another, who played a tribal chieftain in a student production of the play *South Pacific*, mixes serious physics with comedy. And "Murph" marked the centennial of Einstein's birth by riding an elephant across campus.

Professors are not the only ones noted for their peculiar sense of humor. During the school's annual Ditch Day[10], seniors secure their rooms with a variety of clever locks and barriers, then leave campus and challenge the underclass to get in. This year one room was guarded by a computer that had to be addressed in several languages before the door could be opened. "I guess it sounds like a strange way to have fun," says a sophomore from San Jose, "but building strange things is what this place does best."

Such single-minded devotion to problem solving has led to criticism that Caltech turns out scientists who have little understanding of life outside their fields and works its students so hard, despite the fun and pranks, that they have little time for politics or social problems.

But no one denies Caltech's outstanding record or doubts that it will achieve even more. While major astronomical discoveries are still being made with Caltech's 200-in. Hale Telescope, the school has joined with the University of California in building a 394-in. optical scope, the world's biggest, which will enable astronomers to see 12 billion light-years into space.

Time,
June 16, 1986

44. THE SOCIAL CONTROL OF SCIENCE AND TECHNOLOGY

Science and technology are not simply the work of isolated individuals: the selection of research problems and the rate and direction of innovation are strongly influenced by social forces. It is no accident, for example, that so much applied research in the United States focuses on the development of military and commercial products. It follows that science and technology cannot be regarded as somehow independent of society. Like any other cultural products, they are created and controlled by countless individual men and women. The difficulty is that this control is haphazard. We have created a complex institution to ensure the development of science and technology, but we have created few means of monitoring and controlling their effects — despite the impact these effects can have on the social order.

The lack of systematic social control over scientific and technological innovation presents three main problems:

1. A relatively haphazard scientific and technological advance may have many unforeseen social effects, particularly in terms of the quality of the environment. Consider, for example, the growing list of chemicals and food additives that may contribute to human cancers; the increasing atmospheric pollution that some scientists think may lead to climatic changes which could cause a new ice age; the mounting health problems caused by chemical wastes that have been improperly disposed of; and the ominous threat of major accidents in nuclear power plants.

2. Unless society ensures that innovations in science and technology take place in accordance with defined social goals, there may be distortion in the priorities given to research efforts in different fields. Critics argue that under the existing arrangements, scarce and valuable resources may be devoted to producing such trivia as self-heating shaving cream[11], when they might otherwise be devoted to more socially desirable ends, such as medical research or energy conservation.

3. A highly technological society poses a possible threat to democracy. Public participation in the decision-making process may become difficult because the relevant facts about many important issues — such as the wisdom of building nuclear breeder reactors — may be beyond the comprehension of both voters and their elected representatives. Several writers have warned of the dangers of *technocracy*, or rule by experts. In modern corporations and government departments the real decisions are often made behind the scenes by experts whose specialized knowledge and recommendations

are relied upon those who are officially responsible for the decisions.

Occupations expected to be adversely or positively affected by automation

Adversely affected occupations	Positively affected occupations
Boiler tenders	Accountants
Bookkeeping workers	Bank clerks
Broadcast technicians	Bank officers and managers
Buyers	Business machine repairers
Cashiers	Ceramic engineers
Central office telephone crafts	Chemical engineers
Credit managers	City managers
Drafters	Computer operators
Electroplaters	Computer programmers
Electrotypers and stereotypers	Computer service technicians
File clerks	Economists
Hotel front office clerks	Electrical engineers
Insurance agents and brokers	Engineering and science technicians
Insurance claim representatives	Industrial engineers
Machine setup workers	Instrument makers (mechanical)
Machine tool operators	Librarians
Molders	Maintenance electricians
Motion picture projectionists	Mathematicians
Office machine operators	Medical record administrators
Photoengravers	Metallurgical engineers
Photographic laboratory occupations	Physicists
Postal clerks	Political scientists
Printing compositors	Sociologists
Production painters	State police
Radio and television announcers	Systems analysts
Railroad brake operators	Technical writers
Railroad conductors	
Railroad locomotive engineers	
Railroad telegraphers, telephoners, and tower operators	
Shipping and receiving clerks	
Stock clerks	
Telephone operators	
Tool-and-die makers	

Source: Adapted from U.S. General Accounting Office, *Advances in Automation Prompt Concern Over Increased U.S. Unemployment* (Washington, D.C.: Government Printing Office, May 1982), pp. 34–35.

The Uncertain Impact of Automation

Any attempt to apply a more systematic form of social control over science and technology would probably run into severe problems. One such problem involves a conflict of values. The object of science is the pursuit of knowledge, and ideally this activity should take place in an atmosphere of complete intellectual freedom. There are enough unhappy examples in the past of nonscientists attempting to dictate to scientists what they should and should not investigate; we should be wary of doing the same. Should we impose restrictions on research, and if so, what restrictions? A similar conflict of values might arise if society attempted to shift priorities in applied research from the manufacture of trivial commercial products to other social goals. Radical changes in these priorities would inevitably interfere with the workings of the capitalist system that most Americans value so highly.

Another problem involves the moral responsibility for decisions about research that may have far-reaching consequences. The development of the hydrogen bomb is but one example of many in which technical and moral issues are not easily separated in practice. At present, scientists usually cannot and do not control the uses to which their work is put, although there are signs that many scientists are now very disturbed about this situation. Ought the responsibility for decisions about new research and technology rest with scientists themselves, or with government, or with some new control agency such as a "science court"[12] with full legal powers to restrict certain research? The question is a vital one, for scientific and technological advance in the years ahead may change our material and social environment in ways that many people might consider undesirable.

Some of the scientific research currently in progress illustrates the significance of this problem. Scientists are now working on techniques that may make it possible for parents to determine the sex of their children. If a marketable product eventually emerges, commercial interests may encourage widespread sex selection of children. This may sound like a socially useful technology until we consider one factor. Opinion polls in the United States and elsewhere have indicated that a large majority of parents would prefer to have boys rather than girls. The result of sex selection might be a society in which males heavily outnumber females, with important effects on population structure, family patterns, and sexual norms. Do we want this kind of situation, and should the decision be left to commercial interests?

Another controversial field of research involves the re-arrangement of living molecules, in particular the DNA molecule that determines the hereditary characteristics of all living things. This research can have many uses, ranging from the control of insect pests to the treatment of cancers. The danger exists, however, that new and harmful strains of viruses and bacteria can be created in the course of this research. Human beings would have no natural immunity to these strains. Loss of control over such new life forms could lead to catastrophic, world-wide epidemics. Scientists have been quick to recognize this danger and have themselves set up strict guidelines and safety procedures for DNA research. Some scientists, however, believe that even these safeguards are inadequate and have called for a total ban on this kind of research.

These are examples of the problems posed by science and technology that we in America and other societies face. Science and technology have developed far faster than have social mechanisms to control them. A century ago, science was of marginal importance to society and technology was relatively undeveloped. Today they offer the prospect of social upheaval and even the destruction of human life — or the potential for unprecedented social benefits and new levels of civilized existence. An urgent social challenge in the future will be to ensure that science and technology develop exclusively in the second direction.

Sociology, 2nd ed.
Ian Robertson
Worth Publishers, N.Y., 1981

Public Attitudes toward Science

Opinion polls show some decline in public confidence that science can solve many human problems.

Although science is still viewed favorably in most respects, there do seem to be ambiguous feelings about the direction in which scientific advance is leading us.

Do you agree that scientific research and technological development ...	Yes	No	Not Sure
are necessary to keep the country prosperous?	92%	4%	4%
are the only way we can clean up air and water pollution?	69%	20%	11%
are the main factors in increasing productivity?	69%	16%	15%
make people want to acquire more possessions rather than enjoying nonmaterial experiences?	65%	22%	13%
are the real basis of our military strength?	64%	21%	15%
will eventually mean a four-day workweek?	62%	21%	17%
make everything bigger and more impersonal?	56%	30%	14%
tend to overproduce products, and this is wasteful?	52%	36%	12%
are a way to make the rich get richer and the poor poorer?	48%	37%	15%
make the country prosperous enough to take care of the needs of the poor?	46%	38%	16%
are the only way we can create enough jobs for people who need them?	44%	42%	14%
lead to far too much use of scarce raw materials and natural resources?	42%	38%	20%
eventually lead to the loss of jobs?	39%	44%	17%
cause air and water pollution to get worse?	33%	51%	16%

Source: Harris poll, 1978.

"I see by the current issue of 'Lab News,' Ridgeway, that you've been working for the last twenty years on the same problem I've been working on for the last twenty years."