3. The Constitutional Status of Basic Research

• THREE •

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Because the U.S. Constitution says little about science explicitly, analysis of the role of science in American society is rarely perceived as having an important constitutional dimension.[1] Yet numerous provisions of the Constitution have the intent and effect of shaping the relationship between government and science. The result is a framework that is extremely supportive of basic research.

The Enlightenment Background

This result is hardly surprising, given the background of the framers of the Constitution. Veneration of science was a central tenet of eighteenth-century Enlightenment thinking[2] for science was believed to illuminate not merely natural phenomena but political and theological matters as well.[3] Isaac Newton was not simply revered; he was nearly deified. Alexander Pope's tribute to Newton is illustrative: "Nature and Nature's Laws laid hid in night; God said, Let Newton be! and all was light."[4] Leading Americans of the Revolutionary era shared this Enlightenment view.[5] Science and public affairs were so closely related that any distinction between scientific and political leaders was difficult to maintain. David Rittenhouse and Benjamin Rush were important officeholders and political figures. Rittenhouse was a self-taught astronomer whose famous mechanical orrery demonstrated the motions of the heavenly bodies. Regarded by his fellow Americans as a scientist of the first rank, he

was a member of Pennsylvania's general assembly and of that state's constitutional convention. He also provided scientific advice in the Revolutionary War, aided in defining U.S. weights and measures, and served as first director of the U.S. Mint.[6] Rush was a physician who contributed to medical theory and chemistry. He inspired Thomas Paine to write *Common Sense,* attended the Continental Congress, and signed the Declaration of Independence.[7]

Both Rittenhouse and Rush were close friends of Thomas Jefferson, whose scientific interests are well known. Jefferson's observations on natural history in *Notes on the State of Virginia* constitute his most extensive scientific work, but he commented as well on a variety of other fields, including paleontology and geography.[8] James Madison was also intrigued with natural history,[9] whereas Alexander Hamilton studied medicine, enjoyed mathematics, and urged friends to learn chemistry to improve their thinking.[10] With Ben Franklin, the boundary between scientist and political leader dissolves altogether. One of the world's leading physicists and America's foremost ambassador, Franklin was, to many European philosophers, the Enlightenment incarnate.[11]

The science that so appealed to America's founders, and that continues to be valued today, was an outgrowth of the revolutionary advances in astronomy and physics associated with Galileo and Newton. It was characterized by reliance on empirical data as opposed to sacred texts or royal pronouncements, and by an effort to use man's knowledge of nature to improve the human condition.[12] In the eighteenth century, when Newtonian principles were applied to virtually all human endeavors, the very word *science* referred to knowledge generally.[13] Jefferson listed "the sciences which seem useful and practicable" as "Botany, Chemistry, Zoology, Anatomy, Surgery, Medicine, Nat'l Philosophy, Agriculture, Mathematics, Astronomy, Geology, Geography, Politics, Commerce, History, Ethics, Law, Arts, Fine arts."[14] Thus when the framers used the word *science,* they meant to include (among other things) what today would be referred to as basic research in the natural sciences.

Scholars have devoted considerable attention to the way in which infatuation with this type of science affected the building of political institutions. In opposing unicameral legislatures, for example, John Adams invoked "one of Sir Isaac Newton's laws of motion, namely—'that reaction must always be equal and contrary to action' or there can never

be any rest."[15] But the building of a clockwork constitution accounts for only half of the science-government relationship. The Constitution that resulted had an impact on the further development of science.

Free Speech for Scientists

The most dramatic example of that impact came in the First Amendment's requirement that "Congress shall make no law . . . abridging the freedom of speech, or of the press," a restriction on government designed in part to assure freedom for scientists. America's founders believed that the protection of civil liberties in a free state was essential to the growth of science, a growth they strongly favored. This idea found expression in the poems of the Jeffersonian journalist Philip Freneau, who wrote in "The Rising Glory of America" that without "sweet liberty . . . science irretrievably must die."[16] The Enlightenment union of political and scientific progress was also reflected in Freneau's "On the Death of Dr. Benjamin Franklin": "Who seized from Kings their sceptred pride, and turned the lightning's darts aside!"[17]

Rittenhouse and Rush were among the numerous other writers and orators who explicitly linked scientific progress with civil liberty.[18] Jefferson, in a 1789 letter to the president of Harvard College, concluded a call for research in botany, mineralogy, and natural history with the same message: "It is the work to which the young men, whom you are forming, should lay their hands. We have spent the prime of our lives in procuring them the precious blessing of liberty. Let them spend theirs in showing that it is the great parent of science and of virtue; and that a nation will be great in both always in proportion as it is free."[19]

The notion that free speech applied to science was an inevitable result of the idea that proper political decisions came not from monarchical pronouncements but from the application of scientific thinking to social problems. Thus Jefferson, in opposing tariffs on learned treaties, observed that "[s]cience is more important in a republican than in any other government."[20] Indeed, Jefferson's devotion to the free exchange of scientific ideas may have exceeded his devotion to the free exchange of political views that differed from his own.[21]

The intimate relation between science and civil liberty is illustrated in a 1774 letter from the Continental Congress to the inhabitants of Quebec that described freedom of the press as important in part because it

advanced "truth, science, morality, and arts in general."[22] Limiting free speech and press to narrowly political concerns would have been unthinkable; freedom that did not reach the work of Galileo, Newton, and Franklin did not reach far enough.

Judicial interpretations of the speech and press clauses accord science the protected status envisioned by the framers of the Constitution. We are concerned here with the application of those clauses to scientific publications. Chapter 6 discusses the very different constitutional status of technological applications.

The case law makes clear that First Amendment protection from government regulation applies when scientific results or theories are published. Obscenity decisions furnished the earliest demonstration. The first major obscenity precedent relied on in the United States was articulated in 1868 in the British case of *Regina v. Hicklin*.[23] Although *Hicklin* did not concern a scientific publication, Chief Justice Cockburn noted during oral argument that "[a] medical treatise, with illustrations necessary for the information of those for whose education or information the work is intended, may, in a certain sense, be obscene, and yet not the subject for indictment."[24] This straightforward recognition that a ban on sexual matters per se would hinder science and is therefore unacceptable became one of the few consistent threads in the development of obscenity law in the United States. Early decisions limited circulation of medically oriented sexual materials to doctors and students, but by 1940 it was reasonably clear that anyone could have in their homes medical encyclopedias or sex manuals.[25]

Thus, by 1957, when the Supreme Court decided *Roth v. United States*,[26] which set forth a general test for obscenity, science was safely outside the category of the obscene. The government conceded as much in its brief in *Roth*.[27] The Court, while holding that obscenity lies outside the realm of the First Amendment, squarely held that the portrayal of sex in "scientific works is not itself sufficient reason to deny material the constitutional protection of freedom of speech and press."[28] This principle was applied shortly after *Roth* to protect the importation of material for a university's sex research institute, and the principle has not been challenged successfully since.[29] When the Court, in the 1977 case of *Miller v. California*,[30] changed the test for obscenity, the status of science was retained. The Court held in *Miller* that the "First Amendment protects works, which taken as whole, have serious . . . scientific

value."[31] Indeed, in his opinion for the Court in *Miller*, Chief Justice Burger's sole illustration of protected material resembled Chief Justice Cockburn's observation 105 years earlier: "Medical books for the education for physicians and related personnel necessarily use graphic illustrations and descriptions of human anatomy."[32]

In a variety of other contexts, the courts have given scientific material the same high level of protection given to political and social commentary. Prior restraints are extremely difficult to justify;[33] thus a state, through its dental society, cannot require prior approval of a radio broadcast on "scientific dental matters."[34] Legal redress for inaccurate reporting must allow leeway for unavoidable mistakes to avoid chilling the dissemination of knowledge;[35] thus, the First Amendment protects a publisher from a suit based on lost profits stemming from a mistake in its chemical encyclopedia.[36] Accurate advertising is also entitled to First Amendment protection;[37] thus a scientific laboratory can advertise that it will test cholesterol levels for a fee.[38]

First Amendment protection is no more absolute for scientific speech than for any other variety.[39] National security considerations have at times led the government to restrict the dissemination of certain scientific information, usually by classifying such information pursuant to executive order.[40] The classification of scientific work was most widespread during and after World War II when basic advances in nuclear physics were tied intimately to the construction of nuclear weapons.[41] In the postwar period, when First Amendment rights generally fared poorly, scientific work was hampered by severe security restrictions on research and even on teaching, particularly in the area of nuclear physics.[42]

The courts have had little occasion to define precisely the limits of the government's power to classify scientific material. Courts and scholars generally agree that technological plans for advanced weapon systems can be subject to restrictions and even prior restraints. After all, the classic case for a valid use of prior censorship is to prevent publication of "the number and location of troops";[43] revelation of the design of a secret weapon would have at least as great an impact on national security. Thus it is not surprising that in 1979 a federal district court enjoined publication of an article that purported to give details on how to build a hydrogen bomb.[44]

At the other extreme, basic and widely known scientific truths cannot be suppressed merely on the ground that they can be used to build

weapons. As the Supreme Court has stated, a state may not "prohibit possession of chemistry books on the ground that they may lead to the manufacture of homemade spirits."[45] Only a significant imminent threat to national security can justify the removal of scientific material from public view.[46]

The view that science is fully protected by the speech and press clauses is not undercut by occasional academic and judicial statements that "political" speech of one type or another lies "at the core" of First Amendment values.[47] As leading First Amendment scholars have long recognized, suppression of scientific information is inconsistent with the democratic political process.[48] When a scientist publishes a theory on the consequences of power plant emissions, for example, that theory has at least as much relevance to a political controversy on power plant location as does a local politician's speeches. Even when scientific work is not immediately applicable to political controversies, it plays an important role in maintaining a free and informed society. Such was the view of the framers, and it has been the consistent view of the courts. Thus, the observation that political speech lies at the core of the First Amendment does not mean that scientific speech lies elsewhere.

Government Support for Science

In sum, scientific speech receives the full protection of the speech and press clauses of the First Amendment. Yet if science were free but ineligible for direct government support, American science would be a shadow of its present self. Fortunately, government funding for science is built into the constitutional system and is based primarily on firm historical and institutional precedents rather than on short-term political developments.

The Constitution does not state explicitly that the federal government shall fund scientific research. Certain clauses, however, virtually require government support of science, whereas others permit such support for a broad range of activities.

In the early years of the republic, the power conferred in the Constitution to establish a seat of government led to important surveying efforts in Washington, D.C.[49] Madison contended that congressional power over the district also included the power to create a federal university, although such a university was never created.[50] The power to regulate

commerce helped justify activities such as research on the causes of steamboat boiler explosions,[51] and the power to take the census made the government a major source of social science data.[52]

But from the framers' point of view, three areas of congressional authority—the military, coinage weights and measures, and patents—were the most important in bringing about government support for science. And in our times a fourth power—to spend for the general welfare—has outstripped all of the others in this respect.

Let us look first at the military. At least since the time of Leonardo da Vinci, scientists have contributed directly to the development of sophisticated weaponry.[53] At times, the needs of the military have inspired science; at other times, science has inspired the military.[54] During the Revolutionary War, the colonies' leading scientists participated fully in the war effort. David Rittenhouse performed general science advisory work and, in addition, substituted iron for the lead clockworks in Philadelphia to obtain lead for bullets.[55] Benjamin Rush devised a gunpowder production method used at the Philadelphia saltpeter works.[56] One colonial scientist, David Bushnell, even invented a submarine—the American Turtle—which, although unsuccessful militarily, was an important advance in its field.[57]

The constitutional clauses concerning national defense were not written to aid science, but they were written with an understanding born of the Revolutionary War experience that science was an important part of the military effort.[58] After enactment of the Constitution, the military power became the source of some of the federal government's earliest expenditures for science. Wartime experience had convinced George Washington, for example, that the country needed a military academy to train engineers.[59] Thus West Point, established in 1794, became America's first national scientific institution—from the beginning, West Point taught physics and mathematics as well as engineering, and graduates played a major role in government surveys and related activities.[60] In 1802, military needs furnished part of the justification for congressional funding of the Lewis and Clark expedition, which made valuable findings in fields such as botany and zoology.[61] From those early years until the present, military expenditures have included scientific research in a variety of areas, ranging from astronomy to health to nuclear physics.[62]

The only constitutional provision that arguably poses a barrier to

the military-science relationship relates to the congressional power over military appropriations. As a concession to those who opposed a standing army, the Constitution provides that Congress shall have the power "to raise and support armies, but no appropriation of money to that use shall be for a longer term than two years."[63] The debates at the constitutional convention[64] and in the *Federalist Papers*[65] indicate that this clause was designed to provide close congressional oversight of military expenditures. If read broadly to include, for example, prohibition of funding for long-term research programs, the clause could hamper the military's relationship with science: it is difficult to require short and specific time limits for research and development contracts as distinguished for ordinary military procurement because such time limits can hinder the scientific endeavor.[66] Opinions of the attorney general, however, have concluded that the two-year appropriation clause does not limit the military's power to make long-term contracts.[67] Thus the military portion of the constitutional connection between government and science is secure.

Congressional authority over coinage, weights, and measures provides another constitutional link between government and science.[68] Effective implementation of the coinage power was thought at the outset to require the highest order of scientific talent. President Jefferson appointed the ubiquitous Rittenhouse to be the first director of the Mint,[69] and for half a century the Mint was headed by scientists.[70] The appointment of scientists to this directorship was only partially successful. Coinage requires skill, but not that of a scientist.[71] Today, the Mint occupies only a modest place in the government's scientific activities.

The federal power over weights and measures had the opposite development. Although presidents from Washington through John Quincy Adams urged development of exact standards, a task requiring considerable research on fundamental physical constants, Congress was reluctant to spend much money.[72] The study of weights and measures was limited to a minor effort in the Treasury Department's Coast Survey, and even that effort was not formalized until establishment of the Office of Weights and Measures in 1836.[73] In 1901, however, Congress created the National Bureau of Standards and combined its power over the preparation of standards with power to solve "problems which arise in connection with standards; the determination of physical constants and the properties of material, when such data are of great importance to

scientific or manufacturing interests."[74] Creation of the bureau was a major event for America's physicists and chemists.[75] Although bureau funding vacillated over the years, it made important contributions to scientific research since its inception.[76] Today, the bureau, now known as the National Institute of Standards and Technology, carries out basic research in a variety of fields, including physics, mathematics, chemistry, and computer science.[77]

The final direct constitutional link between science and government stems from the patent clause in the Constitution, which provides that "Congress shall have the power . . . to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."[78] Because both the patent and copyright powers stem from this clause, some contend that the clause should be analyzed as a "balanced sentence," giving Congress two separate powers: "to promote the progress of science . . . by securing . . . to authors . . . the exclusive right to their writings" and "to promote the progress of . . . useful arts . . . by securing . . . to inventors . . . the exclusive right to their . . . discoveries."[79] This reading limits the word *science* to the copyright power, a possible result in light of the broad eighteenth-century usage of the word. The "balanced sentence" approach has been challenged vigorously on the ground, inter alia, that early patent laws referred to the "art" and "science" of invention, and thus the patent power properly extends to both "science and useful arts."[80]

In practice, patent law includes what is termed science and technology, subject to limitations such as the nonpatentability of laws of nature. The origins of the patent clause, with emphasis on the key goal of spurring progress, have been exhaustively studied.[81] From our perspective, it is important to note that awarding patents does not involve the government directly in funding[82] or in choosing precise areas of research. Nevertheless, the patent monopoly is an incentive for scientific progress, and the range of patentable items defines the broad areas in which that incentive will operate. Prior to the American Revolution, European patents were granted at times to protect old as well as new products.[83] The American aversion to monopolies and the Enlightenment goal of furthering knowledge combined to limit the patent clause to those inventions that promote progress.[84] Congress and the courts have been reasonably consistent in adhering to this limitation. Thus

patents are not available for obvious developments, however valuable.[85] Nor are they available for nonobvious discoveries such as Newton's laws, because permitting monopolies on laws of nature or mathematics would take essential building blocks away from other scientists and retard the development of science.[86] As a result, the patent power is limited to those discoveries that fall somewhere between the mundane and the magnificent. From the point of view of intellectual property, an obvious discovery or a newly discovered law of nature might be just as valuable as a patentable device, but progress, not value, sets the constitutional standard.

Science Spending for the General Welfare

If government spending for science had been limited to direct furtherance of the constitutional provisions just discussed, that spending would not have risen to its current heights. But from the time President Washington told the first Congress that "there is nothing which can better deserve your patronage than the promotion of science,"[87] American leaders have favored spending for science in areas quite remote from Congress' enumerated powers.

It was Alexander Hamilton who provided the constitutional theory. In his *Report on the Subject of Manufacturers,* Hamilton supported monetary rewards to spur "new inventions and discoveries . . . particularly those which relate to machinery."[88] In the midst of discussing this proposal, Hamilton states that "[a] question has been made concerning the constitutional right of the government of the United States to apply this species of encouragement," but he argues that the constitutional basis is found in Congress' power to "lay and collect taxes . . . to provide for the . . . general welfare . . . ," that is, in what we now term the spending power.[89]

Hamilton was advancing what we now think of as the broad view of the spending power: the constitutional power to spend "for the general welfare" extends beyond the ability to spend for Congress' enumerated powers. The narrow view, that spending for the general welfare must be linked to a specific power (such as support for the military), is in the early years of the Republic identified with Madison.[90] But spending for science has been seductive throughout American history: there is evi-

dence that even Madison took a broad view of congressional power when science was involved.

When John Churchman of Maryland came to Congress in 1789 seeking funds for an expedition to Baffin Bay to test his ideas on determining longitude by the magnetic variation of the compass, Madison, a member of Congress at the time, supported the request.[91] In an argument that foreshadows modern political support for science, Madison maintained that "[i]f there is any considerable probability that the projected voyage would be successful, or throw any valuable light on the discovery of longitude, it certainly comports with the honor and dignity of Government to give it their countenance and support. Gentlemen will recollect, that some of the most important discoveries, both in arts and sciences, have come forward under very unpromising and suspicious appearances."[92]

Brant, Madison's biographer, argues persuasively that support of Churchman "could be justified only under Hamilton's interpretation of the Constitution . . . [that is] only by a sweeping interpretation of the power to spend for the general welfare."[93] In any event, Congress rejected Churchman's petition because of the young nation's troubled financial state.[94]

In general, such proposals had difficulty securing congressional support in the first half of the nineteenth century because of constitutional objections, limited money, the fear of centralized federal power, and attacks on the "speculative" of "visionary" nature of the scientific endeavor.[95] Thus, federal spending for science before the Civil War, although varied, was almost always tied to specific congressional powers.[96] The constitutional question of whether Congress could fund science as part of its power to spend "for the general welfare" remained unresolved.

The major breakthrough came in 1862 when Congress created the Department of Agriculture pursuant to the power to spend for the general welfare, and directed the department to employ "chemists, botanists, entomologists, and other persons skilled in the natural sciences pertaining to agriculture."[97] The same year marked establishment of the land grant colleges, which became centers of scientific agricultural research.[98] As a result of these and related developments, federal scientific research in agriculture increased throughout the nineteenth century.[99]

When the Supreme Court, in 1936, first delineated the scope of the federal spending power, it confirmed federal power to spend for science. In *United States v. Butler*,[100] the Court adopted the Hamiltonian view that federal spending need not be limited to the enumerated powers, but could be for the general welfare.[101] The Court relied on the very passage in the *Report on the Subject of Manufacturers* in which Hamilton supported premiums for scientific advances.[102] The brief for the federal government had urged the Court to take this course in part so that federal science spending programs would not be endangered.[103] The Court cited Madison as supporting the opposing view that spending must be limited to the enumerated powers.[104] With respect to spending for science, however, Madison was no Madisonian; as noted earlier, he favored federal financing of a scientific expedition that could not be justified under any enumerated power.[105]

Butler and later decisions established beyond a doubt that science spending for the general welfare is constitutional. Because scientific advances can provide various benefits for society at large, the general welfare test is met easily.[106] Whereas states also are free to fund scientific research, they traditionally have not been the dominant actors in this area. The federal government's pervasive power over defense, standards, and patents limits the states' role, and federal science spending in those fields as well as for the general welfare has existed for over 100 years. Although state science programs have existed for some time, these typically have been either in partnership with the federal government or minor in scope compared to federal activities.[107] As early as 1846, for example, the federal government provided more than twice as much support to leading scientists than did all state governments combined.[108] In recent years, the ratio has shifted even more in the direction of federal involvement.[109]

Thus federal spending for science is not simply a matter of political preference that shifts dramatically with changing political tides. It is rooted firmly in both Hamiltonian and Madisonian views of the Constitution, and it is tied clearly to historical and institutional realities that stretch back more than a century.

The post-World War II growth of government support for science, spurred by the development of nuclear weapons and the space program, has at times obscured this reality. Yet reference to federal spending levels since the Civil War demonstrates that the federal commitment to science

did not begin with the Manhattan Project. In 1884, when laissez-faire and states' right philosophies prevailed[110] and total federal expenditures were only about $240 million,[111] intramural bickering among federal science programs led to congressional inquiry into the need for reorganization.[112] Federal spending for science totalled several million dollars at the time,[113] and various programs had overlapping jurisdiction.[114] For purposes of comparison with the level of federal activity in other areas, it should be noted that this bickering among several science agencies took place three years before creation of the first modern regulatory agency, the Interstate Commerce Commission.[115] By 1904, federal spending for science was approximately $10 million,[116] a figure that grew to about $85 million by 1940.[117]

Today, government science spending has grown enormously to over $75 billion, about $14 billion of which is for basic research.[118] The basic research figure constitutes over 60 percent of all American spending in that field.[119]

Liberals and conservatives alike support government science spending, demonstrating once again the central role of the scientific ideal in the American tradition.[120] The usual American preference for private market forces does not apply when a product produces a large "public good"—that is, a benefit, like national defense, that all share whether or not they pay for it. In such cases, public support for the product is necessary to ensure that those who benefit pay and to avoid the result that too little of the product will be produced because the producers cannot capture all the gains. Most economists agree that science is a classic "public good."[121] An advance can benefit millions in ways that the private sector can capitalize on only with difficulty. Moreover, advances are uncertain and benefits distant, further supporting public involvement.

Distributional concerns are similarly absent from most public debate over science spending. A federal program to subsidize home buyers is debated in terms of which sectors of the society benefit at the expense of others. Science, however, is generally believed to benefit virtually everyone, at least potentially. Science is viewed primarily as a great equalizer, making better health care, energy, and the like more available to all. There are, of course, dissenters from this view. A few view science as reinforcing existing disparities in American society.[122] But the mainstream view throughout American politics is very much to the contrary.

Thus the overall constitutional status of science is favorable indeed. On the one hand, scientists are able to pursue their profession free of government censorship. On the other hand, scientists receive generous government support.

The Tension between Freedom and Funding

There is, however, an important tension in this constitutional framework. In giving out its money to scientists, the government necessarily chooses among competing applicants. Those who lose out are free to pursue their research, but their freedom may often be theoretical, given the costs of research and the federal dominance in funding that research.

Obviously science is treated differently in our constitutional system than religion, because the First Amendment bars government funding of the latter. But the special status of science under our constitution is best illustrated by contrasting it with the status of the arts and politics. Literature and the arts are usually described as enjoying the same First Amendment protection as science, the Supreme Court having held that the First Amendment protects "serious literary, artistic, political [and] scientific" works.[123] Actually, science may fare better when we recall, for example, that novels by Edmund Wilson and Henry Miller have been banned under varying tests of obscenity, whereas sex manuals of rather limited importance have long been protected because they fall into the category of science.[124]

The greatest contrast, however, between science and the arts appears in the relationship between freedom and funding. Federal spending for the arts lacks the built-in impetus of the military and standards clauses, as well as the historical association of science spending with the general welfare. Thus government spending for the arts, although constitutional, has remained quite low, and, even with recent increases, is a tiny fraction of spending for science.[125] Yet even with support for the arts at such a low level, many artists (not to mention politicians) believe that government funding raises troubling questions concerning government domination of the artistic impulse and government support for "popular" rather than "elite" artistic endeavors.[126] By contrast, scientists are relatively comfortable with their status as recipients of federal largess despite the far more intimate relationship between government and science. Questions are raised about whether the right scientists are receiving

funding, but science in this country long ago crossed the bridge that the arts confront only in the distance. Science is to a large extent a government endeavor, and yet scientists have continued to enjoy considerable intellectual freedom.

Nothing inherent in the nature of art or science compels this unequal status. In Europe, government support for art historically has been far greater than in this country, with no apparent loss of creativity.[127] In contrast, twentieth-century experience in Germany and the former Soviet Union indicates that government domination of science can have unfortunate consequences for the scientific endeavor. Under the Nazis German researchers had to avoid anything that smacked of "Jewish science," whereas in the Stalinist Soviet Union government support of Lysenkoism hampered the development of biology for years.[128] Thus the role of science in American society does not stem from the nature of science itself but rather, in large part, from its unique constitutional status. Funding is combined with protections for scientific freedom, and scientists routinely call for increased appropriations while vigorously invoking the name of Galileo when restrictions on their private inquiries are broached or when the government tightly controls how its research money is spent.[129]

The status of science under the Constitution also contrasts sharply with the place of political speech in the United States. Politics enjoys the same free speech protection as science,[130] although, as with the arts, science may actually fare better in practice.

In *Buckley v. Valeo,* for example, the Supreme Court upheld a congressional limit on the amount an individual can contribute to a political candidate.[131] The Court found justification for this limit in the corruption and the appearance of corruption when large private contributions dominate an election campaign. The Court specifically cited corrupt practices in the 1972 elections.[132] Given the absence of any similar concerns involving private contributions to scientific research, it is not at all clear that Congress could constitutionally limit an individual's freedom to contribute to another's efforts to communicate a scientific theory.

Furthermore, in politics as in the arts, the biggest contrast with science is the relationship between freedom and funding. Supporting politics through government funding raises important First Amendment problems, even when the amount of money involved is small compared

with the amounts spent on science. Thus, in *Buckley* two Supreme Court justices believed that federal funding of presidential campaigns was unconstitutional given the disadvantage this system creates for minor parties who are not funded.[133] Chief Justice Burger even analogized the dangers of political funding to the dangers of establishing religion.[134] Although the majority of the Court upheld the funding scheme on its face, they noted, "we of course do not rule out the possibility of concluding in some future case, upon an appropriate factual demonstration, that the public financing system invidiously discriminates against nonmajor parties."[135]

Federal funding of science is not perceived as raising such questions. The scientists who do not receive funding are certainly disadvantaged in developing and presenting their theories in the marketplace of ideas, but that price must be paid to maintain science's unique dual status as supported and free.

Indeed, even this price is not as high as it might be because of the final episode in the favored constitutional status of science. Typically, when the government funds an activity it has the power to attach strings that might otherwise violate individual rights. But this power has been narrowly construed when it is a science program that is being supported.

The leading modern case on government power in this area is the Supreme Court's 1991 decision in *Rust v. Sullivan*.[136] In a controversial 5–4 ruling, the Court held that recipients of federal family planning money could be prohibited from engaging in abortion counseling and referral. The Court reasoned that recipients could advocate abortion on their own time, but they were bound by the government's restrictions when they were performing services supported by government money. Neither free speech rights nor the right to an abortion could overcome the government's ability to attach strings to its largess.

Shortly after *Rust* was decided, a federal district court was presented with a case that the government maintained was indistinguishable. *Board of Trustees of Stanford University v. Sullivan*[137] arose when the National Heart, Lung, and Blood Institute of the National Institutes of Health decided to award a contract for a five-year research project on an artificial heart to Dr. Philip Oyer of Stanford Medical School. A confidentiality clause in the grant required Dr. Oyer to give a government contracting officer forty-five days advance notice of his intent to publish preliminary findings. If the officer objected to publication, fur-

ther review by the government was available. But ultimately the doctor would have to go to court if the government continued to oppose publication. The basis for these government regulations was a desire to prevent the Stanford researcher from issuing "preliminary unvalidated findings" that "could create erroneous conclusions which might threaten public health or safety if acted upon," or that might have "adverse effects on . . . the Federal agency."[138]

When Stanford challenged the confidentiality clause in court, federal judge Harold H. Greene rejected the government's argument that this was no different than the restriction on speech upheld in *Rust v. Sullivan*. Greene maintained that whereas the grantees in *Rust* remained free to advocate abortion on their own time, Dr. Oyer was barred from ever discussing his artificial heart research during the five-year grant period. The court noted that, although the confidentiality clause only applied to this government grant, it would be hard to police the statements of Dr. Oyer to see if he was referring to work under the grant, because he had worked for almost twenty years in the artificial heart field.[139] Finally, Greene maintained that the government's standards for restricting speech—"unvalidated findings," "threaten public health and safety," and so on—were too vague to be constitutionally permissible.[140] Thus Greene invoked the full force of the First Amendment's free speech clause to remove this limit on the freedom of a scientific researcher.

It may be that Judge Greene was simply distinguishing *Rust* and protecting free speech as an abstract proposition. But the distinctions he drew are not self-evident. The grantees in *Rust* could advocate abortion "on their own time" because the government interest in that case was precisely that abortion not be advocated in a particular federally funded program. The government interest in the *Stanford* case was that the public not be misled by preliminary and misleading results obtained from federally sponsored research. That danger is just as great no matter when during the day the researcher talks about those results.

In reality, Judge Greene had flexibility in deciding whether the restriction in *Stanford* would be characterized as a reasonable effort to achieve a valid government aim or as a clumsy, overbroad attempt to extend the hand of government too far. A major factor in his decision to take the latter course was the weight he gave to scientific values and the views of the scientific community. He stressed, for example, that it was troubling to have a "non-scientist contracting officer" tell "Stanford University, a

premier academic institution, engaged in significant scientific and medical research" what constituted "unvalidated findings."[141] He noted that even "in the Soviet Union, where Joseph Stalin at one time decided what could be published and by whom, the dead hand of government control of scientific research and publication is apparently no more."[142]

It would be a mistake to conclude that the government cannot attach any strings to research projects it funds. It can, after all, attach the biggest string of all—it dictates what sort of research the money is to be used for. But the *Stanford* case shows that in this area of constitutional law, as in others, the science community fares rather well indeed.

Thus government funding plays a central role in the constitutional framework that shapes American science. But precisely how funding decisions are made is not resolved by the Constitution. We must turn to the statutory controls on scientific research to understand that crucial question.