CHAPTER ONE

INTRODUCTION

In the final third of the twentieth century, American culture assimilated the possibility of spaceflight and grappled with the question of what goals to seek beyond the Earth. A revolutionary technological social movement had maneuvered the major nations into developing a near-Earth spacefaring capability, but the social conditions required for great further steps seemed absent. Therefore, it is crucial to survey the culture's evaluation of spaceflight, to learn if it understands the practical benefits of the limited space development already achieved and if it imagines a universe of more radical possibilities that a renewed thrust forward might gain.

This book delineates the values spaceflight holds for American culture and identifies more than a hundred specific goals in space that Americans find plausible. Based on approximately 4,000 questionnaires, it reports both the precise words through which our culture discusses space and the statistical correlations that link the specific ideas in the public mind. Beyond the practical benefits that exploitation of near-Earth orbit has given our economy and communications system, it probes for idealistic and long-term goals that have begun to have meaning for members of our society. Utilitarian motives may keep the space program aloft, but there is serious question whether they alone can drive it to new heights of achievement.

Although a growing library of books and articles asserts that deep space will soon return great rewards, there remains great doubt whether the Earth would benefit economically from exploiting space beyond geosynchronous orbit. Were this the

nineteenth century, it might make sense to talk about the value of iron in the asteroids. But in the modern world of synthetic materials it is hard to imagine that any ordinary raw material would be worth bringing back to Earth from elsewhere in the solar system. Even precious gems are routinely synthesized. Occasionally, scarcities force uncomfortable choices, for example the dilemma the United States faces in getting its chromium either from the Soviet Union or from South Africa. But the big problems are plentiful energy, water, and clean air. Spaceflight near the Earth can make major contributions here, but for the solution of terrestrial economic difficulties, Mars does not matter.

Therefore, the conquest of deep space may have to rely upon non-economic motives, even upon irrationalities that may lurk deep within the human spirit. If so, something is wrong with that general theory of human history known as *technological determinism* (Ogburn 1922; L. White 1959). This is the view that technology is the engine of history, that technical inventions produce all other significant developments in society, and that technology is essentially self-generating. I cannot here do justice to this broad perspective, but with respect to spaceflight it might say that interplanetary rockets were bound to develop once the necessary support technologies were in place and enough scientific research had been performed. However, social scientists have demonstrated that societies do not automatically invest in all the technologies potentially available to them, and some very special social mechanism is necessary if the particular development in question does not have rather immediate economic payoffs (Schmookler 1966; Merton 1970; Simon 1971).

An alternative analysis might begin with Thomas Kuhn's model of scientific revolutions (Kuhn 1959, 1962; cf. Gutting 1980). Kuhn had studied the Copernican revolution in astronomy that displaced the Earth from the center of things, and he became convinced that such scientific revolutions were important episodes in intellectual history. In contrast, most scientific work is decidedly unrevolutionary, adding tiny bits of knowledge to already established conceptual frameworks. This Kuhn called *normal science*, work based on prior achievements, follow-

ing a well-established *paradigm*, a tradition of accepted methodological practice and agendas for research. *Scientific revolutions*, in contrast, overturn old paradigms and establish entirely new perspectives and agendas.

Whether Kuhn is right that scientific revolutions are sometimes necessary and normal science alone cannot achieve all possible progress, the distinction surely clarifies some episodes in scientific history and can also be applied to technology. I believe that spaceflight was the result of a radical social movement, seeking the transcendent goals of interplanetary exploration and colonization, rather than of any more mundane process. Before the spaceflight movement demonstrated the practicality of the multi-stage, liquid-fuel rocket, travel into space was an impractical fantasy. Afterward, exploitation of Earth orbit was an integral part of advanced technological culture. But the standard industrial, financial, and governmental institutions did not invest in rocket development to better achieve their conventional tasks; rather, they were manipulated into the investment by the spaceflight movement.

THE ORIGINS OF SPACEFLIGHT

Fifteen years ago I wrote about the radical social movement that achieved the measure of spaceflight so far gained by humans (Bainbridge 1976). In four great nations, tiny spaceflight clubs emerged, stimulated by the wild dreams that had been developed in science fiction and scientific popularizations. The first and most important was the German club, the Society for Space Travel, founded in 1927 (Ley 1969). The American Interplanetary Society was born at the birthday party of a science fiction editor in 1930. The Russian Group for the Study of Reactive Propulsion came next, in 1931, followed by the British Interplanetary Society in 1933. These organizations were small, lonely groups of enthusiasts with no official support from government, corporations, or scientific institutes.

In the early 1930s, as the Society for Space Travel was about to go out of business for lack of money, it was able to convince the

German Army to develop the liquid-fuel rocket as a substitute for long-range artillery. A key factor was that the treaties which ended World War I limited German heavy guns but said nothing about rockets. However, military solid-fuel rockets had long existed, and their potential for improvement was clear. When the German branch of the spaceflight movement forged its alliance with the army, the partnership seemed good for both sides.

There is some historical question who, exactly, was responsible for this marriage (Winter 1983). An army engineering team was sent in search of rocket engineers, and the Society was hunting for a patron. When they found each other, it is hard to apportion responsibility for this success. However, it is clear that the society was an essential ingredient in the development of spaceflight technology in Germany. Had it not conducted many successful test firings of liquid-fuel rocket engines, this technology might not have seemed practical to the military engineers. And the crucial contribution the society made to the subsequent military program was personnel, in the form of Wernher von Braun and several other former members who had been inspired by the society's dreams of spaceflight and learned much from it about the principles of rocket propulsion.

Under von Braun's direction, a growing team of rocket engineers developed a series of projects that advanced spaceflight technology, including the A-4 (V-2) rocket, which was really a prototype spaceship. Employed during the last phase of the war, the V-2 was not a cost-effective weapon. It was far too small to carry a nuclear warhead, and the German nuclear program was fortunately very far behind that of the United States. Although the V-2 could have carried extremely deadly nerve gas, apparently no serious thought was ever given to this possibility, and its standard warhead was a bit less than 1 ton of high explosive.

I have suggested a sociological model of strategic interaction that describes the social process by which spaceflight advanced (Bainbridge 1976). Small groups of men, often dedicated in early adolescence to spaceflight, manipulated political situations to get their pet projects funded. Unable to get anyone to invest in spaceflight for its own sake, they often discovered a potential patron—in this case the German Army—who was locked in

competition with an opponent and not doing very well in the struggle at the moment. The space leader would sell a project to this powerful patron as a partial solution for the patron's problem and use the resources gained to advance the cause of spaceflight. Although the German Army saw a potential in liquid-fuel rockets, as a way of outflanking the allies technologically and getting out from under the restrictions inflicted by its defeat in World War I, it had many choices before it and invested in this particular possibility only because von Braun and other members of the Society made their case effectively.

Walter A. McDougall (1985), argues that the Soviet space program was a natural expression of Marxist technocracy. I suspect it is too early to come to very definite conclusions about the Russian history of spaceflight, because reliable sources are only just becoming available, and we would expect some important parts of the picture to remain obscure for many years. McDougall's analysis of the early spaceflight societies is based entirely on secondary sources; and he is not very careful in using them. For example, he apparently slipped in cribbing from my book, because he got the date wrong for the founding of the American Interplanetary Society, 1926 instead of 1930, perhaps because he skimmed a page of my book rather than reading it closely (McDougall 1985, p. 26; Bainbridge 1976, p. 125).

A crucial empirical claim McDougall makes, apparently supporting his thesis, was that the Russian space club received significant government support and encouragement, even in its earliest days (McDougall 1985, p. 36). In part, McDougall is merely guessing, because primary sources on this phase of Russian space history are not yet available. And in part, he draws upon a clearly propagandistic book by Evgeny Riabchikov (1971) that offers the standard Soviet line of the late 1960s, with little in the way of factual support. Even Riabchikov (1971, p. 105) admits the Russian club "endured some severe hardships," and Michael Stoiko (1970, p. 47) says that "members were known to have been refused ration books because they were accused of being occupied with 'nonsensical fantasies.'"

Western intellectuals have often projected onto the Soviet Union their own fantasies of what a scientifically run society

might be like. While not claiming the Soviet system was superior to the Western democracies and hinting that its technocracy was not necessarily benevolent, McDougall romanticizes Soviet technological history and did not seriously consider alternative interpretations. Had the Soviet Union been a real technocracy and really been evolving into a workers' paradise, I would have thought that substantial effort would have been invested into development of industrial production technology—robots and the like—but Japan and the United States led in this area. As I write, a remarkable year of events has torn apart the Soviet Empire, revealing endless surprises, and the reader will have the benefit of far deeper insight into its essential nature than I possess today, perhaps even gaining access to documents that establish beyond doubt how spaceflight developed behind the Iron Curtain.

Whatever the historical details of this period, a tremendous impetus to the Russian spaceflight movement came from the successful German development of the long-range liquid-fuel rocket. In 1945, the Russians seized the main V-2 development and production facilities, and in 1946 they kidnapped all the rocket engineers they could find in East Germany. Encircled by American airbases, rushing to develop atomic weapons to compete with the American bombs, the Soviet Union sought any means to outflank its enemy (Tokaev 1951). Without the example of the V-2, it would have had little reason to favor long-range rockets over other technologies.

Today, we all recognize the effectiveness of nuclear-tipped intercontinental missiles, but three facts about them should be kept in mind. First, the technically best form of war rockets is the solid-fuel variety, essentially an upgraded version of the gunpowder military rockets introduced in thirteenth-century China, but spaceflight requires the more powerful and controllable liquid-fuel variety that the social movement promoted. Second, a host of other means for delivering lethal warheads could have been developed as adequate substitutes for rockets; for example, the modern winged cruise missile is the descendent of the German buzz bomb, and experiments on robot aircraft were conducted as early as World War I. Third, large liquid-

fuel boosters like Atlas and Titan, big enough to orbit manned capsules and send probes to the planets, were designed when fusion warheads were heavy, before technical developments reduced their weight until they could be hurled by small boosters of no use for space missions.

Thus, there was a crucial period in recent history—call it a launch window if you like astronautical metaphors—during which the application of liquid-fuel technology to long-range nuclear attack could benefit spaceflight. In taking a military detour, the spaceflight movement was racing against other technologies: the battlefield solid-fuel rocket, the cruise missile, and the compact fusion bomb. It won the race because effective individuals like von Braun were able to convince military planners to fund many expensive technical developments necessary for spaceflight and because world politics provided major international competitions that could be exploited.

Spaceflight technology is sufficiently advanced now to serve nonmilitary, utilitarian motives: communications, weather monitoring, and the like. The historical trajectory is like an orbital shot. Spaceflight took off in a tremendous blast of social energy. As it neared orbit, its thrust cut back considerably. Now it coasts, securely established in a parking orbit but lacking the power to take a new course to the planets. Some slow progress is probable, as near-Earth and synchronous orbits are exploited further, but a second great leap forward requires a second spaceflight revolution somehow ignited by the social movement that has always had its eyes on the stars.

This analysis suggests a conceptual distinction—not a logically perfect one, but useful—that can help us understand the results of my survey research. Following Kuhn, we can distinguish *normal* motives for spaceflight from *revolutionary* ones. Normal motives are utilitarian, either economic or military-political. They can be served by Earth-bound technologies; for example, fiber-optic cables present an ever-greater challenge to communication satellites. But because the first phase of the spaceflight revolution was successful, space systems are viable competitors with terrestrial systems.

Revolutionary motives demand a change in major aspects of

culture, society, or technology. They are the favorite goals of transcendent social movements, and they need not be related to space development. But if the spaceflight movement can connect many of them to grand new projects in the heavens, it could achieve another quantum leap. Often, revolutionary motives dissipate themselves in expressive frenzies, symbolic crusades, and supernatural revivals. But occasionally, like the Christian missionary spirit that assisted pure economic greed in opening parts of the New World, they can shape history.

In examining the values Americans find in the space program, we should distinguish the normal from the revolutionary goals. The former provide that basis of popular support required to maintain funding for a space program dedicated to serving conventional needs. And, therefore, the normal goals must receive high levels of acceptance to be effective targets of funding. In the past, revolutionary goals energized space development through a small, almost fanatical spaceflight social movement. Therefore, such motives need not become extremely popular to have a powerful effect, when amplified by unusual social conditions. To be sure, the more popular they are the wider their influence and the greater the chance they will play important roles in a future cultural transformation. But at the present, it is merely important that the more revolutionary goals are attractive to at least some people who might become influential, as individuals or groups.

Having established basic concepts, we can now begin our analysis of fresh data. Much of this book will focus on surveys I did at Harvard University, delineating the values of spaceflight as conceptualized by young members of the elite who have given the topic considerable thought. However, an essential preliminary step is to examine the views of average citizens, reflected in surveys limited in scope but administered to random samples.

STANDARD OPINION POLLS OF THE NATION

When national polls include a question or two about the space program, their aim is simply to document the level of

support or weigh opinions on some current issue. Thus, their data offer few insights about the meaning spaceflight has for our civilization or the specific goals in space that ought to be achieved. However, a little can be learned from analysis of the levels of support offered by different groups in society, and the information to be gained is an essential basis for understanding the data from polls administered to specially selected sets of respondents.

In July 1944, the Gallup Poll included a pair of questions based on first reports about the German V-2 rocket program headed by Wernher von Braun: "A Swedish newspaperman says the Germans are now building robot bombs which can hit cities on our East Coast. Do you believe this is true?" "Do you think that in another twenty-five years such flying bombs will be able to cross the Atlantic Ocean?" Only 20 percent said yes to the first question, but 70 percent said yes to the second. The American public revealed good instincts in this poll, because in fact the Germans had only the most preliminary plans for rockets to fly farther than the 300-kilometer maximum range of the V-2, but twenty-five years later intercontinental rockets had long since achieved trans-Atlantic distances. The Gallup questions were not phrased in terms of rockets, and no connection with spaceflight was suggested, but the results indicate the wartime public saw aerospace technology developing rapidly (Gallup 1972, p. 456).

Less national prescience was revealed by a poll at the end of 1949. Although 63 percent felt trains and planes would be run by atomic power within fifty years and 88 percent predicted a cancer cure by the same time, only 15 percent felt, "men in rockets will be able to reach the moon within the next fifty years." The first moon landing came in only twenty years, rather than fifty, and at the forty-year mark nuclear trains and planes seem absurd and a general cancer cure remains remote (Gallup 1972, p. 875). By 1955, the percent feeling the moon could be reached in fifty years had risen to 38 (Gallup 1972, p. 1306). At that point, the first Earth satellite was only two years away.

Two weeks after Sputnik I, the Gallup Poll asked respondents in several cities around the world, "All things considered,

do you think the earth satellite is more likely to be used for good purposes or for bad purposes?" Of the Americans polled in Washington and Chicago, 61 percent said good purposes, with 16 percent saying bad and 23 percent holding no opinion. In contrast, only 17 percent of respondents in Oslo, Norway, said good reasons, with 39 percent saying bad (Gallup 1972, p. 1519). Most of the post-Sputnik polls concerned the competition between the United States and Soviet Union, a topic we shall examine again in Chapter 6.

By July 1969, when men were actually landing on the moon, Gallup asked about the next goal: "There has been much discussion about attempting to land a man on the planet Mars. How would you feel about such an attempt—would you favor or oppose the United States setting aside money for such a project?" Thirty-nine percent favored the idea, with 53 percent opposed and 8 percent holding no opinion (Gallup 1972, p. 2209). These figures do not quite square with answers to a question in another poll that year: "The U.S. is now spending many billions of dollars on space research. Do you think we should increase these funds, keep them the same, or reduce these funds?" Only 14 percent wanted funding increased, whereas 40 percent wanted it reduced (Gallup Opion Index 1969). Apparently, many people wanted Mars without paying for it.

In 1973, a scientifically designed national poll, the General Social Survey, first asked a question on space funding, and this item has been included whenever the poll was given, usually every year (Davis and Smith 1986). Thus the GSS offers the opportunity to chart trends in the level of space support, and the many other items in the survey allow one to identify the segments of the public showing the greatest enthusiasm for spaceflight. The GSS space item is one of a set of eleven "problems" or "government programs," and the respondent is supposed to say whether too little, too much, or about the right amount is being spent on each: space exploration; improving and protecting the environment; improving and protecting the nation's health; solving the problems of the big cities; halting the rising crime rate; dealing with drug addiction; improving the nation's education system; improving conditions for Blacks;

the military, armaments, and defense; foreign aid, and welfare.

One of the most consistent findings of such polls is that men give far greater support than women. In 1985, immediately before the Challenger disaster, 15 percent of men felt too little was being spent on the space program, compared with just 7.4 percent of women. And 32.9 percent of men felt too much was being spent, versus 48.9 of women. That is, more than twice as great a proportion of men want funding increased, and women are more apt to want funding reduced.

The fact that there is a great gender difference in support for the space program tells us little about what spaceflight means to our culture. To label spaceflight *masculine* reveals nothing. We must ask which aspects of the differences between men and women—their upbringing, typical social roles, career expectations, modal personality constellations, value systems—are salient for spaceflight. Shortly we shall see that pro-space attitudes are held by the young and educated. Because they live longer, women respondents are slightly older than men, on average. Because equal educational opportunities are a recent phenomenon, fewer women have completed higher degrees.

Men may more often have technical careers, those that draw upon the same sciences and varieties of engineering that create spacecraft. Men more often enter the military and have positive attitudes toward it, a fact that is salient for the space program to the extent that people see it in military terms. Probably, all of these factors contribute, and others besides. I shall leave the job of conclusively explaining the gender differences through sophisticated statistical analysis for another time, because we have a different purpose here. When we examine the various aspects of spaceflight, as conceptualized by our culture, we shall occasionally look at gender differences. But the prime focus must always be on the reasons why people might support space, and the differential reactions to them of subgroups in the population are of secondary importance.

The gender difference holds for young people, as a 1980 national poll of teenagers showed (Gallup 1981). Sixty percent of boys felt the space program was a good investment, and 36 percent thought the money could be better spent on other prob-

lems. But a majority of the girls, 51 percent, favored switching the funds to other problems, and only 44 percent said the investment in space was good.

Despite the consistency of the gender differences across age groups, age is an important variable. The 1969 Gallup poll about an expedition to Mars found that 54 percent of respondents under age thirty were in favor, compared with 40 percent of those thirty to forty-nine and 28 percent of those over fifty.

To belabor the obvious, age is the result of two other variables: when people were born and when they were polled. And these two components of age are sociologically quite distinct. Do the young support space because they were born in more modern times than the old? If so, this is called a *cohort effect*, a characteristic of a group of people born about the same time (an "age cohort") because of the experience of growing up in their particular period. Or do the young support space because of youthful exuberance that will fade as they age? This is called a *maturational effect*, a difference between age groups caused by changes that affect each age cohort as it goes through the life cycle. We can put this in terms of predictions about the overall level of support shown by the entire society. As the years pass, will support for space grow as more and more people are born into the space age, replacing less enthusiastic people born before it? Or will support stay about the same, because an individual's enthusiasm fades with increasing age?

It is possible to explore this set of questions with the GSS data, because the surveys cover the span of a dozen years, a substantial fraction of a lifetime. We can look at how an age group's opinions change over time, to see whether a maturational effect makes older people give up former enthusiasm for novel projects like spaceflight. Table 1.1 does this, contrasting three age cohorts. People who were eighteen to twenty-nine in 1973 were polled at that time, and 10.2 percent of them wanted space funding increased. The same age cohort, all now a dozen years older, was polled again in 1985, and then 13.4 percent wanted funding increased. So, even though the group had aged, their level of support actually increased. (Note that the two polls did not survey exactly the same individuals, which

would be the ideal procedure for research on changes over time, but the effect is almost the same.)

Table 1.1. Change in Support for the Space Program by Age Cohort

	Percent wanting funds for the space program increased	
Age in 1973	*1973*	*1985*
18–29	10.2	13.4
30–49	8.5	11.5
50–69	4.5	3.9

Similarly, the level of support for the space program increased for the group age thirty to forty-nine in 1973. Originally, 8.5 percent felt too little was being spent on space, and a dozen years later the proportion had risen to 11.5 percent. Clearly, neither of the two younger age groups lost enthusiasm for spaceflight, as would have been the case if a maturation effect were primarily responsible for the differences between age groups. The oldest group, those aged fifty to sixty-nine in 1973, shows a slight erosion of support, a drop from 4.5 percent to 3.9 percent. This could be the result of accidental fluctuations. Only 447 people were in this group in 1973, and the difference of 0.6 percentage points represents only 3 people. So, the old people hold steady at their low level of support, while the relatively high level of support of younger people actually increases.

Table 1.1 indicates the support given to spaceflight by the young is indeed a good omen, projecting a steady increase as new generations are born into the space age. The relevance for the meaning of spaceflight is simply that space is an aspect of modernity. As more and more people become true citizens of the modern world, socialized to the norms and values of advanced technical society, the support for spaceflight will grow.

National polls are not a perfect reflection of the strength of support spaceflight enjoys in the society, because decisions about space policy are not made by a random sample of the population. I shall not here enter into the acrimonious debate

over the extent to which America is run by a "power elite" having only its own interests at heart, but clearly many segments of society have negligible influence, and those who have power are apt to have a different balance of views about the space program than those who do not. For example, voters are more positive than nonvoters. The 1985 General Social Survey asked respondents whether they had voted in the 1984 election, and an increase in space funding was approved by 11.7 percent of those who said they had, compared with 8.2 percent of those who had not, a ratio of 1.4 to 1.

Members of the upper social classes, those who presumably have more than their equal share of influence, tend to give more support to the space program than members of lower social classes. In 1985, 15.7 percent of those with incomes over $25,000 wanted space funding increased, compared with only 5.8 percent of those with incomes under $10,000. A very solid majority of the more affluent class wanted funding either increased or kept the same, 68.0 percent, whereas a majority of 54.2 percent of the poorer group wanted funding reduced.

We do not have data that would tell us conclusively which differences between the social classes are most responsible for the different attitudes toward the space program, but informed guesses are in order. The poorer groups may want government money spent on their own pressing needs, whereas the richer groups may feel that an economic surplus can be invested in future-oriented programs. The prosperous classes may identify more strongly with business and industry, appreciating the ways the space program can serve their interests. But more relevant for our study of conceptions of spaceflight, the upper social classes are better educated, on average, and thus both better informed about the space program and more fully committed to the intellectual gains it offers.

The social class difference begins early. The 1980 Gallup poll of teenagers found that parents' social class was a good predictor of young people's support for the space program. Although 58 percent of those from a white-collar background felt it was a good investment, only 48 percent of those from a blue-collar background agreed. Of those whose parents had attended col-

lege, 61 percent felt it was a good investment, compared with 48 percent of those whose parents had not. Interestingly, the students' own academic standing did not seem to matter, 53 percent of those above average and 52 percent of those average or below saying the investments in the space program were well spent.

In 1969, when Gallup sought people's opinions about a Mars expedition, 52 percent of respondents who had attended college were in favor, but only 39 percent of high school graduates, and 25 percent of those with less education. Table 1.2 shows levels of support by education, using the GSS data. In both 1973 and 1985, an absolute majority of those with little education wanted space funding reduced. Although the percent calling for an increase among those who had attended college increased only a little from 1973 to 1985, from 14.3 percent to 17.0 percent, the proportion wanting appropriations reduced shrank almost by half. Thus, for educated people, the value of the space program had been solidly established.

Table 1.2. Education and Support for the Space Program

Those feeling funds for the space exploration program are . . .	*1973 national poll*			*1985 national poll*		
	Some College	*High School*	*Little Education*	*Some College*	*High School*	*Little Education*
too little	14.3%	9.2%	2.5%	17.0%	12.1%	3.4%
about right	44.7%	36.2%	27.9%	60.5%	46.7%	38.6%
too much	41.0%	54.7%	69.6%	22.5%	41.2%	58.0%
Total	100%	100%	100%	100%	100%	100%
Respondents	217	719	552	324	792	412

We can compare these respondents with college students sampled in one of my own surveys. In 1981 I polled 1,465 University of Washington undergraduates. Although the sample was not strictly random, the research replicated results of surveys others had done with random samples, and the large number of items and respondents allowed me to determine that sampling bias was minimal. There was no General Social

Survey in 1981, but we can interpolate between the 1980 and 1982 polls. Support for the space program was at a high level in those years, 15.2 percent wanting appropriations increased. but the young college students were far more enthusiastic, 30.2 percent said that current funding was too little. Although 39.6 percent of the GSS respondents wanted space funding reduced, only 14.8 percent of the college students held this negative opinion. The greatest support came from the college men, 45.1 percent wanting funding increased, and only 8.6 percent, decreased.

A final question from the 1973 General Social Survey can help us understand the popular meaning of the space program, an item unfortunately not included in 1985. Respondents were supposed to say how much confidence they had in science: a great deal, only some, or hardly any. Whereas 11.6 percent of those with a great deal of confidence in science felt space appropriations were too little, only 2.1 percent of those with hardly any confidence in science felt this way. Indeed, 77.3 percent of these critics of science wanted funding reduced.

Much space science can be done without direct human participation. Indeed, a major policy issue of the 1970s and 1980s, which caused great ill feeling between various segments of the spaceflight movement, was the proper emphasis on manned spaceflight versus unmanned probes. The massive funding for the space shuttle came partly at the expense of planetary probes and other robot scientific missions. The public, of course, may not conceptualize the alternatives this way, and no election ever presented voters with the choice. A few national polls have explored the issue, although not in ways that revealed much.

Right after the Challenger disaster, *Newsweek* magazine commissioned the Gallup organization to poll 533 persons reached by telephone (Foley 1986). The most poorly phrased item was, "Do you think that putting civilians into space is important—or is it too dangerous?" Fifty-five percent said "important," 40 percent said "too dangerous," and 5 percent did not know. The meaning of the word *civilian* is quite ambiguous in this context, meaning either nonastronaut or nonmilitary, and important

and dangerous are not logical opposites. Better stated was: "Some people say the United States should concentrate on unmanned missions like the Voyager probe. Others say it is important to maintain a manned space program, as well. Which comes closer to your view?" Although 21 percent wanted a completely unmanned program, 67 percent wanted manned as well. But respondents were not asked why they wanted a manned space program, and items like this are more tantalizing than satisfying, if we want to understand the popular ideology of spaceflight in any depth.

ADVANCED SURVEYS ON SPACE GOALS

To go beyond the limited findings of the national polls, research needs to employ more complex questionnaire items or extensive batteries of items measuring respondents' views on detailed aspects of the space program. Of necessity, this means abandoning expensive and uninformed random samples of the general population. For example, in 1963, Donald A. Strickland polled 211 physicists, asking them what they thought were the underlying motives of the American space program. They ranked international competition far ahead of other goals, 32 percent placing propaganda and prestige first, and 14 percent said that military motives predominated. Five percent each ranked exploration, basic research in natural sciences, or domestic political motives first, 4 percent placed economic motives first, and the remaining 35 percent wrote in another reply or failed to answer. Here the physicists were being asked to judge the goals societal leaders had chosen for the space program, rather than to set their own objectives, although their collective impression of political realities may not be far from the mark.

The most extensive early survey of space goals was a questionnaire administered by Raymond A. Bauer (1960) to 1,717 readers of the *Harvard Business Review,* most of them holding management positions. The response rate was about 31.5 percent, and like the Harvard student surveys I shall introduce shortly, pro-space people may have been more likely than oth-

ers to respond. Therefore the data are better for exploring the early space goals of American business culture than for determining exactly the level of support given the space program by those in business. Eighty-five percent agreed that "outer space is the new frontier. Research and exploration will have profound and revolutionary effects on our economic growth." And 89 percent agreed that "mankind wants to go into outer space because it is there.... We are drawn by our desire to know and conquer anew." But only 9 percent agreed that a manned space program was unnecessary because robot machines could do the job required.

In response to a series of questions about the possible payoffs of the space program, 69 percent believed that revolutionary improvements in communications were almost certain to happen. Majorities were convinced that significant benefits were bound to come in the fields of medicine, biology, meteorology, robotics, mathematics, and physics. In contrast, only 4 percent felt that mining of other planets was almost certain to happen, and just 3 percent had the same confidence about colonizing other planets.

One set of items asked respondents to rank five possible objectives, reflecting the general reasons for supporting the space program Bauer was able to identify. Table 1.3 reveals that "pure science research and gaining of knowledge" was most often placed first, with a substantial number rating "control of outer space for military and political reasons" highest. Three years after Bauer's survey, Furash (1963) repeated the research with about 3,300 readers of the *Harvard Business Review*, and the same set of items was included in my 1986 survey of Harvard students, so I have included the distributions from these surveys as well. The Harvard students overwhelmingly rejected international competition as a goal in 1986, but gave about the same lukewarm response as did businessmen a generation earlier to the idealistic and emotional objective, "meeting the challenge and adventure of new horizons." In contrast, they rated scientific and economic payoffs much higher.

In 1977, I administered a survey to 225 registered voters who lived in Seattle, Washington, a study described in detail in the

next chapter. One set of questions sought attitudes on the general goals of the space program, and they were introduced as follows: "Many reasons have been given for supporting the space program. Below are seven words describing different kinds of reasons. How good a justification is each one? Which are important reasons for continuing the space program? Please check the box after each one that indicates how important you feel it is."

Table 1.3. Rankings of Five Possible Objectives for the Space Program

	Percent rating the objective highest		
	Harvard Business Review		*Harvard Students*
	1960	*1963*	*1986*
Pure science research and gaining of knowledge	47	43	55.4
Control of outer space for military and political reasons	31	31	4.1
Tangible economic payoffs and research results for everyday life on Earth	14	18	30.5
Meeting the challenge and adventure of new horizons	8	8	9.2
Winning the prestige race with the Soviet Union	3	5	0.8

Majorities rated scientific and technological justifications as very important, 68.0 percent and 63.6 percent, respectively. Less than a third of respondents rated the others very important: economic (28.3 percent), social (15.7 percent), political (15.0 percent), psychological (12.6 percent), and religious (4.6 percent). Further, the scientific and technological values correlated highly ($r = 0.62$), indicating that respondents considered them to be very closely connected. Social reasons were connected about equally strongly with economic and psychological ones, achiev-

ing coefficients of 0.50 and 0.55. Thus, the data suggest that plausible justifications can be crudely divided into two groups, the very popular scientific-technological goals of spaceflight, and those with economic, social, and psychological implications.

The Seattle voter survey was but one of an entire series of such projects, spanning more than a dozen years, listed in Table 1.4. To identify each survey efficiently, in the pages that follow I use abbreviations like S1977. The *S* stands for "survey," and the numbers are the year it was administered. So S1977 is the space survey I did in 1977, which happens to be the study of 225 Seattle voters. When more than one was administered in a given year, I add *A* or *B*. S1986A and S1986B are the main surveys administered to Harvard students in the spring and fall of 1986.

Table 1.4. The Series of Space Goal Surveys

Survey	*Respondents*
S1973A	74 members of the New England Science Fiction Association
S1973B	80 participants in a Committee for the Future convention
S1974	102 members of the American Institute of Aeronautics and Astronautics
S1977	225 voters in Seattle, Washington
S1981	1,465 students at the University of Washington
S1983	212 Harvard University students
S1986A	1,007 Harvard University students
S1986B	894 Harvard University students

Social scientists have long recognized that little can be accomplished with the single questions about a public issue often incorporated in national polls. For example, sociologists of religion know that religiousness is a multidimensional phenomenon, and the survey researcher must use a complex battery of questions to measure its variations at all accurately (Glock and Stark 1965; Stark and Glock 1968). As Bauer (1969, p. 91) said about the success of his own questionnaire research on space attitudes, "the multidimensional approach is contrary to the established tradition of journalistic opinion polling, which has dominated our thinking on the sources of support for public programs. For reasons of economy, effort, ease of asking ques-