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There is no need to labor the point that technological change is one of the most pervasive characteristics of the modern world. Since the Industrial Revolution, technological development has been one of the most important stimuli to continual, rapid changes in social, economic, and political patterns and personal experience. During the past thirty years, governmental support of technical and scientific development has grown enormously, and the nation has witnessed the emergence of massively complex organizations bent on technological accomplishments which have touched the lives of virtually everyone. The results have been mixed. Truly heroic achievements have been won, the direct impacts of which have been astonishing; yet as the magnitude of technology's long-term effects is recognized there grows an increasing uneasiness about the social, political, and environmental consequences of unbridled development. A small but growing literature has emerged voicing this concern about tendencies to accept new technologies simply because they are possible.[1] Recently, a number of technological programs have become political issues, debated in the Congressional arena and thrust upon state legislatures and city halls. Environmental issues need no elaboration here, nor do the familiar national controversies over the SST and ABM. Other examples include the sustained debates concerning further manned exploration of space, the approaching limitation of energy production and use, the development of urban mass transit systems, and the earlier furious local controversies attending the addition of fluorides to public water supplies for the sake of fewer cavities.

It seems clear that these and other instances have had a cumulative effect on the character and amount of information flooding the public at large. It has witnessed an accelerating attention given to such matters by the press; editorial positions are frequently taken either in favor of or in opposition to one or the other schemes for technological implementation. The public, moreover, is being asked to make choices, through the electoral process, which have a relatively high technology-specific content. In California, the recent omnibus Environmental Proposition 9 is an excellent example of a popular attempt, through the initiative option, to compel in the name of environmental protection very stringent limitations on technological development.[2]

The people of this country have been continually exposed to change born of technological innovation. They are subjected to massive amounts of information about technologies. They are often asked to support present and/or future technological efforts both with their passive acquiescence and with their resources. Thus, technological developments are factors in long term social change and a source of political demand. The effects of these technology-stimulated changes on the public mind are scantly known, though many advocates claim such knowledge. The manner of public response to the demand for decisions about governmental technological programs is equally unknown, though many groups seek involvement in that process in the name of the public interest. For such an important influence upon the public, we know almost nothing about its attitudes toward this most characteristic aspect of our age, technological advance.[3]

A Study of Public Attitudes: Objectives and Process

Our recent research,[4] a portion of which is reported here, employed a statewide public opinion survey to fill in some of the gaps in our knowledge of how the public regards technology. This sample of Californians' opinions can provide at least a partial base-line for further study of the effects of technological development upon social and political change. A record of changes in perceptions of technologies could over time enable a more thorough examination of the character of shifts in public values and in social and political attitudes associated with various types of technological development. Also, policy considerations could be informed by such data. The public is directly petitioned for political support by promoters or antagonists of various technical enterprises; certainly public support is necessary if resources are to be obtained either for commitments to new technical ventures or for the repair of damage wrought by past ones. What is the level of support in the general population at present for various technical programs? How nearly do the values argued by the many groups seeking to "represent" the public in the decision making processes which formulate governmental policies on technical development converge with those which the public actually holds?

The survey instrument developed for our study sought opinions about a wide range of technology-related topics: the importance of technology as a feature of social change; twelve specific technological capacities; criteria for technology assessment and control; technology's effect on the quality of life; and degrees of technology-related social activism. Data was also gathered on demographic, social, and political characteristics of the respondents. Pre-tests of the interview schedule were conducted in northern California during June, 1972, by the Field Research Corporation, which completed the survey during early July. A total of 980 California residents from a random sample of all adult California residents was interviewed. Demographic and political characteristics of this sample correspond closely to those of the nation as a whole.[5]

A qualification is necessary before moving to our preliminary results. This is a study of the mass public, not of any elite minority within the population. Therefore, no inferences should be drawn from it about the nature of elite attitudes or demands. Nor does the study attempt to discern beliefs about specific modes of implementation for various technological systems. Its scope is limited to attempting to answer the general question of why some technologies find support among the general public and some do not and whether different sectors of the populace hold different attitudes about technology-related issues.

In particular, we shall present the overall profile of attitudes concerning (1) existing technologies as an aspect of social change and their salutary or unwholesome influence; (2) a number of proposed new or improved technologies;

(3) validity of criteria for technology-related decision making; and (4) the groups which influence such decisions compared with those who should influence them.

Perceptions of Technology and Social Change

Those who think and write about the relationship between technology and society hold in common the belief that technical developments are central to many of the social and political changes evident over the past half-century. But to what degree does the general public share this assumption? In the survey reported on here, respondents were asked an open-ended question about their perceptions of major changes in society since 1945, specifically, "What are some of the things that have changed the most in the life of the average citizen of this country -- things such as social and political movements, our way of life, science and technology, or developments in business and industry?" Almost everyone questioned cited at least one change, 18 percent noted one, 42 percent two, and 35 percent three or more. Respondents mentioned in all forty kinds of changes, ranging from the deterioration of the environment and increased leisure time to space exploration and the increased cost of living. Nearly one-quarter of all the changes cited had to do with technology or science. More significantly, almost half of the people questioned named at least one technological change; over 10 percent mentioned two or more.

Some of the changes mentioned by respondents duplicated others. For ease of presentation, we have combined them into the twenty-five types of change organized according to four categories listed in Table 1.[6]

TABLE 1

Important Changes in Society Since 1945

	I. Social Changes	
1.	Changes in life style generally and among the young	21.7%
2.	Improvements in education, interpersonal relations, leisure time	10.5
3.	Life less settled; more pressures	8.9
4.	Breakdown in education, family life and interpersonal relations	11.2
5.	Change and decline in moral standards, more cirme	19.3
6.	Population explosion and environmental deterioration	4.7
		76.3%
	II. Political Changes	
1.	General social and political change	5.7%
2.	More radical politics	4.9
3.	Increased political involvement	8.3
4.	Increased governmental control	4.2
5.	Politics dirtier, less trustworthy	4.3
6.	Improved race relations	4.8
7.	More liberal court and prison systems	5.0
		37.2%
	III. Economic Changes	
1.	Improved standard of living, more employment	15.1%
2.	Increased cost of living, fewer jobs	23.4
3.	Increased taxes	7.2
4.	Growth of large business enterprises	3.8
		49.6%
	IV. Technological Changes	
1.	Science and Technology generally	14.9%
2.	Increased industrialization and mechanization	9.2
3.	New products and inventions	5.4
4.	Medical advances	9.2
5.	Space Program	10.0
6.	Advances in T.V. and communications	6.7
7.	Advances in transportation	8.3
8.	Increased pollution	4.1
		67.8%

In overall emphasis, technological changes challenge various social changes for most frequent mention, with economic and political changes drawing less attention than either. Many of the responses listed in Table 1 are to be expected; changes in life style and in moral standards, increase in the cost of living, and changes in various political customs are things which people experience first hand. Also, technological advance appears to be quite directly experienced by many people. Changes linked to science and technology in general and to increased industrialization combine for 24 percent of the total responses. It is noteworthy that a number of specific technologies elicited special comment: the space program, medicine, transportation, and communications including television. While not a definitive measure, the degree to which science/technology is associated, in this more or less spontaneous manner, with important social changes reflects its relative centrality in the minds of our sample.

Given these findings, to what extent are certain life conditions associated with respondents' greater awareness of one set of major changes over another? As one would expect, demographic and political characteristics do differentiate those among the sample who perceived some types of change from those who did not perceive them. The more highly educated tended to see changes in terms of a freer, more open, society; those with less education saw changes in terms of the problems with the younger generation and of the rising cost of living. Level of income does not appear to be a particularly good systematic indicator of awareness of any special types of change. The most recurrent demographic characteristic distinguishing perceptions of change was race. Whites noted the increased standard of living and a decline in moral standards more frequently than non-whites. Non-whites were much more inclined than their fellow white citizens to cite increased political participation, increased crime and drug abuse, increased cost of living and higher taxes.

Political orientation is associated with some differences in perceptions of change. Democrats were twelve times more likely than Republicans to view the deterioration of the environment as a major change. Respondents who identified themselves as "strongly liberal" were much more likely than those describing themselves as "strongly conservative" to mention changes in life style and improvements in education. Conversely, strong conservatives were five times as likely as strong liberals to perceive changes in moral standards.[7]

These associations may be due to the various effects which those changes -- the rise in crime, the increased cost of living, higher taxes, and greater political participation -- have had on minority groups, the poor, and the young. These groups tend to identify differentially with particular political parties or political beliefs.[8] It may follow, then, that perceptions of those changes by various groups would correlate with traditional socio-economic characteristics.

None of the demographic variables, however, relates systematically to those mentioning changes in the science/technology category or to those who did not. Technology, as yet, has not been presented to the public as affecting any particular groups diferentially. Moreover, no clear cut differences separate the parties on science/technology policy at the present time. Thus, it is not remarkable that the public's perceptions of technological change do not relate to particular socio-economic characteristics.[9] Our analysis suggests that the public as a whole perceives technological change in much the same way. But this is not to say that the benefits of technological advance necessarily have been delivered equitably to the public nor that the implicit promises of our statesmen of science about technology have been realized. We turn now to a consideration of the extent to which the public perceives those promises to have been fulfilled.

One series of questions used in our survey dealt with the perceptions of benefits of several actual technological developments. Respondents were asked to indicate "how much of a change for the better or worse in life in general" each of five different technological developments has made. These five were household appliances, automotive vehicles, automated factories, atomic weapons, and the space program. These were selected as representative of a large range of presently employed technologies that are highly visible, widely implemented, and familiar to the public. The data presented in Table 2 shows considerable variance of opinion about these technologies.

TABLE 2

ATTITUDES ON THE SOCIETAL EFFECTS OF FIVE TECHNOLOGIES

	Very Much to Slightly Worse	In Between	Slightly to Very Much Better	N=
Appliances	3.5%	3.4%	93.2%	(974)
Automobiles	15.9	11.4	72.9	(974)
Automation	19.2	17.7	64.2	(969)
Space Program	19.6	19.6	60.8	(966)
Atomic Bomb	45.7	5.4	48.9	(972)

An index developed by aggregating these responses across the five technologies is likely to reflect reasonably accurately the positive or negative evaluations held about presently employed technology. See Figure 1.

FIGURE 1

TECHNOLOGIES MAKE LIFE BETTER OR WORSE

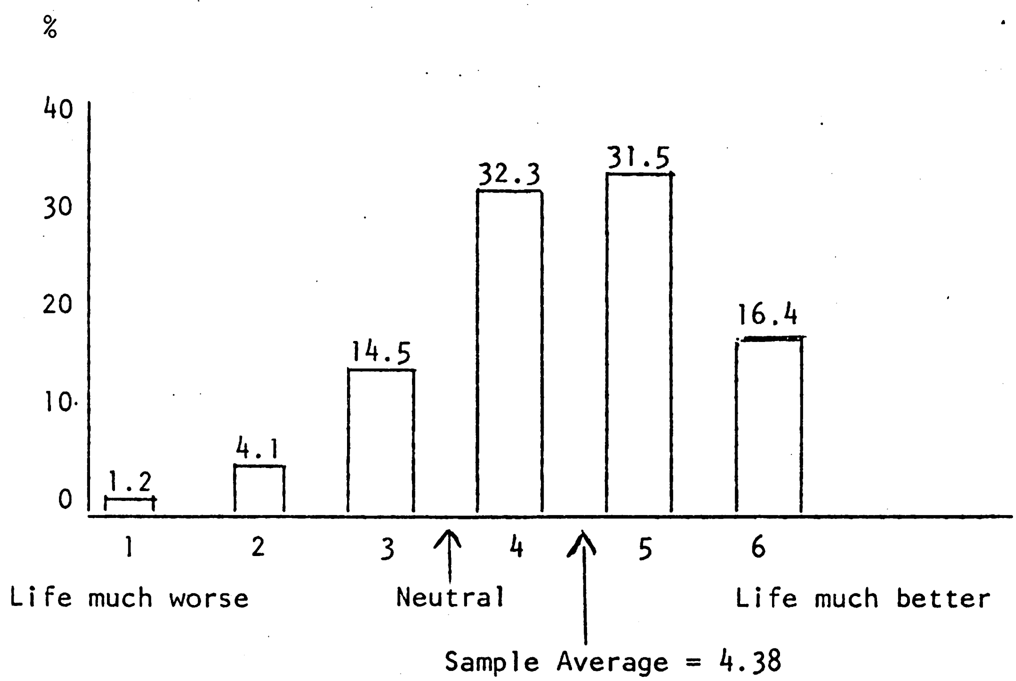


Figure 1 presents the distribution of indexed responses, which is clearly skewed toward the evaluation of technology as making life better. But while the sample is predominantly favorable toward existing technologies, a substantial minority believes them to have eroded the quality of life. When this body of data is analyzed in terms of demographic and political characteristics, some interesting differences emerge suggesting that the vision of technological equity is somewhat dim. While occupation, education, sex, and race do not seem to be associated with differing perceptions of technology's benefits, income does (see Table 3). There are steady and significant differences from high to low income: in general, the higher one's income, the more likely his perception of technology as enhancing the quality of life. Notably, over a quarter of the poor believed otherwise.

TABLE 3

INDEX OF EVALUATIONS OF TECHNOLOGY BY INCOME

	Life Made Worse	Life Made Better	N=
Under $3,000	29.8	71.2	(99)
$3,000-4,999	26.1	73.9	(95)
$5,000-6,999	19.3	80.7	(113)
$7,000-9,999	23.4	76.6	(171)
$10,000-14,999	15.1	84.9	(257)
$15,000-19,999	15.6	84.4	(104)
$20,000+	13.1	86.9	(71)

$F\ (6,\ 910) = 6.141;\ p > 0.001$

Political orientation seems to make a difference also. Table 4 suggests that there is a minority of strongly liberal citizens, who are likely to be Democrats and to have voted for McGovern in the California primary, who question the overall benefit of these technological developments. Although the data does indicate that the population as a whole gives these technologies high marks for improving the quality of life, the number of dissenters nevertheless is surprising in a society which has been so very dependent upon technological developments for its growth and power. It seems apparent that the poor and the politically liberal have not yet coalesced around technology as a political issue. However, the data thus far suggests that some of the conditions which have classically been the grounding for political controversy are present here. There are glimmerings of evidence that one's experience of technology's gifts depends upon one's social class and, apparently, that those with opposed political beliefs also evaluate a bit differently the contributions of technology. We need now to ask what elements will influence people's evaluations not of presently implemented technologies but of potential technological capabilities.

TABLE 4

TECHNOLOGICAL EVALUATIONS BY SELF-IDENTIFIED IDEOLOGY, PARTY IDENTIFICATION AND PRIMARY VOTE

	Life Made Worse	Life Made Better	N=
A. Political Ideology			
Strong Conservative	13.9	86.1	(98)
Mild Conservative	14.6	85.4	(307)
Middle-of-the-road	24.3	75.7	(156)
Mild Liberal	19.1	80.9	(245)
Strong Liberal	40.4	59.9	(88)
	$F (4,895) = 13.7; p > 0.001$		
B. Party			
Democrats	24.4	75.6	(522)
Republicans	10.2	89.8	(305)
	$F (1,825) = 29.0; p > 0.001$		
C. Choice in Democratic Primary			
McGovern	30.8	69.2	(170)
Wallace	18.4	81.6	(22)
Humphrey	12.1	87.9	(103)
	$F (2,296) = 13.38; p > 0.001$		

Perceptions of Future Technologies

A great welter of technological possibilities presently confronts our citizens. Some capacities, such as improvements in cable television and new designs in freeway construction, convey a high degree of personal immediacy to people. Others, such as genetic engineering and organ transplants, seem to them remote in impact and uncertain as to effect.

Since the social meaning of a technology resides not in its machines and systems as such but in the new or improved capacity it makes available to people, the questions about new technologies used in the survey focus directly on those capacities, on what it is that the technology is designed to do. The significance of an urban rail transit system is not its automated trains, but the fact that it can transport large numbers of people quickly from one part of a metropolitan area to another. Similarly, that of nuclear generating plants is that they produce electricity to be used by people. Each of twelve specific potential technological capabilities was described to respondents in terms of its promised functional capacity (see Figure II for the exact phrasing). Each capability was selected to represent a particular type of technological development -- transport, energy collection or conveyance, biomedical innovation, communications/information, national defense, and technologies which enhance national prestige -- and to provide a range from the reasonably familiar to the relatively esoteric.

This portion of the data analysis primarily concerns the degree to which there was support for or opposition to these particular technologies, and, in general, some inferences about factors which might account for these positions. It seemed reasonable to suppose that evaluation of these emerging technologies would be a function of the perception of their possible benefits and costs as well as of opinion about their potential impact. In addition, it was supposed that feelings about presently implemented technologies influence to some degree attitudes about potential future ones.

FIGURE II

TWELVE TECHNOLOGICAL CAPACITIES

Transport

1. High speed trains or monorails covering metropolitan areas to transport large numbers of people quickly from one part of the area to another. (Urban Rails)

2. Passenger airplanes that travel at high speeds and which can also land and take-off in very short spaces so that they can transport people closer to the places they want to go. (STOL)

Energy

3. Power plants that use atomic energy to produce electricity. (Nuclear Power)

4. Power produced from satellites orbiting the earth which collect energy from the Sun and send it back to Earth where it is converted into electrical power. (Solar Energy)

Biological Discovery

5. Surgical procedures to transplant different body organs from one human being to another so that people's diseased or injured organs could be replaced. (Organ Transplants)

6. Altering people's inherited genes to change certain of their characteristics which they will pass on to their children so that the mental and physical capabilities of future generations can be improved. (Genetic engineering)

7. Altering brain responses with special drugs so that the behavior of people who have mental disorders can be improved or controlled. (Brain Drugs)

Information/Communication

8. An expanded number of television channels carried into the home by cable so that in addition to regular TV shows from networks, more programs for special interest groups could be made available. (Cable TV)

9. Storing large masses of information about the characteristics and behavior of the public on computers so that government and business administrators can quickly get up-to-date, factual information on which to base their decisions. (Data Banks)

National Defense

10. Missiles which can intercept and destroy enemy rockets launched against this country before they get near enough to cause serious damage. (ABM)

National Prestige

11. Large passenger airplanes travelling at very high speeds (several times the speed of sound) to transport people across the country or to other parts of the world in a few hours. (SST; also Transport)

12. Space ships which can take people to other planets in the Solar System, such as Mars or Venus. (Space travel)

Because it is quite likely that people can simultaneously foresee both beneficial and harmful consequences of any particular technology, each respondent was asked, for each of the twelve technological potentials, "How sure do you feel that this develop ment would have beneficial results?" and "How sure do you feel that this development would have drawbacks or bad results?" Since is is also quite likely that people might think that a technology would have different effects on themselves from what it would on others, respondents were also asked, for each of the twelve, "If a development like [this] were to be put into operation, how much would it change your own life?" and "How much do you think such a development would change life for most people?"

Comparing our respondents' reactions to the respective technologies in this way produced several noticeable patterns. First, the degree of variation in public support for particular technologies indicated by the group means is considerable. Past studies have suggested that the public is likely to be unfamiliar and passive in the face of relatively complicated public issues.[10] To the extent that this is the case, we would expect responses to have been somewhat randomly distributed among social groupings and judgments about these technologies not to have differed very widely. But the variation in the degree of support from the high level which urban rail transit received from our respondents to the relatively negative reactions they expressed about computerized data banks suggests that they exercised considerable discrimination -- perhaps because they were informed of each technology's intended use.

The public may be more deliberative in its reactions to issues that concern them than many have suspected.[11]

TABLE 5

TECHNOLOGIES COMPARED BY DEGREE OF SUPPORT,
BY PERSONAL AND SOCIAL IMPACT, AND
BY CERTAINTY OF BENEFICIAL OR HARMFUL EFFECTS

Technological Capacity[a]	Support Opposition[b]	Impact On Self[c]	Impact On Others[c]	Certainty Ratio Helpful: Harmful	Percent Uncertain For Both
1. Urban rails	1.83	3.10(2)[d]	4.09(1)	5.11	14.0%
2. Solar energy	1.42	2.97(3)	3.67(3)	4.80	31.0%
3. Transplants	1.35	2.74(7)	3.89(2)	2.97	26.7%
4. Nuclear power	1.23	3.16(1)	3.51(7)	2.54	29.9%
5. Cable TV	0.99	2.76(6)	3.33(9)	2.44	31.5%
6. STOL	0.88	2.51(8)	3.58(4)	1.47	26.4%
7. ABM	0.87	2.94(4)	3.31(10)	1.64	25.3%
8. SST	0.50	2.20(9)	3.58(5)	1.45	26.8%
9, Brain drugs	0.30	1.97(12)	3.23(11)	1.10	37.8%
10. Space travel	-0.25	2.07(10)	2.87(12)	.90	42.0%
11. Genetic engineering	-0.70	2.04(11)	3.34(8)	.57	38.7%
12. Data banks	-0.79	2.92(5)	3.57(6)	.43	31.5%

[a] Arranged by rank order of support.

[b] Based on a scale from +3 to -3.

[c] Based on a scale of 5 being greatest impact to 1 being no impact.

[d] Numbers indicate relative ranking within column.

On the basis of the rank ordering observed, it could be argued that much of the discussion carried on in the media by those who commend or who inveigh against the effects of these technologies has been picked up by the larger audience. The technologies which met with a high degree of support in our survey -- urban rail transit, solar and nuclear power generation, organ transplants -- have been the objects of considerable expert attention as credible solutions to problems of growing proportions. Likewise, those technologies which evoked the most negative public responses are those which have aroused considerable controversy in Congress and among scientific elites -- the SST, the space program, genetic engineering, and data banks. That the public appears to have been influenced by these technology centered disputes may force a modification of some common notions about the attention it pays to public issues: it may be quite susceptible to education about controversial issues.

Consider now the relative strengths of the five independent variables which, we suggest, influence evaluation of the emergent technologies asked about: (1) respondents' perceptions of the technology's impact on their own lives, (2) their perceptions of its impact on the lives of others, (3) their certainty of its advantages, (4) their certainty of its disadvantages, and (5) their evaluations of presently implemented technologies. A series of least-squares regression estimates was made using these variables with the degree of their support for or opposition to each technology as the dependent variable.[12] The estimates of the standardized coefficients (beta weights) are given in Table 6.

TABLE 6

ESTIMATES OF STRENGTH OF INFLUENCE OF FIVE VARIABLES UPON

SUPPORT FOR DIFFERENT TECHNICAL CAPACITIES

Technological Capacity	Impact On Self	Impact On Others	Certainty of Advantage	Certainty of Disadvantage	Evaluation of Present Technologies	R^{2*}
1. Urban rails	*	*	.18	-.22	*	.14
2. Solar energy	*	*	.49	-.21	.12	.45
3. Transplants	*	.12	.42	-.19	*	.39
4. Nuclear power	*	*	.36	-.29	.10	.36
5. Cable TV	.16	*	.40	-.17	*	.36
6. STOL	.06	.06	.34	-.27	.13	.34
7. ABM	.13	*	.38	-.39	.14	.53
8. SST	*	*	.46	-.23	.09	.43
9. Brain drugs	*	.14	.36	-.33	.12	.44
10. Space travel	.12	.12	.36	-.25	*	.40
11. Genetic engineering	.10	*	.41	-.34	*	.44
12. Data banks	*	*	.37	-.36	.14	.46

*Entries are not significantly different from zero at the 0.05 level. R^2 is a measure of the proportion of the variation in the dependent variable which is "explained" by the five independent variables.

It is apparent from these estimates that people support technological proposals that they believe relatively certain to return beneficial results and oppose those which seem certain to return harmful ones. That is not surprising. What is surprising, however, is the relative lack of strength exhibited by the "impact" variables. In most instances, the beta weights for these predictors were not significantly different from zero; when they were, they were consistently less than one-third as strong as those involving perceptions of benefits and disbenefits. Finally, in the majority of cases, attitude about presently available technologies appears to have exerted some influence. This relationship suggests that an individual will use his experience with present technological systems as a basis for judging the potential merits of future systems.

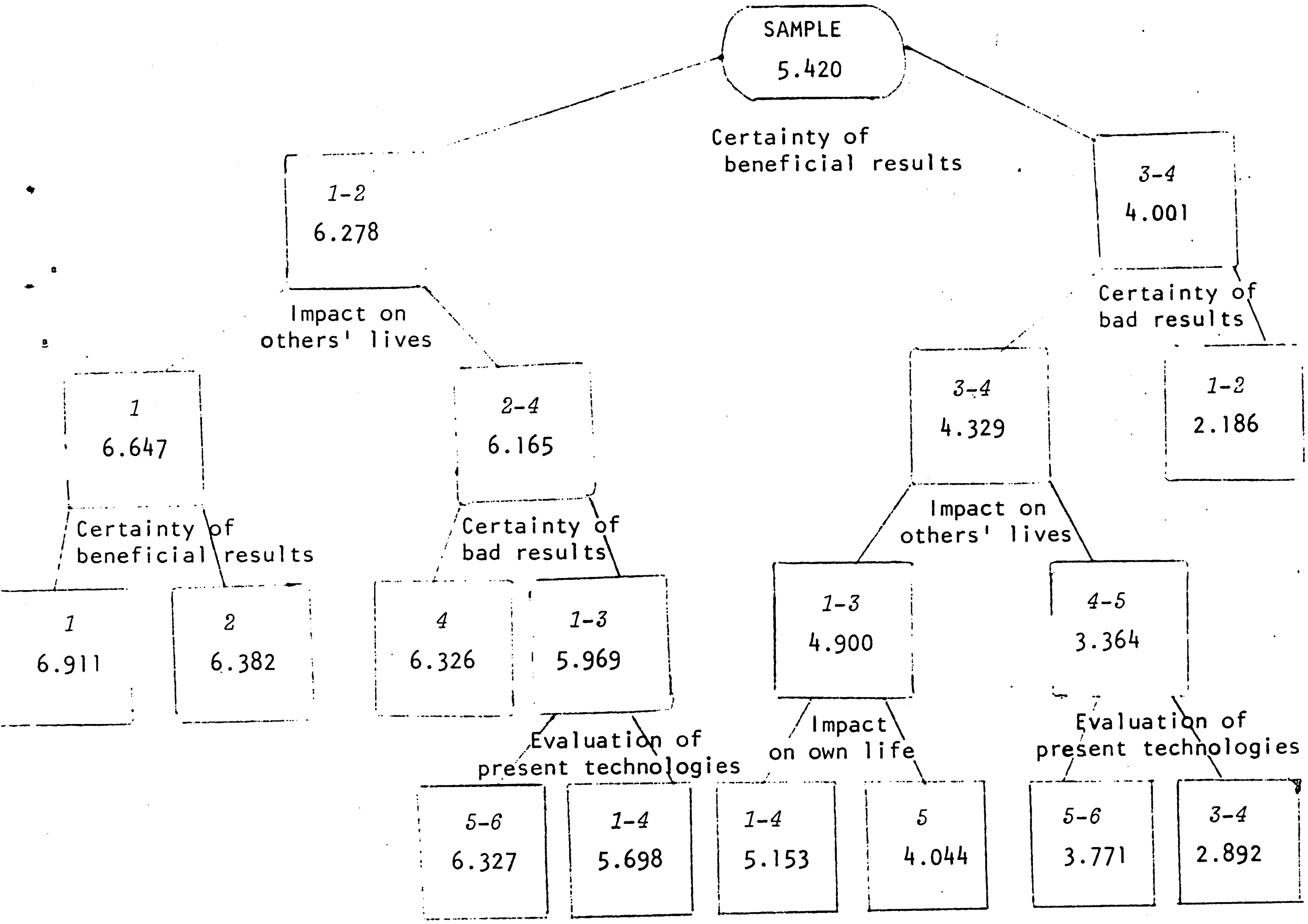
While it would be possible to conduct a more detailed "causal analysis," preliminary results warrant several strong inferences. The public's reaction to a particular technological capacity is quite likely to be a function of its understanding of what it will do. That is, if a technology's anticipated benefits are reinforced -- e.g., "nuclear power plants will produce cheaper electricity" -- and its anticipated drawbacks subordinated -- e.g., "this nuclear power plant is not built on an earthquake fault and will not explode -- then the general public will most likely acquiesce in, if not support, its implementation. Such is likely to be the case even if individuals see themselves as only marginally affected by the innovation.

It seems clear enough that a person's affective evaluation of any particular technological capacity is readily predictable when he is certain either about its advantages or about its disadvantages. What about cases when he is certain about both or uncertain about both? What factors then influence his evaluation?

We employed the following procedure to answer those questions. Because perceptions about the "certainty of advantage" were generally the strongest predictor of evaluation, we first split our sample into two groups, one representing those who were fairly certain about benefits, the other representing those who were not. We then examined the remaining independent variables in turn, trying to find one which could be used to partition each of the two sub groups (the "second generation") subject to the following criteria: (1) that the split would maximally reduce the unexplained variation in the dependent variable in the sub-groups; and (2) that the difference of the means of the two new sub-groups (the "third generation") would be statistically different from zero at the 5 percent level using a t-test. Figure III illustrates this process. The first sub-group (those certain about benefits) was partitioned along the variable "impact on others' lives" because it met the criteria better than any other variable. One new group contained those who were certain about advantages and saw a large impact on others; the other group contained those who were certain about advantages but felt there would be little impact on the lives of others. Partitions were again attempted between every two values of the independent variables. The one which best satisfied the criteria (certainty of advantage in one case and certainty of disadvantage in the other) was selected to produce the "fourth generation" groups. The process continued until no further partitioning was possible. The order of splitting mirrors that of each variable's importance in estimating a person's score on the dependent variable.[13]

FIGURE III

PARTITIONING OF RESPONDENTS' SUPPORT OF SOLAR ENERGY COLLECTION ON THE BASIS OF OTHER VARIABLES



Note: The splits were made along the variable named immediately above it. Each "box" contains two numbers. The upper one indicates the values along which the variable was split. For the "impact" variables:

1 = very much
2 = quite a bit
3 = slightly
4 = not very much
5 = not at all

For the "certainty" variables:

1 = absolutely certain
2 = quite certain
3 = not too certain
4 = no advantages/disadvantages

For the "present technologies" variable, the values go from 1 to 6, with 1 being low evaluation and 6 being high evaluation.

The lower number is the average score of those in the "box" on the dependent variable, support for solar energy. The range was from 1 (strong opposition) to 7 (strong support).

Returning now to the questions posed earlier, we find that for a person who is certain about both costs and benefits, the advantages invariably suppress the weight of the disadvantages: once someone believes that there is a high probability of benefits attending a technology, his opinion about its disbenefits is largely unimportant in determining his evaluation. There was no case which split on "certainty of disadvantages" once it had split on "certainty of advantages." Other variables consistently had more explanatory power than the probability of costs. Yet even they produced only rather marginal differences among those who felt fairly confident that the technology would be beneficial.

The story was quite different regarding what effect a person's uncertainty both about a technology's advantages and its disadvantages would have upon his evaluation of it. The group uncertain about advantages was consistently split along the variable measuring the perceived probability of harmful consequences. The group uncertain about both advantages and disadvantages was subsequently split along each of the other variables. Note, in Figure III, that the range of the final groups derived from those certain of benefits is only 1.3 units, while the range of those uncertain about both costs and benefits is over 2.3 units.

It is apparent that the impact variables and perceptions about present technologies make a difference only when people are relatively uncertain about generalized costs and benefits. Yet, at the same time those who are quite uncertain about the effects of technologies will still express opinions about them; these opinions do not necessarily "cancel each other out," i.e., they are not half for and half against an emerging capability. Since these people, the "uncertain," represent a sizeable minority of the population (about 30% on the average), the weight of their opinion can make a systematic difference. In the example shown in Figure III, a shift from uncertainty about both advantages and about disadvantages to uncertainty about advantages and certainty about disadvantages reduces support by over 2.2 units. Similarly, a shift to certainty about benefits and uncertainty about costs increases support by nearly 2 units. Thus educational or persuasive effort directed toward the public could make a substantial difference in the climate surrounding consideration of new and emerging technologies. Put another way, our data suggests that the public's relationship to technology could become much more subject to political persuasion than has normally been the case in the past.

Interestingly, when either taken singly or aggregated into an index, people's evaluations of technical capacities are not associated with demographic variables such as income, party affiliation, or "ideology" as was the case with the index of their evaluation of presently implemented technology. This finding may suggest that the hostility towared technology observed arises from the ways it is applied rather than from its inherent capabilities.

Finally, it is reasonable to believe that the degree to which one is motivated to enter into a controversy about an emerging technology is likely to be closely related to his beliefs about its beneficial or harmful effects as well as to his sense that the innovation will have an impact upon his personal life. These variables in fact define the dimensions which are often used in the political calculation to allocate public funds to a technical development. How many people will it affect? Will it find political support in the public? In Figure IV the twelve technologies included in our survey are arrayed along these dimensions. The way the public perceives a technology within these dimensions can give political leaders some basis for estimating the political profit likely to accompany their support for or opposition to a particular program.

To the degree that nuclear power and solar energy projects enjoy such marked popular approval, public support would appear to await political endorsement of these two energy technologies. On the other hand, political backing of the technologies in the lower right hand cell in Figure IV would seem to promise little politically. Given the public mood, genetic technologies, behavior altering drugs, STOL, SST, and the space program, if abandoned or curtailed, would not arouse much public reaction.

FIGURE IV

DISTRIBUTION OF TECHNOLOGICAL CAPACITY

BY DEGREE OF SUPPORT AND PERCEIVED PERSONAL IMPACT

SUPPORT BASED ON CERTAINTY OF ADVANTAGE OR DISADVANTAGE

IMPACT ON PERSONAL LIFE	High	Medium	Low
high	Nuclear power Solar energy Urban rail transport	ABM	Data Banks
med.	Organ Transplants	Cable TV STOL	
low			SST Brain drugs Space travel Genetic engineering

Significant political gains -- in terms of public approval -- could accompany the curtailment of "data banks," information gathering and storage systems.

It may be tempting for some to use the foregoing analysis as a rationale to inundate the public with persuasions aimed at selling it one new technology or another. But before policy makers draw only that lesson, they should examine the other side of the coin. In a majority of the cases studied, the public's approval of new technological capacities was a function of their feelings about present-day technological implementation. Thus, while a selling campaign may be effective for a given technology in the short term, in the long run it may be largely counter-productive for technological development in general. Empty claims and promises may serve only to increase the weight given by the public to its evaluation of current technologies, which partly determines their attitudes toward future ones. Toward what values, then, should technologies be aimed so as not to risk public disapproval?

Criteria and Actors in Decision Making about Technologies

Decisions about the design and implementation of highly visible, widely spread technological systems must ultimately involve some tradeoff between generally desired values. For the most part, industrialized societies have required only economic tradeoffs in the past, mostly involving questions of quality, cost, and optional features. But recently, various groups have championed new decision criteria. Concerns for the environment, questions of social equity, and fear of increased taxation have joined the more familiar values of economic progress, high employment, more leisure time, and national prestige and are being pressed upon technologists and technology-intensive agencies. Yet while society is demanding a change in the role of both technical manager and designer, only ambiguous and sometimes contradictory guidelines for their actions are offered. Moreover, it is often because no consensus has been reached on the criteria for technological development that so many programs face stiff political opposition. Although we cannot, in this article, develop a very detailed analysis of preference rankings for technology assessment, a general idea of the different values held by the public at large can be outlined.

Persons interviewed in our survey were asked to evaluate each criterion listed in Table 7 in terms of how much importance it should have in influencing decisions about whether or not a particular technology should be developed. They then were asked to rank those criteria in the order of their importance. Both the absolute magnitudes of importance and the overall rankings are instructive. Four of the seven criteria were perceived to be "extremely important" by at least a majority of the sample. The effects of implementing the technology upon pollution levels, employment, the conditions of the poor, and taxes apparently are matters which the public believes should be weighed in such decisions. This choice of criteria is reflected in the relative importance of mean rankings as well, though there is an interesting reshuffling of values when a tradeoff situation looms. Employment and environmental considerations are still at the top of the list, but their order of importance is reversed. The importance of effects upon the poor slides below concern about taxes, replaced by interest in the quality of life. Tax concerns remain squarely in the center. Such an ordering of concerns suggests a degree of tension in the public's mind about the practical problems of tradeoffs and the social conditions they want.

The results presented in Table 7 hold for people of different age, income, occupation, race, and sex. Level of education seems to be associated with some distinctions, though not dramatically so. The less educated appear more likely than those with higher education to emphasize the absolute importance of employment, taxes, and the international image of the United States. They also ranked U.S. prestige more highly, whereas the more educated stressed enhancement of the quality of life a bit more. Systematic differences appear in relation to political orientation as well. Conservatives tended to emphasize the U.S. image, both in absolute importance and in higher ranking; liberals stressed the importance of the effects of technology upon the poor and ranked this consequence highly. More

Democrats than Republicans stressed effects upon the poor. In opinions on the absolute importance of taxes and pollution problems there was also a conservative/liberal divergence, with the conservatives stressing taxes and the liberals pollution. Each of these differences was statistically significant, though not pronounced.[14]

TABLE 7

ABSOLUTE AND RELATIVE IMPORTANCE

OF CRITERIA IN TECHNOLOGICAL CHOICE

Criteria	Extremely[a] Important	Mean Ranking
Effect Employment	60.6%	3.00
Effect Pollution	72.3%	3.16
Make Life Enjoyable	47.0%	3.33
Effect Taxes	56.3%	3.71
Effect Poor People	59.7%	3.76
Effect U. S. Image	32.8%	5.05
Effect Leisure Time	17.8%	5.96

[a]Rest of distribution does not distort the meaning of these figures.

Perhaps the most interesting results in Table 7 are the overall degrees of importance as criteria attached to national prestige and to leisure time. Both of these values have been used as rationales for the development of various technologies in this country. But their apparently minor appeal to those in our survey suggests that a change has occurred in their absolute importance to the public and/or that technology is not seen as important in realizing these values. Since there is no comparable data from the past, there is no way to demonstrate statistically that such a change has in fact taken place. Our data does suggest that appeals to the importance of technological development as a measure of international prestige will have little effect when put alongside other criteria people use in judging the appropriateness of a particular proposal about technology.

The analysis of data on decision criteria preferences, while not conclusive, does urge several things for policy analysts to watch in the future. First, there is evidence that the range of values held by the public about tax supported technological programs (perhaps about privately promoted ones as well) is expanding and that the new values emerging should be taken seriously by the designers of new technologies. Second, there is some evidence suggesting that technology and its advocates may be increasingly drawn into political debate about the social consequences of technical development. While the relationships between people's political orientations and their insistence upon particular criteria for justifying new technological development can be demonstrated only modestly here, they do exist. It is possible to imagine that belief systems which influence the public's perceptions of the more traditional social and political issues may likewise have begun to affect the evaluations of what technology and the technologist should contribute to the commonweal. This tendency should be seen in the context of the small but significant differences in judgments about the benefits of existing technologies between the poor and middle income groups and between the extremely liberal and the more moderate (see Tables 3 and 4 above). Should this tendency become intensified, it could engender increasing political conflict about technological proposals.

Our analysis thus far suggests that the public has a reasonably high propensity for making estimates about the probable consequences of proposed technical developments and for making judgments about their possible benefits and/or harmful effects. Such judgments are apparently based, in part, on a set of values which has been extended to include more socially centered criteria. This expanded value system represents an interesting challenge to technological designers, to the men who manage large technological programs, and to those who make the decisions to begin, continue, or extinguish such programs.

An important part of the ideology of almost all political groups in this country is the tenet that the actions of public officials ought to reflect changes in values experienced by the public. All goes well if there is the assurance that the public's values are adequately represented by those who commit public treasure and facilities to new tasks. An air of legitimacy about the men and women who do the things that shape the public's life is maintained so long as they are perceived to involve themselves with and to act out desired social criteria. In a sense, the most important aspect of the political context of technology becomes the question of whether those involved in making decisions bearing on its development are seen as legimitately doing so.

Respondents in our survey were asked to consider questions bearing on decision formation about the use of the six different areas of technical development noted above in Figure II. Questions included (1) how the use of electrical power should be limited in the face of serious shortages; (2) how a system of mass rapid transit should be put into use; (3) whether medical information enabling genetic alterations on unborn infants should be put into use; (4) whether space stations which could be used as missile launching sites should be built; (5) how information stored in large computers about individual members of the public should be used; (6) whether space ships capable of going to Mars should be built. For each question, people were asked which of eight groups of actors in the decision process are, in their opinion, actually the most influential ("have the most say"), which are the least influential ("have the least say"), which groups should have the most influence and which should have the least. In this way, data was gathered about the public's perceptions of where decision making power actually lies and about the degree of legitimacy it attributes to various decision actors. Responses to these questions were used to compute scores for the degree of actual influence people assigned to each decision group and a score for the degree to which various social sets felt that it should be influential. Table 8 presents these scores for each decision question related to the six different areas of potential technical development.[15]

A detailed review of the figures in Table 8 raises some quite interesting questions about the differences among the technical areas as perceived by our sample. For ease of reporting, four-fold tables were constructed to summarize the relative placement of the eight potential decision actors for each technology-related decision (see Figure V). This was done by locating each decision group according to the degree our sample believed it actually to have influence and the degree to which it felt that influence ought to prevail. "Technical experts," for example, who were perceived as having considerable legitimate influence in the kind of decision under consideration, were placed in the upper left-hand cell of Figure V. Placement of a group in the upper right-hand cell indicates, on the other hand, that it is believed to have little say in decisions but ought to have more; consistently, "the public" occupies this position. Conversely, the lower left-hand cell includes those groups believed to prevail in decision making whom respondents feel should not -- a rough measure of the public's perception of illegitimate involvement in decision processes related to technology. Finally, actors in the lower right-hand position are those perceived as not having much say in decisions and that that is the way it should be.

TABLE 8
WHO DOES AND WHO SHOULD INFLUENCE DECISIONS ABOUT USING TECHNOLOGIES

Technologies

Actors	Power Useage Have	Power Useage Should	Urban Rails Have	Urban Rails Should	Genetic Eng'ring Have	Genetic Eng'ring Should
Govt. Leaders	5.12[a] (2)[b]	7.12(4)	5.10(1)	7.29(5)	6.87(3)*	8.41(8)
Tech. Experts	5.02 (1)	4.70(2)*	5.87(3)	4.94(2)*	4.04(1)	5.73(2)*
Busin. Leaders	5.68 (3)	8.26(8)	5.64(2)	8.25(8)	7.62(7)	8.20(7)
Congressmen	6.70 (4)*	7.18(5)	6.47(4)*	7.16(4)	7.06(4)	7.38(4)
Courts	7.38 (7)	8.03(7)	7.46(6)	8.19(7)	6.73(2)	7.44(5)
Consumer Groups	7.27 (6)	6.87(3)	7.19(5)	6.92(3)	7.56(6)	7.35(3)
No one	7.21 (5)	8.00(6)	7.46(7)	8.00(6)	7.18(5)	7.70(6)
Public	10.77 (8)	4.58(1)	9.84(8)	4.18(1)	8.42(8)	3.30(1)
	Military in Space		Space Travel		Data Banks	
Govt. Leaders	2.27(1)	5.92(3)	2.60(1)	6.32(3)	4.20(1)	7.93(7)
Tech. Experts	5.49(2)	5.84(2)	5.13(2)	5.42(2)	5.92(3)	6.49(2)
Busin. Leaders	7.03(4)	8.65(8)	6.88(4)*	8.52(8)	5.91(2)	8.12(8)
Congressmen	6.08(3)*	6.55(4)*	6.06(3)	6.82(4)	6.65(4)	6.95(4)
Courts	7.56(6)	7.72(6)	7.58(6)	7.80(6)	6.72(5)*	6.92(3)
Consumer Groups	7.80(7)	7.59(5)	7.72(7)	7.45(5)	7.19(6)	6.96(5)*
No one	7.28(5)	7.75(7)	7.33(5)	7.94(7)	7.23(7)	7.65(6)
Public	11.36(8)	4.84(1)	11.32(8)	4.49(1)	11.35(8)	4.15(1)

[a]Numbers in first column represent average ranking, from 2 (highest) to 16 (lowest).

[b]Numbers in notes parentheses represent rank order of actors.

*Indicates point where split was made to construct Figure V.

FIGURE V

PERCEIVED INFLUENCE AND LEGITMACY OF ACTORS INVOLVED IN TECHNOLOGICAL DECISIONS

Actor Should Have Influence:

Power Usage/Rapid Transit Decisions

Actors Have Influence:

	Does	Does Not
Should	Technical Expert	Public
Should Not	Government Leaders Business Leaders Congressmen	Courts Consumer Groups No one

Genetic Engineering Decisions

Actors Have Influence:

	Does	Does Not
Should	Technical Expert	Public
Should Not	Government Leaders Courts	Congressmen Business Leaders Consumer Groups No one

Actors Should Have Influence:

Space Travel/Military Use of Space Decisions

	Does	Does Not
Should	Technical Expert Congressmen Government Leaders	Public
Should Not	Business Leaders (space)	Business Leaders (military) Courts No one Consumer Grps.

Data Banks Decisions

	Does	Does Not
Should	Technical Expert Congressmen Courts	Public Consumer Groups
Should Not	Government Leaders Business Leaders	No one

Several striking results are clearly evident from the pattern that emerges in Figure V. First, of all eight groups which influence decisions about how technologies are to be used, the technical experts are the most positively viewed. They are influential and should be. Their claim to influence comes from their knowledge of technical matters. They can understand "the works"; the design and operation of the system rests upon them. Second, there is very clear evidence that the public feels itself to be quite distant from the process of making decisions about technology and is somewhat agitated about its exclusion. On all six decision questions the public sees itself as the least influential by some distance, but in every case indicates that it wants to be the most influential, again by a considerable margin.

The third pattern emerging here is related to the second; our respondents seem to have an uneasy distrust of the leaders of large administrative organizations. In all but two technical areas, both of them involving programs which are government monopolies, a substantial portion of the public seems to be asking business and government leaders to withdraw from the field of decision making about technologies. This attitude is directed particularly toward business leaders, who are in a sense the biggest "losers" in the legitimacy dimension: in every case, the public wanted them to stay out of decisions if they were out and to get out if they were perceived as having any influence in them. These findings are a clear signal that, from the viewpoint of the general population, business is illegitimately involved in making decisions about public technologies. Finally, another bit of evidence apparently indicates that the concept of laissez faire no longer holds much appeal. Though respondents had the opportunity, from the way the questionnaire was constructed, to indicate that "no one" should wield influence in any or all of these decision problems, few people so opted for any of the six. Control there must be, though the public seems frustrated about the institutions available to carry out the authoritative role.[16]

Specific technologies drew different responses which fall into several distinctive patterns. Opinions about decisions on the use of electrical power and on urban mass transit fall into similar patterns; so also do the two "public monopoly" technologies, space travel and the military uses of space. The major difference between these two sets is that Congressmen and governmental leaders are expected to remain active in space-related decisions but to remove themselves from the others.

The pattern of opinion on the uses of biological manipulation is similar to that on power and transport, with the exception that Congressmen and business leaders are seen as not having power, a position the public strongly endorses. Beliefs and attitudes about decisions related to public information storage, "data banks," also produced a special pattern. Many more of the possible decision actors are believed to be involved here; everyone seems to the public to be getting into this act. Government and business leaders are again seen as influential, though without much endorsement from the public. The participation of the courts and of Congress appears to be desired in policy formation about this issue, perhaps because they are institutions of protection against those governmental and business organizations that would use the information.

The data may be further interpreted by considering what often is meant by "a decision." Following from the work of decision theorists,[17] the term can be divided into two components, one based on factual premises, the other on valuational premises. Thus, on the strength of their understanding of the factual aspects of decisions related to complex technical programs, technical experts can readily be seen as having legitimate influence. Governmental and business leaders and Congressmen should influence technology-related decisions only on the grounds that they have a role in setting goals and determining preferences about outcomes. In doing so, they they are expected to reflect the public's value premises -- to foster those which the people believe it important to achieve or preserve. When viewed in terms of this two-fold meaning of "decision," our analysis suggests very definitely that the public is highly unsatisfied with the influence exercised both by some of its top officials and by businessmen. This disaffection should be seen as stemming from disagreement with or distrust of the values used by these two groups in making choices.

It is sometimes argued that it would be "impractical" for the public to enter into policy decisions related to technology and that it has so many conflicting preferences that confusion would reign if it took part in them. But the dilemma revealed by analysis of our data cannot be so easily dismissed. The attitudes of our sample of California citizens seem to be suggesting that there is a need for institutions which can mediate between the public and the technologists and incorporate public values, goals, and preferences about outcomes into decisions involving the design and implementation of technology.[18] In some cases, Congress and the courts seem to be considered as having an appropriate role, although the general pattern suggests a shaky confidence in those institutions. Such an interpretation is certainly consistent with the support received from the general public by conservation groups such as the Sierra Club, by "public interest" and consumer groups, and by individual public advocates like Ralph Nader. It also explains the sizeable support received by initiatives on the California ballot which sought to preserve environmental values which the traditional goals of technological growth and economic development appear to threaten.[19]

The picture is a rather disturbing one; for while the public wants to be involved, it seems to reject those very institutions established specifically to represent and nurture that involvement. If this discontinuity between the public, which believes that it should determine values, and those who are entrusted with achieving them increases in magnitude and intensity, the consequences for the technologist could threaten the considerable confidence which at present is placed in his role as technical expert. For to the degree that he continues to be seen as influential in decisions about the uses of technology which do not adequately reflect widespread public values, he too could lose his "political legitimacy." If this happens, it is not too hard to imagine that a reaction against "domination by the experts" would follow close behind.

Conclusion

The results drawn out of this survey provide new insight into a number of areas involving public attitudes about technology. A substantial portion of the California population sees advances in science and technology as major factors in changing the fabric of society since World War II. Those questioned did not view science and technology as abstract concepts beyond their ken but as realities occupying a relatively central place in their life experiences: respondents could make evaluations of how presently implemented technologies have affected their lives. These evaluations were not randomly distributed, but to some extent were associated with income and with political attitudes.

In addition, the public appears inclined to make distinctions among technologies on the basis of what they are purported to accomplish. There was a wide variation in terms of support expressed for the twelve capacities investigated. That support appears largely to be a function of a cost/benefit "calculation." Small shifts in perceptions produce large shifts in evaluation -- a circumstance which argues an increasing role for persuasion. Yet, in certain instances, the individual's evaluations are colored by his experience with existing technologies and by the extent to which he perceives that new ones will affect him. These factors should therefore serve as incentives for decision makers to be responsive to public needs.

The nature of these needs and values was articulated by our sample, both in terms of absolute and relative importance. While something of a tension exists between individual needs, such as employment opportunities, and the more general societal values, such as those related to environmental preservation, it is clear that planners and designers are being asked to consider a wider range of criteria than heretofore. To limit consideration to questions of economic profitability is no longer acceptable to much of the general population. Perhaps the strong disjuncture between those who are perceived as exercising power in making decisions about technologies and those perceived as more legitimately meriting such power is a reflection of this attitude. As a result of this disjuncture the legitimacy of institutions which transmit values has been called into question.

The results of our survey, in short, suggest the potential emergence of technology as a political issue of growing magnitude. For while science may be value-neutral, technology is not: the manner in which it is applied and implemented does not affect all equally. Automobiles and highways do cut through cities and transform communities. Data banks do infringe on the privacy of the individual. Funds consumed by the space program cannot be used for social projects. In each such instance some groups gain and others lose; it is not a positive sum game. It is probable that people's experiences with technology have alerted them to this fact. And while many of them still subscribe to that traditional American ideology of "progress through technology," many also have "wondered and worried and tried to understand."[20] Unless those in positions to decide how technology will be implemented concern themselves about this emerging awareness on the part of the public, the watchers and wonderers may become transformed into doers, and policy makers may find themselves -- and their programs -- immersed in growing conflict and controversy.

February, 1973

NOTES

1. See especially Jacques Ellul, The Technological Society tr. J. Wilkinson (New York: Knopf, 1956); H. L. Neiburg, In the Name of Science (Chicago: Quadrangle Books, 1966); Victor Ferkiss, Technological Man: The Myth and the Reality (New York: Braziller, 1969); Lewis Mumford, The Myth of the Machine, Vol. I: Techniques and Human Development (New York: Harcourt Brace, 1967); Wylie Sypher, Literature and Technology: The Alien Vision (New York: Random House, 1968). See also J. D. Douglas, ed., The Technological Threat (Englewood Cliffs: Prentice-Hall, 1971); M. Brown, ed., The Social Responsibility of the Scientist (NewYork: Free Press, 1971); J. G. Burke, ed., The New Technology and Human Values (Belmont: Wadsworth, 1966); Paul Goodman, The New Reformation: Notes of a Neolithic Conservative (New York: Random House, 1970); and Langdon Winner, "On Criticizing Technology" Public Policy (Winter 1972).

2. The environmental initiative which appeared on the June 9, 1972, California Primary ballot sought to exercise greater control over a large spectrum of activities. It specified permissible composition and quality of gasoline and other fuel for internal combustion engines, specified shutting down of businesses and factories violating air pollution standards, imposed restrictions on leasing and extraction of oil and gas from tidelands or submerged lands or onshore areas within one mile of mean high tide line, prohibited construction of atomic powered electric generating plants for five years, and established restrictions on manufacture, sale, and use of pesticides. While not overtly anti-technological, the measure heavily discounts benefits derived from technology -- by prohibiting the implementation of a wide range of technical capacities -- in favor of other values. Such a radical tradeoff would strongly suggest, at the very least, a suspicion of the conventional wisdom which promises progress through technological advances.

3. See G. R. Funkhauser, "Public Understanding of Science: The Data We Have," a paper prepared for the National Science Foundation, Workshop on the Goals and Methods of Assessing the Public's Understanding of Science (Seattle: September, 1972) and Irene Taviss, "A Survey of Popular Attitudes Toward Technology" Technology and Culture 13 (1972), pp. 606-21.

4. This survey is part of a larger study of technology and social change and the social assessment of technology. It is supported by the Ames Research Center, National Aeronautics and Space Administration (Grant no. NGR 05-003-0471). Further support from the International Technology Assessment Program, Institute of International Studies, made the wide scope of the survey possible. We gratefully acknowledge the encouragement and assistance of Professors Ernst Haas and William Bicker of the Department of Political Science, Dr. Trieve Tanner of Ames Research Center, Mr. Robert Heyer of the Field Research Corporation, and the staff of the Institute of Governmental Studies through which this project was administered, particularly the industry of Mary L. Sapsis, one of its editors, who oversaw the preparation of the present paper and several earlier ones related to it. (All academic units cited are those of the University of California, Berkeley.)

5. The only exception concerns education levels. This sample is significantly more highly educated than the U. S. population as a whole.

6. Because an individual may have mentioned two or more changes, categorized, for example, under "Social Change," the percentages sum to more than 100%. For each change the percentage can be interpreted as the fraction of the sample which mentioned it.

7. This probability statement is based on the null hypothesis which holds that Republicans and Democrats are equally likely to make any given response. This qualification extends to all such "likelihood" comparisons made throughout. All differences reported are significant at least at the .01 level using an f test.

8. For detailed investigations into the correspondences between social groupings and political attitudes, see, for example, Angus Campbell et al., The American Voter (Survey Research Center, Institute for Social Research, University of Michigan, 1960), Elections and the Political Order (New York: Wiley, 1966); Group Differences in Attitudes and Votes (Survey Research Center, Institute for Social Research, University of Michigan, 1956) and The Voter Decides (Survey Research Center, Institute for Social Research University of Michigan, 1954); see also V. O. Key, Southern Politics in State and Nation (New York: Vintage Books, 1961) and Lester Milbrath, Political Participation (Chicago: Rand McNally, 1965).

9. That science/technology is generally a subject not central to nor salient in the minds of most people creates major difficulties for attempts to understand the nature of opinion in this area. Attitudes tend to be not well formed cognitively and extremely unstable. Taken to its logical conclusion, the existence of unstable cognitive structures suggests that there is a segment of the general population who will answer questions dealing with science and technology essentially on a random basis. (But see below, pp. 15, 36-37, and note 11). In addition to low salience, low information levels among the public may introduce formidable barriers in any attempt to understand public attitudes about technology. Together, the two factors reduce the strength of observed relationships. Nevertheless, primary relationships do persist among the population, and it is these with which we will concern ourselves here.

10. See, for example, Philip Converse, "The Nature of Belief Systems in Mass Publics" in Ideology and Discontent, ed. David Apter (New York: Free Press, 1964) and Milbrath, op. cit.

11. This argument for the public's relative political sophistication is addressed, in terms of observable consistencies between ideology and voting behavior, in William Bicker, "Ideology is Alive and Well in California: Party Identification, Issue Positions and Voting Behavior," a paper delivered at the American Political Science Convention (Washington, D.C., September, 1972).

12. For a good discussion of regression analysis, see Jan Kmenta, Elements of Econometrics (New York: Macmillan, 1971), pp. 9, 197-306, 347-308. While we are not strictly dealing with cardinal leval data and are uncertain of the strictly linear causal structure, we believe that they are good approximations in our case. By allowing for interactive effects we can increase our explained variation by roughly 8 percent.

13. We are indebted to Greg Streeter of the State Data Program and to Patrick Pritchard, a programmer for the Institute of Governmental Studies, for their assistance in obtaining these results. The University of Michigan's Institute for Social Research originally designed the program used, called Automatic Interaction Detector. See John Sonquist and James Morgan, The Detection of Interaction Effects, monograph no. 35 (Ann Arbor: University of Michigan, Institute for Social Research, 1964).

14. All but one were significant at $p > 0.001$; the exception was at the $p > 0.01$ level.

15. The significance of these figures is greatest at the extremes due to the manner of calculating the numbers. Rankings of approximately 7 indicate few mentions on either the "most say" or "least say" questions. We wish to thank William Bicker for suggesting the method of computing these figures.

16. This inference is reinforced by the results reported in Taviss, op. cit., pp. 617-620.

17. See Herbert Simon, Administrative Behavior (2nd ed.) (New York: Free Press, 1957), pp. 45-60 and J. D. Thompson, Organizations in Action (New York: Mc-Graw-Hill, 1967), pp. 134-139.

18. A study related to this inference is Martin Landau, "Linkage, Coding, and Intermediacy: a Strategy for Institution Building" in Institution Building and Development, ed. Joseph W. Eaton (Beverly Hills: Sage, 1972), pp. 91-109.

19. Although Proposition 9, the initiative cited above (see note 2), was defeated, it received 40 percent of the vote and won fervent advocacy. A subsequent environmental measure, Proposition 20 on the November, 1972, ballot, passed with a substantial margin.

20. Quoted from a letter to the editors of Science from Anne Elizabeth Holmes, Vancouver, B. C., protesting the "technological imperative" position in the context of a debate over the impact of the computer on society. (Science, January 26, 1973), p. 329.