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THEY WATCH AND WONDER PUBLIC ATTITUDES TOWARD ADVANCED TECHNOLOGY

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Final Report to Ames Research Center
National Aeronautics and Space Administration
of
Work Funded Under NASA Grant NGR 05-003-0471
Todd La Porte, Principal Investigator

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FOREWORD

This report ends a project which for the past four years has explored aspects of technology and social change. Predominantly supported and encouraged by the Ames Research Center, National Aeronautics and Space Administration, the work reported here was one of several efforts focusing on the relationship of technological development to individual and community response These studies began partially in response to the interest of Dr Hans Mark, Director of Ames Research Center, in the potential impact upon community life of a particular technology--the short-take-off-and-landing aircraft (STOL). Convinced that complex advanced technologies trigger both social and political changes which are as yet only vaguely understood, Dr. Mark initiated conversations with us which have culminated in the present report and several complementary studies. Since those first discussions in the spring of 1971, several increasingly more refined studies have been completed which attempt to provide a general conceptual, as well as empirical basis, for a better understanding of the impact of advanced technologies upon social life. In addition to research on public attitudes toward technology, these efforts included an exploratory field study on the impact of improved airtransportation systems upon rural communities *

Our earliest probe of public attitudes toward technology was in the winter of 1971, when several questions were included in Field Research Corporation's *California Poll*. This initial and tentative foray warned us of potential difficulties in seeking out attitudes toward technology--a matter that could well have been of only modest interest to a public already swamped with information about a host of social problems and events The Field Research Corporation assisted us in questionnaire design and data collection for both the 1972 and 1974 surveys Support from NASA for the 1972 survey was supplemented by funds from the International Technology Assessment Program of the Institute of International Studies, University of California, Berkeley That assistance enabled us to broaden the scope of the survey In 1974, supplementary funds from the National Science Foundation's Office of the Public Understanding of

*See Todd La Porte, Stephen Rosenthal, Stuart Ross, K.N. Lee, and Edith Levine, *Interactions of Technology and Society: Impacts of Improved Airtransport--A Study of Airports at the Grass Roots*, Report to Ames Research Center, National Aeronautics and Space Administration (Institute of Governmental Studies, University of California, Berkeley, December, 1974).

Science assisted us in maintaining that broader perspective

The two authors of this monograph have worked together from the beginning of this study. Each of us has contributed somewhat different interests and skills, and these are reflected in the final form of the report. Its overall structure was developed jointly, with different chapters being drafted by one author and then critically reviewed and revised by the other. La Porte had initial responsibility for Chapters I, VI, VII, VIII, and X, and Metlay for Chapters II, III, IV, V, and IX. Of course, we bear together the responsibility for the character of the analysis and interpretation.

In addition to our appreciation of Dr. Mark's continued foresight and support, we are pleased to acknowledge the encouragement and guidance of Professor Ernst Haas of the Institute of International Studies and the Department of Political Science, University of California, Berkeley, of Richard Stephens of the National Science Foundation; of Eugene Lyman, Director of NASA's Aeronautical Life Sciences Division in Washington, D C , and of Mr Robert Heyer of the Field Research Corporation who gave generously of his expert skills. In their various roles as colleagues, interested grant administrators, and technical experts, they have made this project both more extensive and more effective. Additional technical assistance has come from our colleagues in the Department of Political Science on the Berkeley campus Professors William Bicker, Director of the State Data Program, Merrill Shanks, Director of the Survey Research Center, and Peter Sperlich, of the Department of Political Science, have graciously assisted us in various aspects of questionnaire construction or data analysis. Greg Streeter, also of the State Data Program, provided important programming assistance And Donald Chisholm has worked mightily and over time to extract reams of data for analysis from the computer The staff of the Institute of Governmental Studies greatly facilitated our labors in administering the grant and in the preparation of this and other reports * Our thanks to Joan Barulich, Kathy Gura, Catherine Winter and Sidney Dong. But our most grateful acknowledgements are reserved for Dr Trieve Tanner, the Ames Research Center representative who supervised the grant, and for Mary Fenneman, who has labored with us in the preparation of this report. For quite different reasons they both have made this effort more interesting for us and for our readers. Trieve Tanner has followed with sympathetic involvement our several efforts over the past several years His fine sense of the research process and his administrative abilities have enhanced and facilitated the cooperative relationship between Ames and our research group. From our view, and we hope it is shared by Ames, this relationship has been close to optimum. Mary Fenneman, for her part, has greatly improved the flow and coherence of our presentation Her editorial skill, insistence on clear language and

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*For reports of preliminary analyses of survey data reported within, see Todd R. La Porte and Daniel Metlay, "Technology Observed: Attitudes of a Wary Public," *Science* 188 (11 April 1975), 121-127, and "Public Attitudes Toward Present and Future Technologies: Satisfactions and Apprehensions," *Social Studies of Science* (November, 1975).

precise explication, and her professional spirit have been of great help to us and will assist readers beyond their knowing.

Finally, a word of appreciation must be given to the many anonymous people who patiently answered questions put to them by interviewers from Field Research. These are the unsung heroes of the piece. Their cooperation after all was necessary for any study to be done at all From them we have gained a heightened appreciation of the subtleties of the public mind. Midway through this project, one member of the public voiced what ultimately became its predominant finding. In a letter to the editors of *Science* (26 January, 1973), Anne Elizabeth Holmes protested the "technological imperative" position taken by some scientific elitists In the immediate context of a debate over the impact of the computer on society, this citizen from the Northwest noted that while many still subscribe to the traditional ideology of "progress through technology," many others have "wondered, worried, and tried to understand " We believe the findings of this study to be at best quite encouraging Many in the public do wonder and seek to comprehend the significance of technology's effects on their lives. Their concern and judgments are a measure of the promise for a more responsible politics of technology

Todd R La Porte
Principal Investigator
Berkeley, California
October, 1975

PART ONE

ISSUES AND PERSPECTIVES

It is a commonplace to assert that advanced technology is the hallmark of our age. Everywhere, its processes and artifacts pervade our lives, proclaiming that ours is indeed a "technological society." Since the Second World War technological development has increasingly become a function of government as well as industry. In our enthusiasm to use technology's awesome capacities for the support of our political system and the pursuit of international stature--whether by venturing into outer space or by assisting underdeveloped nations--the public purse has been opened often. Vast sums from our national treasure have been poured into basic science and applied technology. Over the past two decades, public and private funds allocated for research and development have increased from some $5.1 billion in 1953 to an estimated $34.3 billion in 1975. The National Science Foundation figures for the total amount of funds devoted to research and development from 1953 to 1975 is $404.4 billion.[1] This public support has been accompanied by a strong sense of optimism, seemingly justified by past rewards of technological development which solved the puzzles of agricultural and industrial production and ushered in the wonders of the space age. What was once impossible now seems commonplace.

There are signs, however, that this optimism is being tempered by uneasiness and wariness. The assumption that technology's blessings are so many and its disturbing consequences so few as to be unworthy of concern no longer draws near-unanimous agreement. Having thrown technology's bread upon the waters, things both blessed and foul come back to us. Traditional concern for military might and national prestige is now being supplanted in some circles by concern over polluted air, limited energy resources, and shrinking food supplies. Still, the citizen/consumer is being asked from many quarters to give both his monies and his assent to stimulate the engines of technology even more. The world is breaking down, and technology might have "the fix."[2]

Through the years when technology was virtually deemed a public good, the public absorbed large technological programs mainly as passive consumer/citizens--subsidizing them, cheering, fearing them Only recently has there been much evidence of any other pattern[3] indications of disquiet are sprinkled throughout the media and have entered the public forum in debates ranging from concerns about environmental damage to the pros and cons of fluoridating water supplies. At once sponsor and debtor, "doer and done-to,"[4] the consumer/citizen seems no longer to wait patiently for the next series of technology-induced surprises. This report is concerned with how the public views technology and the institutions conducting its development. What is the shape of public perceptions of and attitudes toward this most characteristic aspect of our time?

Those perceptions and attitudes are in part both the object of and the boundaries around government's stimulation of technological development. Insofar as government supports that development and attempts to regulate its effects in the name of service to "the people," it is intrinsically important that citizen attitudes be made known Also, public attitudes toward technology and programs established in pursuit of technical virtuosity often form permeable boundaries within which decisions are made. Certainly in the rhetoric of policy advocates who seek political approval, citizen attitudes become the benchmarks for their proposals. Claims about such attitudes cannot be too wide of the mark for very long before public sentiment congeals and the outcry reduces alternatives for policy action and limits the direction of legislative response.

Though many claim to speak for the public, either in the name of technological advocacy or dissent, no sound basis exists for judging the accuracy of their interpretations of the public mind--one way or the other. Few sources are available to the search for answers to questions about public attitudes toward technology. Our study has attempted to assemble materials needed for a deeper appreciation of the range of attitudes on this subject. An initial charting of the parameters of the internal structure of individual perceptions of technology, it establishes a base-line against which to gauge future studies, in which the degree of change or stability discernible in public attitudes could be related both to political events and to technological developments

Part One recapitulates the underlying conceptual organization of the study and presents the initial methodological con siderations which governed sample selection and data collection. Part Two explores public attitudes toward technology and science, probing for evidence of perceived distinction between them, public evaluations of presently implemented technologies are reported along with the profile of value preferences held by the public in their judgments about technological decision making. Part Three reports attitudes toward a range of future-oriented technologies and some apparent social correlates of these attitudes--with special attention to energy producing technologies and the issues surrounding the "energy crisis" of 1973-74. Part Four presents dominant opposed views on future control of technological development and attempts to marshall evidence bearing on the validity of the central hypotheses of each, that is, evidence concerned specifically with the alleged uncritical acceptance of technology by the public. The book concludes with a summary of the findings reported and a discussion of the implications they hold .for present and future policy and for further research

[1] See National Science Foundation, *National Patterns of Resources for Research and Development: Funds and Manpower in the United States, 1953-1975*, NSF 75-307 (Washington, D.C.: GPO, 1975), esp. p. 26.

[2] See the optimistic discussion by the thoroughgoing technologist Alvin Weinberg, "Can Technology Replace Social Engineering," *Bulletin of Atomic Scientists* 22 (Dec., 1966), 4-8, reprinted in A. Teich, Ed., *Technology and Man's Future* (New York: St. Martin's, 1972), 27-35. See also, Hyman Rickover, "A Humanistic Technology," *Nature* 208 (Nov. 20, 1965), 721-726, and Amitai Etzioni and Richard Remp, "Technological 'Short-cuts' to Social Change," *Science* 175 (Jan. 7, 1972), 31-38. For less optimistic views, see Jack D. Douglas, Ed., *The Technological Threat* (Englewood Cliffs, N.J.: Prentice-Hall, 1971) and Eugene S. Schwartz, *Overskill, The Decline of Technology in Modern Civilization* (Chicago: Quadrangle, 1971). It is in part the business of the present report to contribute information on public impressions of the social role of science and technology which might lean toward either the "optimistic" or "pessimistic" outlook advanced by the aforementioned spokesmen. See especially Chapters I, III, IV, and IX.

[3] For an interesting attempt to document this shift, based on the historical analysis of non-technical commentary on technology, see Thomas Parke Hughes, *Changing Attitudes Toward American Technology* (New York: Harper and Row, 1975), esp. Part I.

[4] Coined by Geoffrey Vickers, *Freedom in a Rocking Boat: Changing Values in an Unstable Society* (New York· Basic Books, 1971).

CHAPTER I

TECHNOLOGY AND PUBLIC PERCEPTIONS: AN ORGANIZING PERSPECTIVE

Much in popular literature and the media seems to suggest a public enamored with technical virtuosity, trusting of scientists and technologists, and docile as it is led to support technological solutions to many current problems.[1] Perhaps in response to the over-enthusiastic images presented there, literature critical of unrestrained technical development exhorts the public to beware of technology's consequences and not to trust scientists and technologists, especially those supported by government funds, whose ranks include the inventors of the fearful engines of destruction and human control This literature suggests that the public makes, or ought to make, qualitative judgments about such developments as nuclear power plants, biological engineering, mass rapid transit, personal information storage, space exploration, and so on[2] It follows, given the plural nature of our society, that these judgments would reflect variant, even contradictory, attitudes toward technology, But when, for clarification, we seek out professional literature based on opinion survey research, we reach something of an impasse We are told that the public's attitudes, if indeed they have any at all on this subject, are likely at best to be ephemeral[3] This assessment of the public as uninformed and inattentive to complex matters, including technology, implicitly runs counter to the critical literature There, observers suggest that technology is saliently perceived--as being ingrained in social experience, not simply as isolated machines or systems

In our attempts to explore public attitudes about technology's effects on experience, we have been open to both interpretations Certainly "technology" is complex, and issues surrounding its development are akin to those which up until now have not held particularly great salience for the public-at-large. Forewarned by the possibility of this low salience, we have weighed indications, noted by some observers, that technology is experienced by people as a part of the wider social context of their everyday lives. Recently the technological character of our society has become obvious to greater numbers of people than in the past and the source of growing concern and commentary. It is plausible, therefore, to suppose that the public perceives of and responds to various technologies in a more sophisticated way than what it is often credited with.[4] The first step in investigating this possibility is to conceptualize "technology" in a way that will allow us to discern the more salient variations in public response to the phenomenon, to the extent they exist.

In this chapter we outline a conception of technology-as-social-experience, attempting to distinguish it from public perception of science. We then discuss the relationship between technological development and social change. The chapter ends with a description of two prevailing, diametrically opposed theories on the political future of technological development. The social control of technology, or lack of it, envisioned in these perspectives projects provocatively divergent public attitudes The material in this chapter has informed our perspective as we developed those probes of public attitudes toward technology Its sweep has carried us beyond both the methodology and resources available to enable us to develop a theory relating those public perceptions to the various aspects of social experience we are about to discuss. Hence, our major attention in this chapter is directed to a series of informal hypotheses summarizing certain theoretical arguments. Instances where these hypotheses bear on our own data and analysis are noted and the location of their further treatment in the present book indicated

TECHNOLOGY AS SOCIAL EXPERIENCE

As the term is used in this study, "technology" refers to those applications of scientific knowledge in the service of particular socially defined purposes.[5] The primary emphasis is upon the *activities* associated with the *use* of scientific knowledge for the purposes of solving technical problems which are, in large part, defined in terms of socially desirable objectives Technology or technological developments are sets of activities which result in generally quite predictable changes in the physical world. Technologists base their activities on more or less agreed upon premises about the nature and dynamics of the physical and biological world; this largely implicit consensus assists them in working together to develop the processes, machines, and structures we associate with advanced technology [6] People other than technologists, however, determine what economic or political problems are to be "solved" through the use of technology. The financial resources required to carry on technological activities almost invariably must be obtained from public or private organizations having a vested interest in the outcome of those activities Thus, technological development is nearly always shaped by a search for solutions to problems or for satisfactions of needs defined by the "donor," its employers, or clients [7]

The increasingly sophisticated science-based requirements of technology make it impossible for technical problem solving to be done by broadly versatile technicians working as generalists Ever more specialized training has been necessary for coping with the complexities of advanced technical knowledge. Specialization in turn requires that the men and women in command of particular understandings of the physical and biological world work in interdependent cooperation Thus, a strong imperative exists for technology-based organizations in both the private and public sectors to expand and to become increasingly interdependent As this process is carried forward, technologists--engineers, chemists, architects, physicians, operations researchers, and industrial managers--are brought together in large or moderately sized complex organizations which attempt to control and coordinate their activities. This remarkable achievement of social organization has provided us with enormous capacities for directly altering the physical world and for indirectly shaping the social world as well.

The web of interpersonal relationships implicit in the organized activities of these technologists, their managers, sponsors and clients, reveals the social texture of technology Participating organizations touch the lives of countless citizens--by employing them, taxing them, and approaching them as consumers Hence, carried on through the medium of cooperating technologists and their organizations of development, production, and distribution, "technology" is an identifiable aggregation of people--people joined by roughly similar premises and expectations about technological processes and enabled thereby to relate to one another in certain predictable ways. In sum, technology can be seen as a techno-*social* system, one which over the past century has been the agent of ever-increasing growth in society's sheer ability to alter economic and political conditions and the personal opportunities of its members.[8]

As the people who animate the social infra-structure of technology interact--technologists, managers, suppliers, promoters, customers, regulators, citizens--the number of those who can be considered to be "outside" the system, as opposed to "insiders," diminishes. "Technology" becomes the source of unexpected and often quite surprising changes in the social experiences of all concerned. These changes may be associated with new, unforeseen physical capabilities, with improved economic production or dislocation, with military victory or defeat, with freedom of movement or incarceration, with improved health or attenuated death. In countless such examples, technical developments have sustained or altered the capacities of people to act, and "technology" has entered the circle of individual relationships that shape the character of personal experience for all members of society In this sense, then, technology is not mere machines, remote and disembodied, not abstract analytical processes or mute structures, technology *is* social experience Through networks of individual relationships technologies translate scientific knowledge into devices, institutions, and tangible experience for all people A long series of links joins all members of the "technological society"--from "science" through "technology" to the large organizations of production and distribution to organizations administering the rules which govern citizen relations among the former And within this series of links it is "technology," not "science," which in our view is the engine of change This reasoning leads us to our initial informal hypothesis that

> technology is perceived by the public *as part of social experience*, instrumental in triggering changes in society and stimulating conditions that account in part for experiences which some people value and others seek to avoid.

Implicit in this hypothesis is an assumed distinction between science and technology. In the next section we argue for such a distinction.

TECHNOLOGY IS NOT SCIENCE

The terms "science" and "technology"--science-and-technology--are so frequently linked in the parlance of the popular media, in the informal language of both the technical and industrial communities, and in the reports and pronouncements issuing from official bodies such as the National Science Foundation (NSF) and the National Academies of Science and of Engineering (NAS, NAE) that they suggest a tight--nearly inseparable--bond. That two different terms persist indicates certainly that in some time past there were two distinct concepts and sets of activities, but the present frequency of their combination implies that "science" and "technology" have become so closely united that the distinction serves no useful purpose.

Contemporary science and technology indeed share a large intricately woven common web of concept and logic about the character and dynamics of the physical world Modern technologists are deeply indebted to scientists for the discovery of reliable laws concerning the structure and dynamics of nature These discoveries have enabled technologists to plan and construct the machines and structures which so radically transform materials of limited intrinsic worth into the awesome implements of industry and war. In their turn, scientists clearly depend on technologists for increasingly accurate scientific measurements and often for the basic apparatus without which "science" would remain pure theory [9]

While the degree to which scientific knowledge informs various technical ventures differs from field to field, there is no question that theoretical and experimental scientific work has contributed immeasurably to the solution of technical problems But does that contribution make the people who carry out technology and those who carry out science one and the same? Are the activities so similar that the agents become indistinguishable?

We have argued that technology can be seen as a social system If we also conceive of science that way, does it turn out to be the same system of social action as technology, carried on by the same people? If it does, then the way science-and-technology is heralded in the press, in science policy documents, and by the statesmen of science, as well as by sponsors of technological programs, serves quite adequately to identify the people and activities engaged in those startling discoveries and events that shape our world. If, however, it turns out that neither most of the people nor many of the activities are the same, then the language generally used to describe science-and-technology serves only to confuse and mislead both the public and policy makers

The choice of one as against the other of these perspectives is crucial to our strategy in exploring the public's perceptions of and attitudes toward technology. Were science-and-technology to be indistinguishable in the social sense, then surveys such as the ones reported here would be required to range across all the activities of scientists as well as technologists. Questions related to the conduct of scientific research and to theoretical controversies within science should be included in them as well as queries about the character of technological implementation If, on the other hand, the social character of "technology" can be distinguished from "science," then the focus of our surveys of public response to technology should concentrate on those activities and consequences which are perceived to be associated with "technology" and avoid confusions with those associated with "science." We shall argue here that there is a sociological basis for distinguishing between them. In Chapter III, our assertions are put to the empirical test of whether such a distinction is perceived by the public.

Intuitively at least, it does not seem sensible to lump scientists and technologists, nor the activities they pursue, into the same overarching category. While there are many instances in which scientists have turned their hands to engineering and to healing, there is a distinct difference between scientists and technologists. This difference is apparent in the organizations they inhabit, in the professional associations they join, in the spirit in which they conduct their work, in the goals they pursue, and in the character of their respective relationships to the sources of their financial and political support. To typify the differences between scientist and technologist, we shall use caricature for reasons of brevity, clearly recognizing that our descriptions are not so pervasive or so simplistic as we shall suggest. Nonetheless, they represent tendencies, and, for the purposes of this study, the differences are quite important.

The objective of science, and of those who call themselves "scientist," is the discovery of the underlying structure and dynamics of nature [10] Primary value is attached to increasing the power of explanation, whether or not it may lead to the solution of a socially defined problem area. Understanding is the scientist's aim, and his rewards are dispensed by peers for adding significantly to increased understanding of a particular phenomenon.

The technologist pursues other ends For him, practice is as central as understanding, and his aim is the solution of problems defined in technical, economic, and sometimes political and social terms.[11] Increasing efficiency, hopefully both technical and economic, becomes his goal Understanding of physical or biological phenomena becomes a means, not the objective of his enterprise It is true, of course, that technological ventures have for centuries uncovered "scientific" enigmas--questions about the physical, biological, and social world for which no adequate explanation existed. Consequently, technological work has stimulated considerable scientific inquiry. Much more the case in centuries past, this contact still occurs with enough frequency that scientists and technologists share in their day-to-day activities a close reciprocal energy

Differences in objective and style prompt one of the most salient distinctions for the social understanding of science and of technology Scientific activities are organized in such a way that their influences radiate outward--away from the scientist, his work subject to little reciprocal impact from the social environment. Those outside the circle of scientific competence would not be considered justified in specifying the particular problems upon which a scientist should work Technology, on the other hand, is significantly influenced by "outsiders." Indeed one prominent theme in the professional literature is the importance of service to social and economic values Thus, in developing technologies which shape social experience, technologists, in addition to their own enthusiasms, receive "outside" direction concerning the types of problems upon which they should work.

The goals and perspectives of scientists, as contrasted to those of technologists, have resulted in rather striking differences in the organizations with which each group is associated.[12] An extensive and sprawling literature mulls over the puzzles of organizing basic scientific research activities which defy the familiar coordinating devices of managerial hierarchy Technical development, on the other hand, is much more operationally shaped and the object of forceful managerial controls At the extremes, the structure and workways of university-based scientific research teams or departments differ sharply from those of industry-based engineers or physicians in private practice. The professional life and work style, for example of high energy physicists and geneticists, is very different from that of construction engineers and general practitioners. Their professional associations contrast markedly as well Compare, for example, the topics addressed in any particular year at the meetings of the American Physical Society with those of the American Society of Mechanical Engineers Compare the American Biochemical Association with the American Medical Association. Major substantive questions, policy concerns, and even the style of conversations convey very different qualities

Finally, scientific work and technological work tend to be characterized by markedly different relationships to governmental agencies providing financial support. Typified in the terms "grants" as opposed to "contracts," scientific support allows a much greater freedom for the researcher to define and conduct his project, with little or no supervision by the funder, than do contracts for technological work. These by contrast include quite rigorous specification of the problem to be solved, a time estimate on when the solution will be forthcoming, and requirements for frequent reporting to the funding agency on the intermediate progress of the work There is little latitude for deviation in a contract; in a grant there is a great deal. The assumption which prompts these differences is that in scientific work neither the questions nor the answers can be rigorously specified in advance, whereas in technological work, the problem to be solved is specifiable and the answers presumably attainable within a particular span of time.

To what extent is the public aware of these differences in the social activities and objectives of "science" as contrasted to those of "technology"? On the one hand, the evidences of scientific activity remain at a far remove from everyday experience On the other, involvement of those members of society touched by technological activities is immediate and pervasive. While *technology* in this sense is very much a part of everyday life, it is certainly plausible that the public would not even recognize the existence of *science* activities, though if they did they might very well perceive them differently from technological activities. Accordingly, our next informal hypothesis, following from the argument just presented, is that

> *the public perceives a distinction* between the activities of "science" and those of "technology" and infers a crucial difference in the degree of restraint that should be imposed on each activity--less regulation for "science" than for "technology."

Disproving the null hypothesis formed of that proposition--that the public recognizes *no* distinction between scientific and technological activities and assigns the same degree of expected regulation to both--complements the present analytic task

The questions used in the surveys were designed to keep "science" and "technology" cleanly distinct, in order that the degree to which such a perceived difference exists might be discovered. Responses to the relevant questions are subjected to close scrutiny in Chapter III We turn now to some preliminary considerations of "technology's" most telling aspect for political and social experience. its relationship to social change

TECHNOLOGY AND SOCIAL CHANGE

Underlying our interest in technologies and the attitudes of citizen/consumers toward them is an assumption that technological development has been and will continue to be a prime impetus for social change Clearly, any exploration of public attitudes toward "technology" should consider the impact of this relationship on personal experience Although there is ample descriptive evidence in the literature that given cultures have been subject to strong and surprising impacts from the introduction of various technologies, a well formulated theory of technological change and social change unfortunately has not been developed To be sure, considerable attention has been levied on the relationship between technological development and economic development [13] And there continues to be a keen interest in the conditions stimulating technological innovation and the diffusion of new technical devices and processes [14] Indeed most of the interest in the relationship of technological development to change in advanced or advancing societies has centered on the problems of understanding the conditions for successfully introducing new technologies for the sake of enhancing the economy These studies have been colored with a quite positive view of technology as a source of beneficial consequences for the receiving society Such studies suggest another informal hypothesis. that

> the public perceives past and presently implemented technology *to be beneficial and useful* in the solution of social problems.

The more extreme form of this proposition, one characterizing the assertion of some critics concerned about the "seductive" effects of technology, would be that *all* presently implemented technological development is seen by the public as quite beneficial. Attitudes related to the public's sense of the beneficence of past technological developments are explored in Chapter IV and Chapter IX below

Another type of interest has been piqued by the apparent challenge that technological development poses for the institutions of governance and political decision making. Here the tone has been less enthusiastic [15] It is alleged that technological development has produced an increasing dependence of political decision makers upon technical experts, that ever increasing knowledge requirements have added enormously to the burden of already overloaded decision makers and have removed them even further from contact with a citizenry which remains untutored about technology-centered political decisions The consequences of this situation for democratic forms of governance are obvious and disquieting both to the public and to a worried intellectual elite committed to the ideals of political participation To the degree this situation obtains we would expect the following hypothesis to hold that

> the public is *suspicious of decision makers* involved in decisions concerning technological policies, and feels illegitimately excluded from a process in which it seeks to participate

Several aspects of these concerns are discussed in Chapter V.

There is emerging recognition that technological developments have been and are likely to remain central to the great military and economic expansions of this century, and, at the same time, that these developments result in a widened gulf between the governed and the governors [16] But no closely reasoned conceptions of *what* it is about technological development that prompts these changes informs that recognition Nor has there been much systematic examination of the various *kinds* of change society undergoes as a result of technological development, of the formation of attitudes and changes in attitude, or of the *processes* through which technical innovation affects the social experiences of the public. To be sure, stories abound about the impact of this or that technology upon particular groups and about the increased difficulties technical development makes for political figures [17] But little attempt has been made to relate these stories within an overall conception of technology and social or political change In the absence of such a formulation, we have outlined the elements of one that has informed the surveys reported in this book.

Our initial point of departure is a conception of technology, noted near the beginning of this chapter, as a system of social activities experienced by those both directly and indirectly associated with its production and distribution In this sense, technical innovations (whether their emergence is a "scientific" breakthrough or a pragmatic one) stimulate social changes directly--by providing new or improved capacities to be taken up by consumers--and indirectly by altering the character of public and private organizations in a society New or improved capacities have ranged from the familiar to the fantastic, from the accommodating to the horrifying· we have witnessed increased efficiency in producing consumer products and improved facilities for moving goods and people rapidly from place to place, the ability to construct more massive and higher buildings; greater precision in arriving at a particular point in an earth or lunar orbit, but we also witness more efficient means for the wholesale destruction of people, vegetation, and structures; more pervasive, quicker ways to pollute streams and induce lung cancer, increased densities of automobile traffic in downtown urban areas and of nuclear waste over a nation.

As these new capacities become widely dispersed they often open up new experiences to individuals through activities which they will come to value as much or more than previously valued activities [18] This may be the case, for example, for the capacity to travel to formerly inaccessible areas, to consume new types of food in greater quantities, to engage in sexual activity without fear of pregnancy, to communicate face-to-face over very long distances, to extend life through organ transplants, or, depending on the society's military posture, to destroy large communities with little personal risk In providing capacities not previously available, technological development can increase the alternatives open to members of a society And, depending on how they are used, they may work to increase the short term integration of the existing social order or to prompt disruptions in it Accordingly, citizens may perceive these technical capacities as having directly beneficial effects on their social and/or political experience or as potentially erosive to that experience because they provide novel challenges to cherished values Which interpretation will emerge depends, in part, on individual estimates of the likelihood that a new capacity will have consequences that affect conditions or beliefs deemed important In hypothetical form, this argument asserts that

> the public, in considering future technological development, supports or opposes a particular technology to the degree

it is *certain of beneficial results* from its implementation. As these certainties vary so varies the degree to which the public is likely to support specific technologies. Were this hypothesis to be confirmed, it would cast in doubt assertions made by those who attempt to account for apparent public hostility to science and technology on the grounds that the public irrationally rejects the results of systematic, analytical thought--i e , scientific thought.

Technological development also has less direct effects on the experiences of citizen/consumers, effects stemming from the uses to which a new capacity may be put by commercial or public organizations New technical capacities may be viewed as having the potential to buttress the economic, social and/or political influence of those in positions of corporate power But they can also be a threat to that influence Many technical innovations increase the competitive advantages to the developer and/or user of the new capacity This is often the case for new technical capacities introduced into industry. It is presumed by the innovators that this advantage will enhance the firm's relative economic power If hopes are borne out, the firm's political power is likely to increase as well. Thus, through the utilization of new technological development and/or in pursuit of enhanced economic advantage in its use, industrial and commercial firms become enmeshed in political affairs.[19] This involvement can take place on the local level, as instanced by oil companies influencing the shape of local zoning regulations regarding refinery siting, on the national or state level by the involvement of automobile manufacturers in matters affecting everything from speed limits and auto safety regulations to pollution control standards; and on the international level by the behavior of the multinational corporations in working to avoid nationally imposed constraints on their activities.

Technological development almost invariably expands government's role in society and thereby affects the experience of its individual members--whenever government itself takes on the task of producing a new technical possibility and whenever it is pressed to regulate existing or future technical development In the first instance, perhaps the most startling example of government stimulated technology has been its promotion of the engineering virtuosity associated with the establishment of NASA and the race toward outer space. Paralleled on a lesser scale by the U S. Army Corps of Engineers' flood control work and the government-sponsored efforts in search of a cure for cancer, these activities stimulate directly the growth of public organizations and indirectly the expansion of those contracting firms almost totally dependent on government funding which actually carry out the particular tasks of the development. In the second instance, government's intervention as regulator has sometimes taken the form of continuously monitoring operations which market technical processes, operations such as the air lines industry, sometimes it has been to prohibit hazards stemming from technical development. The latter function began as early as the 1800's with regulation of steamship boiler manufacture[20] Most often carried out at the national level, the scope of government's regulation of technology has grown enormously, now even government's own agencies are subject to it-- note, for example the recent establishment of the Environmental Protection Agency (EPA) and most recently the reorganization of the Atomic Energy Commission, which established the Nuclear Regulatory Commission It seems reasonable to expect this regulatory trend to intensify as the longer term negative effects of technological development become more readily apparent Indeed, the institutionalization of the Office of Technology Assessment as an arm of the Congress and of the EPA in the Executive signals the growth of this tendency Aspects of the public's perception of of the regulation of "technology"--and to some extent of "science"-- are discussed in Chapters III, VII, and VIII

Social change results from technological development according to the extent that new capacities are dispersed. To accomplish delivery of capacity, large industrial and governmental organizations are essential. And as technological capacities enhance their influence in society, this influence in turn affects the experiences between consumer/citizens and the dispensers and regulators of technology How all of these private and public organizations, then, absorb the technical capacity, gather themselves to produce, deliver and regulate it, and how they behave in relation to their market on the one hand and to the citizenry at large on the other has a strong effect on the public's social and political experience Insofar as the challenges and opportunities of technology alter the way such organizations are experienced by the public, technology as a social system is indirectly affecting the social experiences of the public.

Thus technology assumes a potentially enormous role, conditioning the social experience of us all It can alter the immediate social context around citizen/consumers by directly changing the character of technical alternatives available to them and by shaping the interactions between them and the many public and private organizations participating in the delivery or regulation of technology. People may experience these alternatives and interactions as integrative or as alienating--as positively reinforcing their personal values or as challenging and even threatening them. The public, then, can be understood to be the recipients of "technology" as a social activity and to experience it as a part of everyday life. Some of the feelings expressed by the public about that experience are explored in Chapters III and V.

CONTRASTING PERSPECTIVES AND PUBLIC RESPONSES

While a well formulated theory of technology and social change yet remains to be developed, there is no lack of commentary either about potential consequences of technological development or about potential policy responses to the changes that follow in its wake.[21] Among these commentaries, two perspectives stand out as particularly cogent, consistently argued, and most comprehensive They differ in their prognoses for man's future and in their underlying assumptions about the social control of technology. Most crucially for our purposes here, they differ implicitly in their expectations for public or mass opinion about technological developments. Each suggests a particular cast to public attitudes toward technology, and from each we will draw informal hypotheses and subject them to empirical examination in Chapter IX

The first perspective, most succinctly articulated in a panel report of the National Academy of Science, relies heavily upon pluralist-incrementalist thought; joined, curiously, by the writings of the gentle radical Paul Goodman, it projects a fundamental optimism about the future of technological politics.[22] The second perspective is much more pessimistic. Deeply rooted in the European tradition and most forcefully presented in the work of Jacques Ellul, this view holds that decision makers and the masses have become so conditioned by faith in technology's "one best way" that it has become a self-moving, autonomous force, condemning society to a headlong rush into technical developments inevitably fraught with frequent unpleasant surprises. Any amelioration of past efforts will be bought at the price of further unpleasant surprises and technical domination. The two perspectives are virtually diametrically opposed in their assertions about the possibilities and outcomes of public or mass attitudes

<u>Optimistic incrementalism</u> Fueled by pluralist conceptions of American politics, the case has been made for incremental approaches to policy making concerning technology[23] The report on technology assessment prepared by a panel from the National Academy of Science for the House of Representatives states that case very strongly It is concerned with the deficiences of existing processes of decision making and explores how the present process might be altered "so that private and public choices bearing on the ways in which technologies develop and fit into society will reflect a greater sensitivity to the total systems effects of such choice " (p. 13f) Reflecting a basic confidence in our political system, the panel opts for more finely tuning the processes we presently employ Their emphasis is not on technologies per se, but rather on the human behavior and institutions engaged in our political decision process. They stress the need for decision makers to broaden their perceptions about the problems and opportunities inherent in technological development "at sufficiently early stages to make a difference and in terms of sufficiently broad.. criteria to overcome the bias toward technologies .that promises immediate utility to those for whom they are designed" (p 18)

To accomplish these conditions the panel proposes that in considering technology-centered policies, "technological changes. ought not to be made in ways that subordinate every other consideration to the dominant purpose of the immediate project ." (p. 31), that "a basic principle of decision making should be to maintain the greatest practicable latitude for future action". "reversibility of an action [being] counted as a major benefit, its irreversibility a major cost" (p 32), that the negative side effects or second-order consequences of technological development ("externalities" to the economist) be included in any analysis and pressed upon the producer of the technology (p 33ff), and, most startling among the report's proposals, that decision making about technology be brought more directly into the political process through the creation of constituencies and "conflict inspiration" (p 39f).

Paul Goodman, whose political philosophy often seems at odds with that of the members of the NAS Panel, reaches many of the same conclusions in his prescriptions for a more humane technology. In addition to endorsing the same reversibility criterion, Goodman calls for prudence and humility on the part of the technologist (and, by extension, on the part of decision makers engaged in technology policy as well) He cautions them not to oversell technology and to resist the temptation to apply every new technical device without serious second thoughts. Announcing that his "bias is pluralistic," Goodman holds that increased knowledge, coupled with active participation on the part of affected groups, offers the best hope of taming the technological beast and rendering it more humane

While neither of the sources just described deals directly with the public attitudes implied by their views, we can derive them quite straightforwardly.

Several dicta in the NAS report--that decision makers should adhere to the criterion of reversibility and to heed concerns other than immediate technical utility by including "externalities" into their decision calculus--imply that its authors see decision makers as capable of becoming responsible enough to warrant public confidence. By the same token, confidence that the public is sufficiently discriminating about technology to respond sensitively to issues raised by its secondary effects is strongly suggested by the report's encouragement of broader public participation in technology-centered decision processes.

Pessimistic predictions of "The Technical Phenomenon." Running counter to the views of the "optimistic incrementalists" are those typified in the writings of Jacques Ellul[24] He claims that man's absorption with technical advances inexorably extends technology into every realm of human existence. Once begun, this spread of technique is moved by an internal logic no longer amenable to human control, it simply pushes aside critical human values such as spontaneity and freedom. Finding "widespread, if not universal, acceptance among intellectuals,"[25] Ellul's thesis weaves an apparently consistent logic, reinforced by a barrage of historical and contemporary illustrations.[26] His argument is complex, and our summary of it here will be limited to a series of claims directly informing his interpretation of mass perceptions of technology

The key assertion of Ellul's perspective is that humankind is subject to "the technical phenomenon"--an acceptance, based on reason and self consciousness, of the "quest of the one best means in every field [of human endeavor] And this 'one best means' is, in fact, the technical means. The technical phenomenon is the preoccupation of our time, in every field men seek to find the most efficient method the-best means in the absolute sense, on the basis of numerical calculation "[27] His argument continues· once established as a decision criterion, technical efficiency produces decisions by men about human affairs that sweep away other values and tend to standardize social preferences. Based on the short term effectiveness of technical methods, technological enthusiasm grows and technology becomes dominant, an end in itself, first challenging, then subordinating other social ends In effect, the means becomes the end--the search for the one-best-way becomes a universally valued activity As this attitude spreads, technique, in Ellul's words, "becomes self directing, self augmenting," without decisive intervention of man (p. 80). No human choice can really exist when society is overwhelmed by the fundamental belief in the primacy of the most efficient (one best) way.

An important element in this perspective is the assertion of a general preference for the "technological fix." Technique increases the efficiency of a technology or process, it also results in major difficulties, for a society or organization, which can consequently be resolved only by additional doses of technical virtuosity. Thus, in automating housework for the sake of convenience and efficiency, garbage disposal units are invented whose products pollute rivers This pollution necessitates new means of purifying water, often with the use of bacteria But the bacteria consume oxygen, with the result that the indigenous population of the ecosystem is killed off So we try to reoxygenate the rivers . And so the process goes, perpetually compounding technologically induced problems in the attempt to find technological solutions.

In the Ellulian world, man does not choose; he calculates And man does not forego the immediate benefits of technologies--their primary capacities, he inevitably "takes advantage" of them In so doing he activates successive generations of technological developments which call for more technological solutions to the secondary problems occasioned by prior development The result, in Ellul's judgment, is a hopeless morass of "technique " To the degree such "self augmentation" occurs, "autonomy of technique" inevitably leads to the "complete separation of the goals from the mechanism, the limitation of the problem to the means, and the refusal to interfere in any way with efficiency" (p 33).

Several properties of the "technical phenomenon" convey an implicit profile of public attitudes in necessary consonance with its advent and persistence. The emphasis on efficient means defined in calculable terms implies a rationality of numerical calculation reducing everything to quantities. Input and output factors subsume even human elements in a technical situation. Quantitatively predictable elements only are considered, which relieve men of the problems of choice and with it the obligations of responsibility [28] The notion of the one-best-way implies that the public, given the analytical limitations of most of its members, is not likely to know what means is most efficient, nor to imagine new ends attainable through technological development. It follows that the public would come to have total, unquestioning faith in the expert, in the skilled purveyor of technical devices and procedures The wonders of increasingly efficient techniques and technologies implicitly reduce the public to wide-eyed, faithful believers in those most technically skilled Add as corollaries an acceptance of efficiency as the overriding criterion for justifying technical programs, meriting higher priority than any other social values, and a general inclination to accept with little question all innovative technical programs, and a logical hypothesis emerges portraying the kind of public attitudes undergirding Ellul's "technical phenomenon " A comparison of that ethos with what we have actually discovered about the public's attitudes toward technology is discussed in Chapter IX

For now contrast the perspective of "optimistic incrementalism" with the pessimistic predictions about the "technological phenomenon " Two sharply opposed theories emerge, which, nevertheless, agree on some things They both focus on the impossibility of fully anticipating technology's consequences, they both see that today's technical magic may, like the albatross, change from good omen to a force exacting retribution But the two theories arrive at dramatically different, mutually contradictory predictions about the possibilities for "taming" technology The NAS/Goodman theory augurs generally continuous progress predicated on thoughtful action and constant monitoring by a body of officials and a public increasingly sensitive to the value consequences of public policies and able, when necessary, to retrench, mitigate, and ameliorate technical development Ellul's conception, in contrast, posits a dynamics immune to any of these error-correcting mechanisms The "technical phenomenon," inexorably sweeping over the populace and political leaders, opens the floodgates to rapid, ever more pervasive technological development, soon propelled by technical efficiency as its own end

In effect, both perspectives agree that public trust is to be placed in society's technical political experts--but for vastly different contributions In the NAS/Goodman perspective, such leadership is confidently expected to be able to include social values and estimates of "externalities" into their decision processes For Ellul, the experts are the technological phenomenon personified, the masses turn to them on blind faith, in dumb wonder at their skill in their ability to translate the predominant value of efficiency into technique. Thus the two views differ sharply in their understanding of the public. The NAS/Goodman view holds that the public should be and, by inference, is able to contribute effectively to the multifaceted process of review of technological programs. Ellul gloomily believes that the masses have been seduced by the glories of the immediate capacities of technology and that there is little likelihood of escaping the headlong plummet into the horrors of a technological society He allows only three conditions which would upset his prediction. an Act of God, a general war which would eliminate most modern technique, and a change in human consciousness. In a very real sense the business of this book is to explore the character of human consciousness of technology.

NOTES

[1]We could not find any reporting of studies which review the content of media presentations concerning science and/or technology. Based on the content of television, radio, and newspaper reporting of technological and scientific events, it is our impression that if such a study were conducted, it would find a clear reiterated message of the wonder and promise of technological capacity. Implicitly, that approach on the part of the media assumes a public enamored by such marvels. Popular scientific and technical magazines, such as *Popular Mechanics*, *Popular Electronics*, etc., strongly reinforce our impression.

[2]See T.B. Sheridan, "Citizen Feedback: New Technology for Social Choice," *Technology Review* 73 (Jan. 1971), 46-51; James Carroll, "Participatory Technology," *Science* 171:3972 (Feb., 1971), 647-653. See also Frank Von Hippel and Joel Primack, "Public Interest Science," *Science* 177: 4055 (Sept. 29, 1972), 1166-1171, and Ernest M. Jones, *Advocacy in Technology Assessment* (Washington, D.C.: George Washington University Program of Policy Studies in Science and Technology, Staff Discussion Paper No. 209).

[3]For perhaps the best summary of the issues surrounding this question see Gerald M. Pomper, "From Confusion to Clarity. Issues and American Voters, 1956-1968," *American Political Science Review* 66:2 (June, 1972), 415-428, esp. 415f.

[4]That the electorate, at least, does so with respect to complex issues generally is argued by William E. Bicker, *Ideology is Alive and*

Well in California: Party Identification, Issue Positions, and Voting Behavior, Paper delivered at the American Political Science Association Convention, Washington, D.C., September, 1972. See also Pomper.

[5]Our conception of science and technology includes both the definition of their activities and the people who are mainly engaged in carrying them out. The definitions in both cases are familiar; see J.K. Feibleman, "Pure Science, Applied Science, Technology, Engineering· An Attempt at Definitions," *Technology and Culture* 2.4 (Fall, 1961), 305-317; and C. Mitcham and R. Mackey, Eds., *Philosophy and Technology* (New York: Free Press, 1972).

[6]For a more extended discussion see Todd R. La Porte, "Beyond Machines and Structures Bases for the Political Criticism of Technology," *Soundings. An Interdisciplinary Journal* 57:3 (Fall, 1974), 289-304.

[7]For example see Rodney W. Nichols, "Mission-oriented R & D," *Science* 172.3978 (April 2, 1971), 29-37; and David Allison, Ed., *The R & D Game: Technical Men, Technical Managers and Research Productivity* (Cambridge, Mass.: M.I.T. Press, 1969).

[8]See, for example, F.E. Emery and E.L. Trist, "Socio-technical Systems," in *Management Sciences Models and Techniques* Vol. 2 (New York: Pergamon Press, 1960); Tom Burns, "The Social Character of Technology," *Impact of Science on Society* 7:3 (September,1956), 147-165; and Todd R. La Porte, et al., *Interactions of Technology and Society: Impacts of Improved Airtransport--A Study of Airports at the Grass Roots* (Institute of Governmental Studies, University of California, Berkeley, Report to Ames Research Center, NASA, December 1974), Chapter I. In part this notion is at the root of the conception of "supporting system" as employed in the National Academy of Sciences' report to the U S. House of Representatives Committee on Science and Astronautics (July, 1969), esp. 16. See note 22.

[9]See especially Henrik W. Bode, "Reflections on the Relation between Science and Technology," *Basic Research and National Goals,* (A Report by the National Academy of Sciences to the U.S. House of Representatives Committee on Science and Astronautrics, March, 1965), 41-76; and Howard Reiss, "Human Factors at the Science-Technology Interface," in W.H. Gruber and D.G. Marquis, Eds., *Factors in the Transfer of Technology* (Cambridge, Mass . M.I.T. Press, 1969), 105-116. Compare Harold A. Foecke, "Engineering in the Humanistic Tradition," *Impact of Science on Society* 20:2 (April-June, 1970), 125-135.

[10]Norman Storer, *The Social System of Science* (New York: Holt, Rinehart, Winston, 1966); Warren O. Hagstrom, *The Scientific Community* (New York: Basic Books, 1965); and William Kornhauser, *Scientists in Industry: Conflict and Accommodation* (Berkeley· University of California Press, 1952).

[11] See Robert Perrucci and Joel E. Gerstl, Eds., *The Engineers and the Social System* (New York: Wiley, 1969), esp. 41ff.

[12] Daniel D. Roman, *Research and Development Management: Economics and Administration of Technology* (New York: Appleton, 1968); Arthur Gustenfeld, *Effective Management of Research and Development*, (Reading, Mass.: Addison-Wesley, 1970). See also Chris Argyris, "On the Effectiveness of Research and Development Organization," *American Scientist* 56:4 (Winter, 1968), 344-355.

[13] Richard Nelson, Merton J. Peck and Edward Kalacheck, *Technology, Economic Growth and Public Policy* (Washington, D.C.: Brookings Institution, 1967). See also Jacob Schmookler, *Invention and Economic Growth* (Cambridge, Mass.: Harvard University Press, 1966); and National Science Foundation, Division of Scientific Resource and Policy Studies, *Colloquium on Research and Development and Economic Growth/Productivity*, April 26, 1971, papers and proceedings (Washington, D.C.: December, 1971).

[14] K. Pavitt and S. Wald, Eds., *The Conditions for Success in Technological Innovation* (Paris: Organization for Economic Cooperation and Development, 1971); Nathan Rosenberg, "Economic Development and the Transfer of Technology: Some Historical Perspectives" *Technology and Culture* 11 4 (October,1970), 550-575; G.F. Ray, "The Diffusion of New Technology: A Study of Ten Processes in Nine Industries," *National Institute Economic Review*, Issue 48 (May, 1969), 40-83; and Everett Rogers, *Diffusion of Innovations* (New York Free Press, 1969). See also Sumner Myers and Donald G. Marquis, *Successful Industrial Innovations: A Study of Factors Underlying Innovations in Selected Firms* (Washington, D.C.: National Science Foundation 1969). For comparison with the latter, see K. Pavitt, "Technology, International Competition and Economic Growth· Some Lessons and Perspectives," *World Politics* 25·2 (January,1973), 183-205.

[15] See Don K. Price, *The Scientific Estate* (Cambridge Harvard University Press, 1965); Murray L. Weidenbaum, *The Modern Public Sector; New Way of Doing the Government's Business* (New York: Basic Books, 1969); Irene Taviss and Judith Burbank, *Technology and the Polity* (Cambridge, Mass.: Harvard University Press, 1969). See also Joseph Haberer, *Politics and the Community of Science* (New York: Van Nostrand, 1969); David Loth and Morris Ernst, *The Taming of Technology* (New York: Simon and Schuster, 1972) and Sanford A. Lakoff, Ed., *Knowledge and Power: Essays in Science and Government* (New York: Free Press, 1966).

[16] Chandler Stevens, "Citizen Feedback and Societal Systems," *Technology Review* 73 3 (January, 1971), 38-45; compare R.L. Chapman, "Congress and Science Policy. The Organizational Dilemma," *Bulletin of Atomic Scientists* 25:3 (March, 1969), 4-7, 28.

[17] Richard S. Lewis, *The Nuclear Power Rebellion: Citizen vs. the Atomic Industrial Establishment* (New York: Viking, 1972); compare Dorothy Nelkins, *Nuclear Power and Its Critics: The Cayuga Lake Controversy*

(Ithaca, N.Y.: Cornell University Press, 1971). See also, S. Zwerling, *Mass Transit and the Politics of Technology: A Study of BART and the San Francisco Bay Area* (New York: Praeger, 1974); Richard Rettig, et al., Ohio State University, School of Public Administration, "Kidney Therapy and Public Policy· A Study of Medical Innovation," (research project proposal to National Science Foundation, 1973); D. Nelkins, *Jetport: The Boston Airport Controversy* (New Brunswick, N.J.: Transaction Books, 1974); and J.D. Starling, *Prometheus Unbound: A Study of the Dallas/Fort Worth Regional Airport,* Center for Urban and Environmental Studies, Southern Methodist University (October, 1974).

[18] For a revealing discussion of the relationship of novel experience to emerging values, see Michael D. Cohen and James G. March, "Leadership in Organized Anarchy The Technology of Foolishness," in *Leadership and Ambiguity· The American College President* (New York: McGraw-Hill, 1974). For particular emphasis on the part technical innovation plays in this matter, see Melvin Kranzberg, "Technology and Human Values," *Virginia Quarterly Review* 40.4 (Autumn, 1964), 578-592, Emmanuel C. Mesthene, "Technology and Human Values," *Science Journal* 5A·4 (October, 1969), 45-50; and Robert Nisbet, "The Impact of Technology on Ethical Decision-making" in *Tradition and Revolt: Historical and Sociological Essays* (New York Vantage Press, 1970), Chapter 10.

[19] There are numerous authors who make this point; perhaps the most trenchant observations are to be found in John K. Galbraith, *The New Industrial State* (New York: Signet, 1968) and *Economics and the Public Purpose* (Boston: Houghton, Mifflin, 1973).

[20] John Burke, Ed., *The New Technology and Human Values* (Belmont, Ca.: Wadsworth, 1972).

[21] For a representative representative sample of it, see Victor Ferkiss, "Man's Tools and Man's Choices the Confrontation of Technology and Political Science," *American Political Science Review* 67:3 (September, 1973), 973-980. See also Galbraith, *The New Industrial State*; and Don K. Price, *The Scientific Estate*. For more recent comments, see Robert L. Heilbroner, *An Inquiry into the Human Prospect* (New York: W.W. Norton, 1974)

[22] National Academy of Sciences, *Technology: Processes of Assessment and Choice,* Report to U.S. House of Representatives, Committee on Science and Astronautics (July, 1969); Paul Goodman, "Can Technology Be Humane?" *New York Review of Books*, 13:9 (November 20, 1969), 27-34.

[23] See the major efforts by Robert Dahl and Charles Lindblom, *Politics, Economics and Welfare* (New York: Harper and Row, 1953); David Braybrooke and Charles Lindblom, *A Strategy of Decision* (New York: Free Press, 1963); and Robert Dahl, *A Preface to Democratic Theory* (Chicago: University of Chicago Press, 1956).

[24] Especially *The Technological Society*, tr. J. Wilkinson, (New York: Knopf, 1956).

[25] Ferkiss, 973.

[26] Among those testifying to the force of Ellul's vision is William Kuhns, *Post-Industrial Prophets: Interpretations of Technology* (New York: Weybright and Talley, 1971), 111; see also Langdon Winner, *Autonomous Technology and Political Thought* (Cambridge, Mass.: M.I.T. Press, 1973).

[27] Ellul, 21.

[28] Ellul puts it this way: "The combination of man and technique is a happy one only if man has no responsibility. Otherwise he is ceaselessly tempted to make unpredictable choices and is susceptible to emotional motivations which invalidate the mathematical precision of this machinery...and the techniques of prediction." (*Ibid.*, 136).

CHAPTER II

RESEARCH DESIGN   BASIC PARAMETERS AND METHODOLOGY

A major hope of this research is to begin closing the gap in information about how the public regards technological development   The vehicle for this effort has been two extensive surveys of public attitudes, the first (TECH I) conducted in 1972, the second (TECH II) in 1974 Originating as part of a larger study of technology and social change, TECH I was designed and pretested between January and May, 1972, in cooperation with the Field Research Corporation   Its sequel, TECH II, was designed and pretested between January and May of 1974, again in cooperation with the Field Research Corporation

It is well known that there are inherent limitations to all types of attitude surveys. The data gathered are based on "opinions" which may be transiently held, particularly when they relate to concerns not highly central to the person being questioned; such may often have been the case with opinions gathered here   Also, opinions may be founded on misinformation and thus subject to alteration by new facts acquired by respondents from educational efforts or other sources   Measurement problems, moreover, are always formidable   Throughout every stage of instrument construction and data analysis, we were acutely mindful of the limitations that accompany them   Nevertheless, the survey technique with all its shortcomings was the best one available to us in our pursuit of knowledge about how the public-at-large views technology   We believe that in this particular instance enough internal consistency is suggested by the data to warrant its being taken seriously. At various points in our discussion, we will present evidence that supports our confidence in its intrinsic validity

We had hoped, from the outset, to provide at least a partial baseline for future study of the effects of technical development upon social and political change. Such a record of changes in perceptions of technology over time could be a basis for examing the character of shifts in public values--specifically, of the responsiveness to political and social events of the public's attitudes toward various types of technological development TECH I, undertaken in 1972, polled 980 adult Californians selected by means of a multi-stage sampling design which approximates a random sample[1] During the first three weeks of June of that year these respondents were interviewed in their own homes for about 70 minutes.[2] The "energy crisis" of the winter of 1973-74 offered us a logical opportunity for a second look We expected that some very interesting shifts in the public's attitudes were taking place With events so sharply focused on people's dependency upon the energy technologies, we reasoned that at the very least the salience of the general issue area was bound to increase Were attitudes *crystallizing*? Could significant *changes* in attitudes be monitored?

TECH II was designed to explore these questions Employing the same sampling and administration techniques as were used in the 1972 survey, this second one was administered to *both* another, smaller cross-section sample of the California population--316 people--*and* to 472 people from among the original sample interviewed two years earlier This group of reinterviewed subjects provides the crucial *panel* of responses necessary in any attempt to monitor individual attitudes over time. As resources allowed, attempts were made to recontact *all* persons who had participated in TECH I Approximately 66% of them were recontacted, but only 48% agreed to be reinterviewed.[3] This reinterview rate of 48% is somewhat less than the 65% obtained for the three-wave panel study which has become the model for subsequent comparative research of this kind, the election study undertaken by the Michigan Survey Research Center (MSRC) in 1956-1960. But whereas MSRC had the resources to trace most persons who had moved from a former address, ours allowed us to do so only if they had moved to another residence within the same city

<u>Overall representativeness of California data</u> Because the scope of most policies related to developments in science and technology is clearly national, California data will do little to inform decision makers of the public's mood if its residents differ very markedly from their national counterparts. Tables C-1 through C-6 in Appendix C present

comparative U.S. Census data for the United States, California, TECH I respondents and TECH II respondents, these tables, respectively, show distributions of the demographic characteristics of race, sex, age, education, occupation, and income for these four groups. A fifth group is added for purposes of further comparison respondents in a national survey undertaken by MSRC in 1972 [4] In the main, these demographic tables denote the striking representativeness of California to the nation as a whole. California profiles deviate no more than 4% (and usually somewhat less) from nationwide distributions of race, age, sex, occupation, and income. On only one important characteristic, education, does California's population differ significantly from the national average The percentage of Californians with at least one year of college education is about 35% greater 31 4% compared to 23.3% nationally. This skewing of educational level distributions suggests that Californians in general may be more likely than respondents in a national sample to be informed about science and technology and therefore to bias the results of the poll When appropriate, we shall point out how a particular variable or relationship is affected by education level. For now, suffice it to say that although this effect does occur, it does not distort findings sufficiently to prevent their applicability to the national population.

While only a replication on the national level of the surveys reported here could absolutely prove that claim, we believe that if one were undertaken it would not produce results greatly different from our own. Indeed, the claim is strongly reinforced by comparison of our results with those of a recent national survey sponsored by the National Science Foundation (NSF) [5] Distribution of responses to several items common to both surveys shows a reasonably high degree of correspondence, these responses will be discussed at length in Chapter V We do not claim that California mirrors the rest of the nation perfectly, but we are confident that attitudes of its residents can be reasonably extended to their national counterparts.

Representativeness of TECH I and TECH II samples The basic sociopolitical characteristics of our two samples are summarized in Table 2-1·

TABLE 2-1

DEMOGRAPHIC CHARACTERISTICS OF POPULATION CROSS-SECTION SAMPLES: TECH I (1972) AND TECH II (1974)

	Race			Sex		
TECH	White	Non-white	N	Male	Female	N
I	82.1	17.9	966	47.4	52.6	976
II	86.1	13.9	312	48.5	51.5	312

Age

	18-20	21-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+	N
I	5.8	12.3	15.6	8.2	6.1	8.2	10.1	7.7	6.4	19.5	976
II	6.0	12.2	15.1	10.9	5.8	5.8	8.9	9.1	6.7	19.3	313

Education

	8th Grade or Less	9th-11th Grade	12th Grade	1-2 Yrs. College	3 Yrs. College	Completed College	Advanced Degree	N
I	9.6	13.8	29.6	22.6	6.6	10.2	7.6	974
II	5.4	9.7	33.0	24.9	6.2	14.5	6.3	314

Occupation

	Professional & Technical	Managers	Clerical & Sales	Skilled Workers Craftsmen	Operatives	Service Workers	Farm & Unskilled Workers	N
I	25.4	12.2	19.1	25.6	5.7	8.6	3.3	774
II	32.4	10.9	14.6	18.7	11.9	6.8	4.7	248

Income (of Chief Earner)

	Less than $3,000	$3,000-4,999	$5,000-6,999	$7,000-9,999	$10,000-14,999	$15,000-19,999	$20,000 and over	N
I	10.9	10.4	12.4	18.8	28.2	11.5	7.7	912
II	7.5	8.2	6.1	12.4	35.5	14.8	15.5	291

Partisan Identification

	Republican	Decline to State	Democrat	N
I	33.0	10.9	56.1	929
II	22.0	23.4	54.6	312

Ideological Identification

	Strongly Liberal	Moderately Liberal	Neither, Middle of the Road	Moderately Conservative	Strongly Conservative	N
I	9.9	27.5	17.5	34.5	10.7	894
II	11.7	30.0	17.7	30.6	10.0	301

Comparing the demographic make-up of our two samples with the populations from which they were drawn (see Tables C-1 - C-6, Appendix C) admittedly reveals some apparent over-sampling of certain groups females, non-whites, the highly educated, the affluent, and those with higher socioeconomic occupations. These groups are only moderately disproportionate in number, however, and such over-representation, especially of the first group, is not unusual. Additional support for our claim that our samples are representative is evident in comparisons of the distribution of their political party and ideological make-up with that of the national sample surveyed by MSRC Tables C-7 and C-8 in Appendix C present these data

Because TECH II conducted in 1974 surveyed two groups, one of which, the "panel" as it will be referred to hereafter, had comprised almost half of the original cross section sample surveyed in 1972 for TECH I, an *internal* comparative question about sampling outcomes is posed. How representative is this reinterviewed panel, both of the overall 1972 cross-section ('72 XSEC) from which it was drawn and of the subsequent cross-section ('74 XSEC) comprising the other part of the 1974 sample? To what degree, if any, was the reinterviewed group different demographically from the people who were questioned only once, either in 1972 or in 1974? The question is an important one because it bears on the generalizability of findings related to *stability and change of attitudes* on certain crucial issues--matters to be dealt with at length in subsequent chapters.

As Table 2-2 shows, some minor differences were discovered when an "F-Test" was used to determine whether any statistically significant differences obtain among the groups; "tau-b" is used to measure the extent of the difference.[6] The panel is significantly older than both the '72 and '74 cross sections, compared to the '72 cross section it contains more females and is also wealthier, and, compared to the '74 cross section, the panel is more Republican

TABLE 2-2

COMPARISON OF DEMOGRAPHIC CHARACTERISTICS: INDEPENDENT CROSS-SECTION SAMPLES, '72 & '74, AND REINTERVIEWED PANEL SAMPLE

Characteristic	'72 X-Sec/Panel F-Test	'72 X-Sec/Panel Tau-b	'74 X-Sec/Panel F-Test	'74 X-Sec/Panel Tau-b
Age	5.78*	.107	4.45*	.096
Sex	5.89*	.100	.25	-.087
Education	.22	.002	.67	.011
Occupation	.16	.034	1.17	.033
Race	.25	-.016	.00	.000
Income	4.17*	.124	2.10	.092
Party	.51	-.027	10.41*	.077
Pol. Ideology	3.09	-.060	2.47	.098

*Significant at $p < .05$.

SUBGROUPS WITHIN OUR SAMPLES: ISOLATION OF THE "POTENTIAL PUBLIC" FOR TECHNOLOGICAL POLITICS

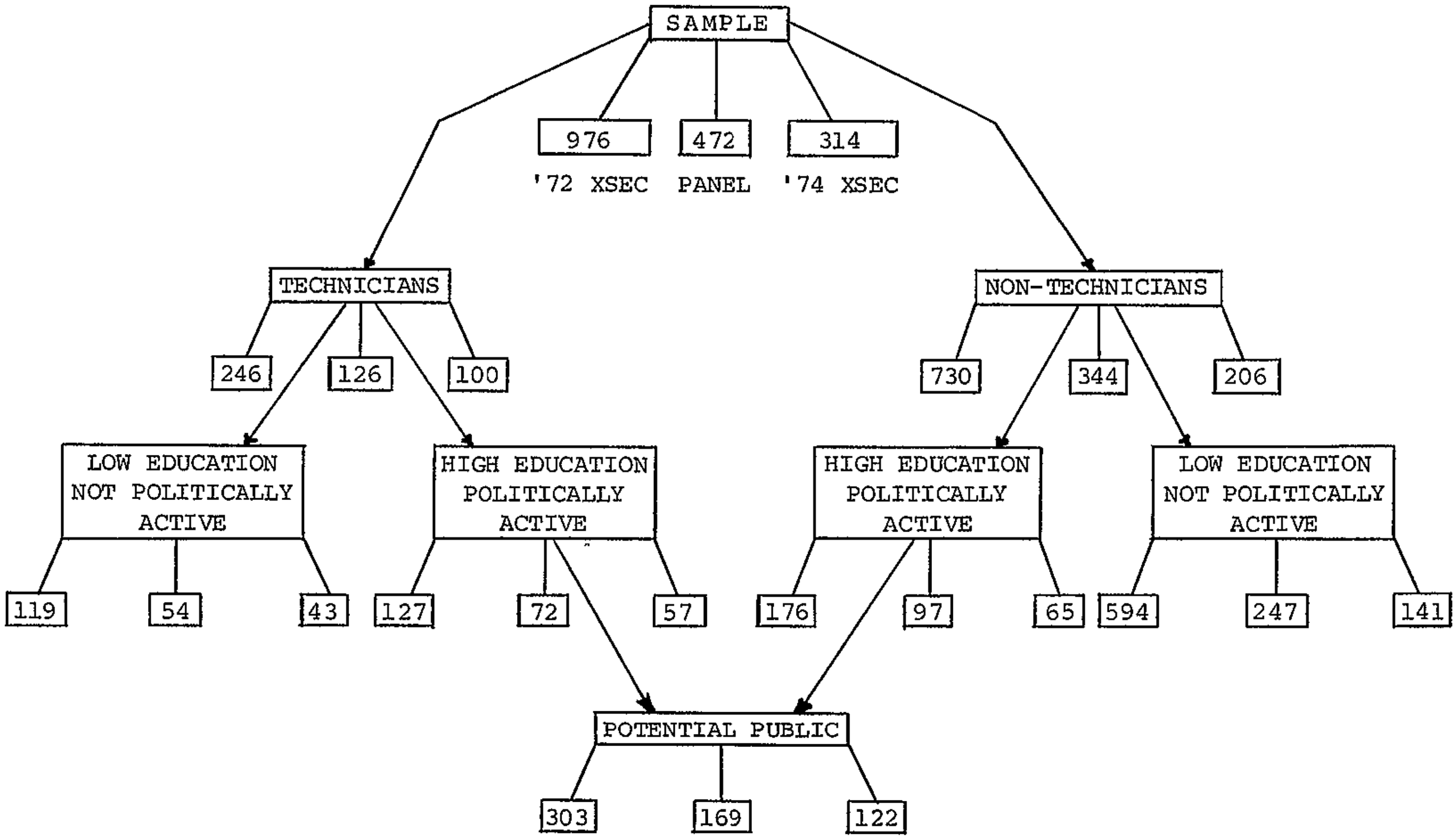
Various sub-samples of our respondents, selected on the basis of one or more key criteria, will serve as focal points in much of the discussion to follow on concrete issues. Preliminary factors in organizing and differentiating our gross samples were the type of *occupation* engaged in by the respondent (or the chief earner) and the type of professional/industrial *setting* in which the occupation was carried out. From a scale constructed on the basis of those two factors issued our first important differentiation: "technicians" from "non-technicians." A person holding a quasi-technical job in a highly technical setting was categorized as a technician, while a person doing the same job in a non-technical environment was, for our purposes, a non-technician. Subsequent differentiation was carried out using a scale combining education level with past political activity, i.e., voting in previous primary elections.[7] The people on the upper half of this second scale were assigned to the "high education/politically active" classification, those on the lower half to the "low education/not politically active" classification.

The final and most important group was isolated by combining the educated, politically active technicians and non-technicians. We call this group the "potential public for technological politics." It is analogous to the group which Philip Converse has termed the "issue public" and similar to the one Donald Devine has labelled the "attentive public."[8] For whatever the public's attitudes toward technological development, they are not likely to become the basis for public policy unless crystallized into articulate demands for change. Efforts to voice demands, to organize pressure for or against policies and political candidates come only from those portions of the general population motivated to social action Certain social factors seem *a priori* to provide a basis upon which to isolate that set of people Education, occupation, and past electoral behavior are among such plausible indicators, these were the variables used to isolate the potential public

The method used to partition our sample into the groups just described is illustrated in Figure 2-1 How different are these groups from each other? Along what, if any, demographic variables are they skewed? Table C-9 in Appendix C presents comparisons among the various groups and reveals that most of the demographic differences are expected on the basis of two of the variables providing the criteria for the partitionings--occupation and education Differences in income are also seen when highly educated groups are contrasted with those having less education. (This is typical and expected) Differences on five other demographic variables--age, sex, race, party identification, and ideology--are generally not statistically significant; when they are, they are not substantively great. Thus, the various sub-samples considered are quite representative of the whole sample on some important variables

FIGURE 2-1

PARTITIONING INTO SUBGROUPS OF ALL RESPONDENTS IN TECH I AND II SURVEYS



NOTE: N's may not always sum perfectly because of missing data on different components.

INTERPRETING RELATIONSHIPS

At numerous points in the forthcoming analysis, associations between findings will be considered Efforts were made to control for other plausible relationships--intervening or spurious--and any reported association will, in general, have passed those tests.

A more difficult task, however, is the interpretation of statistical associations which occur between variables at two points in time, i.e., those associations appearing when data from TECH I is compared to data from TECH II Perhaps the most important point to be made here is that the conceptual background of this study rests on relatively unrefined theory and almost no prior data.[9] While we had strong intuition about some of the relationships between public experience and attitudes toward advanced technologies, this study in essence is mainly an exploratory attempt to provide a basis for more refined understanding of that relationship. Before we collected a substantial body of data in 1972, few hypotheses were available to prepare our expectations, and, as we anticipated, some associations turned up on their own as surprises--"post hoc," so to speak, after the fact

Thus the problem arises of interpreting the meaning of significant correlations for which there was no prior prediction, the problem of what we are to make of the surprising results of a "fishing expedition," as one author has put it.[10] Moreover, do correlations which appear in one year between two variables but not in the other indicate a random response? a chance association resulting from the many individual calculations between variables? And how are we to understand a correlation between two variables which appears in both TECH I and TECH II data?

The strongest case for a *significant finding* occurs when a correlation exists between two variables in data derived from both surveys. More tentatively, we have treated correlations in 1972 data as evidence for a potential relationship, that is, as evidence for a speculative hypothesis that two factors are related The second survey we have treated as a replication of the first and as a test of emergent hypotheses The probability of a genuine relationship between data from 1972 and 1974 is the product of probability of significance in 1972 and in 1974 Similarly, an absence of correlation for two variables in 1972 data and 1974 firmly establishes an independent relationship Figure 2-2 summarizes in schematic form these four inferential situations

FIGURE 2-2

ATTRIBUTED MEANING OF CORRELATIONS BETWEEN VARIABLES OVER TECH I AND TECH II

		TECH II-1974	
		Correlation Significant	Correlation Not Significant
TECH I-1972	Correlation Significant	*Significant Finding* consistent relationship over time	Basis for *Speculative Hypothesis* of waning relationships
	Correlation Not Significant	Basis for *Speculative Hypothesis* of emerging relationship	*Significant Finding* of absent relationship over time

The most difficult cases are those for which a correlation appears in the data for one year but not for both We shall treat such cases as bases for *speculative hypotheses*, that is, as if the relationship is genuine but subject to doubt due to a lack of replication In the event of a correlation in 1972 but not in 1974 we shall suspect a waning influence of one factor upon the other. If, however, the correlation only appears in 1974, we shall interpret this as the possible emergence of growing importance of one factor upon the other The reader will do well to keep in mind this distinction, it differentiates the strength of our convictions about the conclusiveness of various data Further opinion survey data yielding a significant relation would be required for any speculative hypothesis to become a *significant finding*.

SUMMARY OF METHODOLOGICAL PROCEDURES

In seeking answers to how the public has reacted to and evaluated technological development, two surveys were undertaken· TECH I in 1972 and TECH II in 1974. In the initial study, 980 adult Californians--a cross-section of the State--were interviewed, in the second survey, another and smaller cross-section of 314 people were questioned along with approximately half of the first cross-section sample

We have discussed evidence that suggests the similarity of our findings for California to those which might be uncovered nationally This evidence is documented in Appendix C, where demographic tables show, in particular, that California's characteristics rarely deviate much from those found in the rest of the country Other, more indirect evidence of the generalizability of our findings was noted. We were also concerned in this chapter with showing that, with some exceptions, our sampling of Californians adequately reflects the demographic character of the population. Neither the '72 cross-section nor the '74 cross-section deviated to any great degree from its population parameters The panel of reinterviewed subjects in turn is generally representative both of the 1972 cross-section from which it was drawn and the one along with which it was questioned for a second time in 1974

We have identified a potential public for technological politics as well as other subgroups and noted their demographic differences. Patterns of opinion visible within these groups will be analyzed in subsequent chapters Finally, we have clarified our analytic procedure in regard to attributing significance to statistical associations found in the data presented throughout

Having considered these points of research design and methodology, we turn to a discussion of our substantive findings.

NOTES

[1]The details of the sampling design and the procedure for administration is presented in Appendix A.

[2]See Appendix B for a synopsis of the questionnaires used in the interviews.

[3]2% refused on the grounds of their dislike for the first interview, 5% because they had insufficient time, 4% because of illness, and 7% for a variety of other reasons.

[4]Center for Political Studies, Inter-University Consortium for Political Research, *1972 Election Study*, Volumes I-III (Ann Arbor, Michigan, 1975).

[5]National Science Foundation, *Science Indicators* (Washington, D.C.. GPO, 1973).

[6]See Herbert Blalock, *Social Statistics* (New York: McGraw-Hill, 1974), 418-426.

[7]The method used to construct this scale is given in Appendix D.

[8]See P. Converse, "The Nature of Belief Systems in Mass Publics," in *Ideology and Discontent*, Ed. D. Apter (London Free Press of Glencoe, 1964) and D. Devine, *The Attentive Public* (Chicago: Rand McNally, 1970). We have risked adding to terminological confusion here because matters dealing with technology have not *yet* become broadly "political" issues. Both the "issue public" and the "attentive public" refer to groups already focusing on public issues. But we are arguing that in an area not yet fully "politicized" in this sense, there are some groups with higher potential for becoming "attentive" as the area increases in political visibility.

[9]Very little has been published in this area so far. Among the few materials available, the following should be noted: G.R. Funkhouser, "Public Understanding of Science: The Data We Have," a paper prepared for the *Workshop on the Goals and Methods of Assessing the Public's Understanding of Science*, Pennsylvania State University, Materials Research Laboratory (September, 1972); Irene Taviss, "A Survey of Popular Attitudes Toward Technology," *Technology and Culture* 13 (1972), 606-621. See also R.C. Davis, *The Public Impact of Science in the Mass Media* (Survey Research Center, University of Michigan, 1958); Amitai Etzioni and Clyde Nunn, "The Public Appreciation of Science in Contemporary America," *Daedalus* 103:3 (Summer, 1974), 191-205; and *Science Indicators* (see note 5). For an international view, see "Research on Public Opinion Concerning Scientific Research," mimeo., Center for the Study of French Contemporary Political Life (Paris, 1973). Unfortunately, these previous studies are

flawed because of sampling problems (Taviss), dependence on secondary analysis of data designed for other purposes (Etzioni, Funkhouser), or conceptual primitiveness (National Science Board). In all but one case, no analysis beyond a listing of marginals or perhaps a few cross-tabulations is attempted.

[10]James L. Payne, "Fishing Expedition Probability: The Statistics of *Post Hoc* Hypothesizing" *Polity* 7·1 (Fall, 1974), 130-138.

PART TWO

PUBLIC PERCEPTIONS OF PAST DEVELOPMENTS IN SCIENCE AND TECHNOLOGY

In Part Two we begin our analysis of data collected for this exploration of public attitudes toward technology Spelling out specific questions asked survey respondents, we will submit evidence that by and large responses to them were not merely random or capricious, but viable indications of public sentiment. This claim is supported by the stability of responses found both at the individual level in data derived from the responses of the reinterviewed panel of respondents and at the aggregate level in mean scores computed from responses made by the respective cross-section samples, 1972 and 1974. We also commence here our analysis of the "potential public for technological politics," whose responses, predictably, we found to display greater coherence and restraint in attitude set than the samples at large The implications of such differences are first considered here and will be amplified in other chapters

The three chapters which make up Part Two focus on several distinct but overlapping substantive areas related to the public's attitudes toward technology and its implementation In Chapter III we explore the question of whether the public mind perceives the activities of science differently from those of technology and consider the possible ramifications of that difference as it bears on the *value* accorded each activity and on the issue of their *control*

In Chapter IV we turn from generalized attitudes toward science and technology to opinions about *specific* presently available technologies Our samples' evaluations of a representative range of them are analyzed and ordered in terms of apparent public preference. Also in this chapter we attempt to assess perceptions of the relative significance of the role played by technology as a source of societal change over the last quarter century Finally in Chapter IV, opinions about the social utility of further technological development are explored.

Chapter V concludes Part Two by considering the important question of decision making for policies bearing on technological development. Here the different values which the public wishes to see used as criteria in that decision process are discussed, along with its attitudes toward the public and private institutions influencing decisions on technology policy.

CHAPTER III

PUBLIC PERCEPTIONS OF TECHNOLOGY AND SCIENCE MERGED OR DISTINCT?

In our introductory discussion, we argued that although a single web of logic and theory undergirds both scientific knowledge and its technological applications, the activities of the two pursuits are conceptually and sociologically distinct But the force of this distinction is not universally accepted by scholars or by practitioners. Historian of technology Melvin Kranzberg, for example, has argued that these two fields, while perhaps once distinct, can no longer be seen so. Invoking the argument that although science and technology may be different theoretically, for all practical purposes--*and particularly in the public's mind*--the two are inseparable, Kranzberg claims,

> The public makes no distinction between science and technology. To them, science and technology are the same, the scientist and technologist indistinguishable--any white coated man in a TV commercial represents the combined power of both. .[1]

There is a ring of truth to such a claim Certainly the statesmen of science have not gone out of their way to separate the two in their *public* statements [2] Nor has the mass media been particularly careful to observe a distinction But we in this study wished to subject the easy assumption of public consensus on the merger of science with technology to systematic inquiry thus a number of questions were included in the surveys which would test whether any significant difference exists in the public mind Of course, it is impossible in a general study to explore all the ramifications of this matter, our efforts here were confined to probing (1) how the public evaluates the *results* of science as contrasted to those of technology and (2) public perceptions related to *control* of the two activities

If, we reasoned, the public does distinguish science from technology, then concepts like "investigation," "study," and "knowledge" would lie at the core of popular notions of scientific activity, and at the core of such perceptions of technological activity, notions of "use," "production," and "invention " That is, if it could be demonstrated that those two conceptual cores exist separately in the collective cognitive structure of the general public, then we must reject the assumption that the public makes no distinction in the activities designated by the two sets

SCIENCE AND TECHNOLOGY

One appropriate way of examining whether people make the distinctions just described is to probe the dimensions along which their responses to statements in the questionnaire about science and technology are ordered If the two activities are *not* conceptually distinct in the minds of the respondents, only a single dimension should be evident If, however, two or more dimensions appear, greater cognitive sophistication is implied (Moreover, if the same multiple dimensions appear across time, then even greater confidence is justified that they are valid indicators of respondents' apparent differentiations of science from technology, not simply artifacts of statistical method.)

Figure 3-1 lists the statements made about science and technology with which respondents were asked to agree or disagree,[3] and groups them within the broad attitudinal dimensions along which responses to them clustered when factor analyzed [4] These dimensions reflect the underlying issues related to the various statements--issues of the social benefits and costs of the two enterprises, of the degree of autonomy or control they should have and of their intrinsic value as a social activity The results of factor analysis strongly suggest that the public views scientific activity differently from technological activity responses implying that technology should be controlled clustered apart from responses implying confidence in the intrinsic value of scientific activity To be considered in close conjunction with Figure 3-1 is the further information, presented in Table 3-1, which resulted from factor analysis of responses to the statements about science and technology As arrayed in Table 3-1, the extrapolated distinctions are not cleanly made in all instances Some ambiguity is suggested by the presence of item 3, which reads

FIGURE 3-1

ITEMS USED TO DIFFERENTIATE PUBLIC ATTITUDES TOWARD SCIENCE AND TECHNOLOGY--GROUPED BY ATTITUDE DIMENSIONS DENOTING SOCIAL VIEWS OF THEIR ACTIVITIES

I CONTROL OF TECHNOLOGY

(1) Any attempt to control which inventions are widely produced or made available will make our lives worse.

(2) Basically, all scientific discoveries are good; it is just how some people use them that causes all the trouble.

(3) If they are given money and left alone, scientists can be counted on to discover things that will make our lives better.

(4) No one should attempt to regulate which inventions are produced because it interferes with the individual's right to decide what he wants to buy.

(5)* No one should attempt to regulate which inventions are produced because they do not know how to do it.

(6)* We could solve more of society's problems if we did not place so many controls on the way inventions are used and produced.

(7)* We ought to increase our control over how inventions and other technologies are used. or
The way we control how inventions and other technologies are used is just about right.

II VALUE OF SCIENTIFIC ACTIVITY

(8) The only way to make sure that what scientists learn will not cause a lot of harm is to stop them from studying things unless they are clearly important and beneficial.

(9) Unless scientists are allowed to study things that don't appear important or beneficial now, a lot of beneficial things probably won't ever be discovered.

(10)* We must make certain that scientists are not allowed to study certain things in the first place because they may cause a lot of harm.

(11)* People who try to think in a scientific manner cannot appreciate most of life's beauties.

(12)* Relying only on scientific and logical thinking to solve society's problems can only make things more complicated.

III OUTCOMES OF TECHNOLOGY

(13) Technology has made life too complicated.

(14) People have become too dependent on machines.

(15) It would be nice if we would stop building so many machines and go back to nature.

(16)* The material things that technology has provided have freed us to find more satisfying lives. or
The material things that technology has produced trap us and prevent us from finding satisfying lives.

IV OUTCOMES OF SCIENCE (Potential Public Only)

(2) Basically, all scientific discoveries are good; it is just how some people use them that causes all the trouble.

(3) If they are given money and left alone, scientists can be counted on to discover things that will make all our lives better.

*Used in TECH II (1974) only.

TABLE 3-1

CLUSTERS OBTAINED USING FACTOR ANALYSIS ON RESPONSES TO GENERAL STATEMENTS ABOUT SCIENCE AND TECHNOLOGY (cross sections and potential publics, '72; '74)

	ITEMS IN:	
ATTITUDE DIMENSION	TECH I(72)	TECH II(74)
Control of Technology	1,2,3,4,5[a] / 1,4,5	1,2,3,4,5,6,7 / 1,4,5,6,7
Value of Scientific Activity	8,9,10 / 8,9,10	8,9,10,11,12 / 8,9,10,11,12
Outcome of Technology	13,14,15 / 13,14,15	13,14,15,16 / 13,14,15,16
Outcomes of Science	— / 2,3	— / 2,3

[a]Throughout this book top line figures record responses from or data relevant to total cross-section samples; lower figures relate to potential publics.

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as science-specific in Figure 3-1, in the "control technology" cluster of responses from both the 1972 and 1974 cross-section samples. But that equivocation is not evident in responses from the potential publics The cluster made up of items 2 and 3 sharply emerges, and can be interpreted in the case of the potential public as a tapping of attitudes toward perceived outcomes of scientific activity Finally, attitudes about the generalized outcomes of technological activity appear in a cluster distinct from all others.[5]

Table 3-1 also shows that although some differences occur in specific items within a given dimension, cluster formations among the four groups of respondents and across time are fundamentally consistent In the remaining sections of this chapter, we will examine the composition of the four attitudinal dimensions along which responses clustered feelings about (I) the control of technology, (II) the value of scientific activity, (III) outcomes of technology, and (IV) outcomes of scientific activity. Throughout, inferences will be drawn about the way the public perceives science and technology, these will be based on (1) the marginal distributions of the four attitudinal dimensions, (2) the stability of these distributions over time, and (3) their association with various demographic variables

CONTROL OF TECHNOLOGY

Modern industrialized countries accept the premise that technology ought to be regulated, but major political battles continue to be waged over the content of such regulation. How clean should automotive emissions be? How safe is safe enough when nuclear power plants and new drugs are licensed? How can individual privacy be maintained in the face of increased use of computerized data banks? These questions, of course, relate to specific issues. And while they may be important, we are more interested here with making an overall assessment of public attitudes concerning how and why technology should or should not be controlled.

Data summarized in Table 3-2 show that majorities disagree that controls on technology will make life worse (1)*, and that the sample is almost evenly split as to whether the advantages of regulating technology outweigh the benefits of a laissez faire approach to control (4). Interestingly, this split was also evident with respect to people's judgments about whether or not there was "sufficient knowledge" to regulate technology Two questions, asked only in 1974, clarify this picture somewhat. Majorities disagreed that there were too many present controls on technology, but agreed, when confronted with a forced-choice situation, that we ought to increase our controls over the way technologies are used. Generally, the potential publics were somewhat more intense about their feelings, and their responses fell more clearly within the indicated dimensions than those of the cross-section sample of which they were part

Comparison of those group distributions over 1972 and 1974 suggests that the attitudes are relatively stable But can anything be said about the degree of stability in terms of the *individual* attitudes? Measurement

*Indicates item number in Figure 3-1

TABLE 3-2

DISTRIBUTION OF RESPONSES TO ITEMS COMPRISING CONTROL OF TECHNOLOGY DIMENSION

(cross-section sample and potential publics, '72, '74)

ITEM	TECH*	STRONGLY AGREE (5)	AGREE (4)	AGREE-DISAGREE (3)	DISAGREE (2)	STRONGLY DISAGREE (1)	(N)
(1) Control of inventions will make life worse	I	15.5%[a]	24.2%	12.0%	27.1%	21.2%	903
		17.4	22.4	9 9	26.4	23.9	293
	II	14.1	19.6	16 6	28.7	21.0	297
		11.5	14.4	12.2	36 4	25.5	120
(4) The right to buy what is invented should not be interfered with	I	19.4	26.9	9.0	25.5	19.1	933
		19.9	21.0	8.6	32.3	18.3	299
	II	27.1	25.3	10.0	21.5	16.1	298
		25.0	22 6	7.0	20.8	24.7	112
(5) Insufficient knowledge for regulating inventions	I	21.5	25 4	12.0	27.3	13.9	921
		17 2	25 0	8.0	29 3	19.7	289
	II	16.3	36.2	10.0	24.4	13.1	288
		15.6	26.5	12.0	29.1	16.8	116
(6) Too many controls on inventions prevent solutions to social problems	II	8.4	22.6	15.9	37.5	15.6	285
		3.6	23.2	12.6	41.7	18.9	114
(7) Increase control over technology	II	21.0[b]	25.8	3.0	41.6	8.7	313
		20.8	29.3	3.0	42.6	4.3	122

[a]Top row figures for cross-section samples, lower row for potential publics.
[b]Agreement is with first part of forced-choice question.
*I = TECH I, 1972, II = TECH II, 1974.

of actual attitude change is, of course, fraught with many methodological problems Observed differences in responses between 1972 and 1974, for instance, may be due to an actual shift in respondents' underlying beliefs, or, equally plausibly, they may be due to a measurement error A measurement error can, in turn, be due to the unreliability of the particular question or to the unreliability of the individual respondent At minimum, three data points are required to say definitely whether an observed change is due to actual attitude shift or to measurement error.[6] However, by making a few simplifying assumptions, we can make some estimates of stability with the data at hand.

We will assume that at the individual level, a response range exists such that a person may maintain the same underlying attitudes but yet respond differently to the same question on two separate occasions The magnitude of that range will for analytic purposes obviously determine the degree of stability: a range which extends to include the entire scale will yield perfect stability; a range consisting of a single point allows the least flexibility in responses and therefore imposes the most stringent requirements on determinations of stability Here, we shall assume "stability" when response to a query in 1974 was within one opinion-category of what it had been in 1972 That is, stable reponses are those rendered by people who maintained their identical position, or, if they altered it at all, moved it (analytically speaking) only into a contiguous category within the agree-disagree range, or moved it from a neutral point Thus, a stable attitude would not be attributed to people who shifted from agreement to disagreement or vice versa. The first numerical column in Table 3-3 presents data on responses made in the control-of-technology dimension by the panel of persons interviewed both in 1972 and in 1974. The other columns display the means and standard deviations for the two separate cross-section samples polled in those years Also included are data on the respective potential publics within the panel sample and the two cross-section samples.

It is clear from Table 3-3 that considerable stability is evident in responses along the control-of-technology dimension about two-thirds of the panel sample maintained stable attitudes over the two-year

TABLE 3-3

STABILITY OF RESPONSES ALONG CONTROL-OF-TECHNOLOGY DIMENSION

ITEM	PANEL:[b] (Percentage of Respondents within ± One Category of Original Response)	CROSS-SECTION SAMPLES: MEAN '72	MEAN '74	STANDARD DEVIATION '72	STANDARD DEVIATION '74	N '72	N '74
(1) Control of technology will make life worse	64.6%[a]	2.86	2.77	1.40	1.36	903	297
	71.1	2.83	2.50	1.46	1.32	293	120
(4) No interference with right to buy is justifiable	63.9	3.02	3.26	1.44	1.46	933	298
	68.6	2.93	3.02	1.44	1.56	299	112
(5) Insufficient knowledge for regulation of technology	67.0	3.13	3.18	1.39	1.32	921	288
	74.7	2.91	2.95	1.42	1.37	289	116

[a]Top line for total samples; lower for potential publics.

[b]Panel sample were those respondents in TECH I reinterviewed for TECH II, 1974.

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period And, when certain assumptions about measurement error are made, stable responses at the aggregate level are evident also In particular, we shall assume that either the mean of the error is zero, or, if it is not, that it is constant over time This assumption does not seem unwarranted; if important shifts in attitude occurred, they would be reflected in significantly different mean scores, yet, when comparison is made between the mean scores for these variables, no statistically significant differences (at the 5% level) are observed (See columns 2 through 5 on Table 3-3)

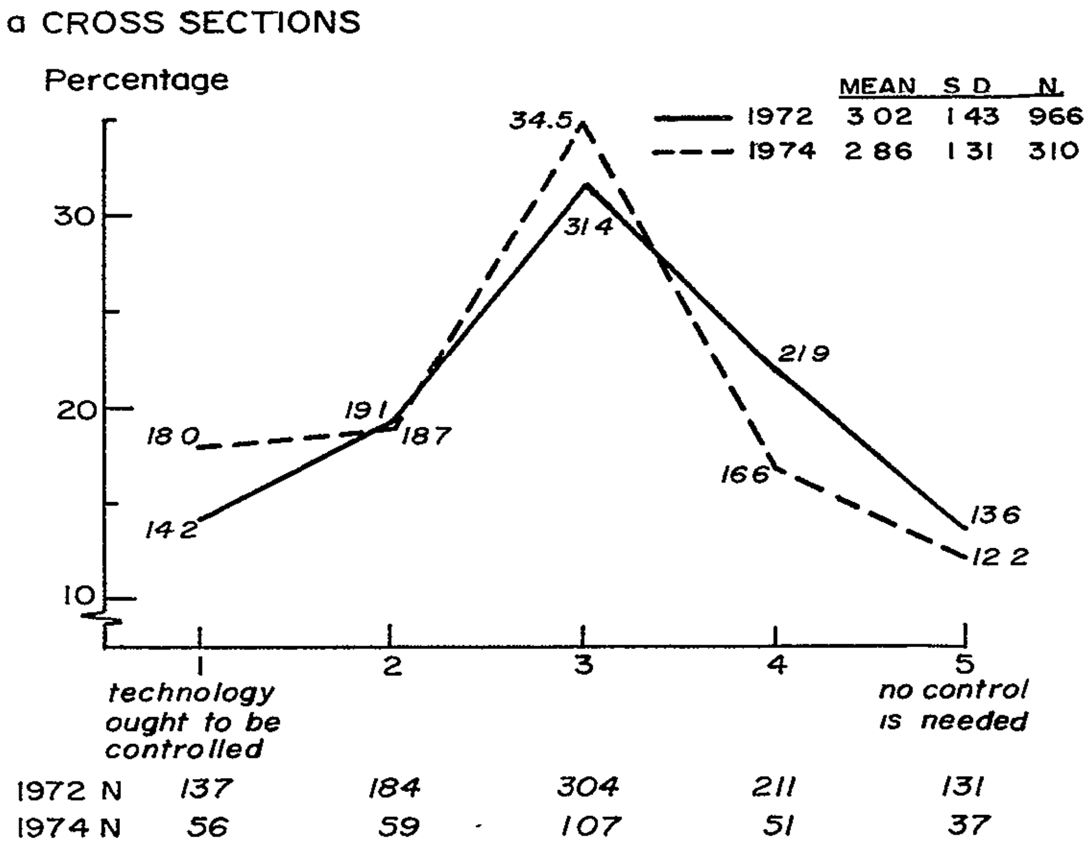
Attempts were made to determine whether stable attitudes were associated disproportionately with any particular demographic characteristics Using the responses from the sample panel, a dichotomous variable was created to indicate their stability or instability over the two-year interval between interviews; another variable was used to measure the differences between the first and second responses. Both variables were arrayed against seven demographic variables: age, race, sex, income, education, political party identification, and ideological identification. No correlations resulted which show them having much influence on either stability or instability in responses from the entire panel sample In the potential public drawn from the panel, some slight association was found between education and change in agreement that there is insufficient knowledge to warrant regulation (r = - 15); the more highly educated were less certain the second time around that there was adequate knowledge to do so. Also, younger respondents from the panel's potential public were more likely than their elders to maintain a constant response to the question asking whether control of technology would worsen life (r = - 13).

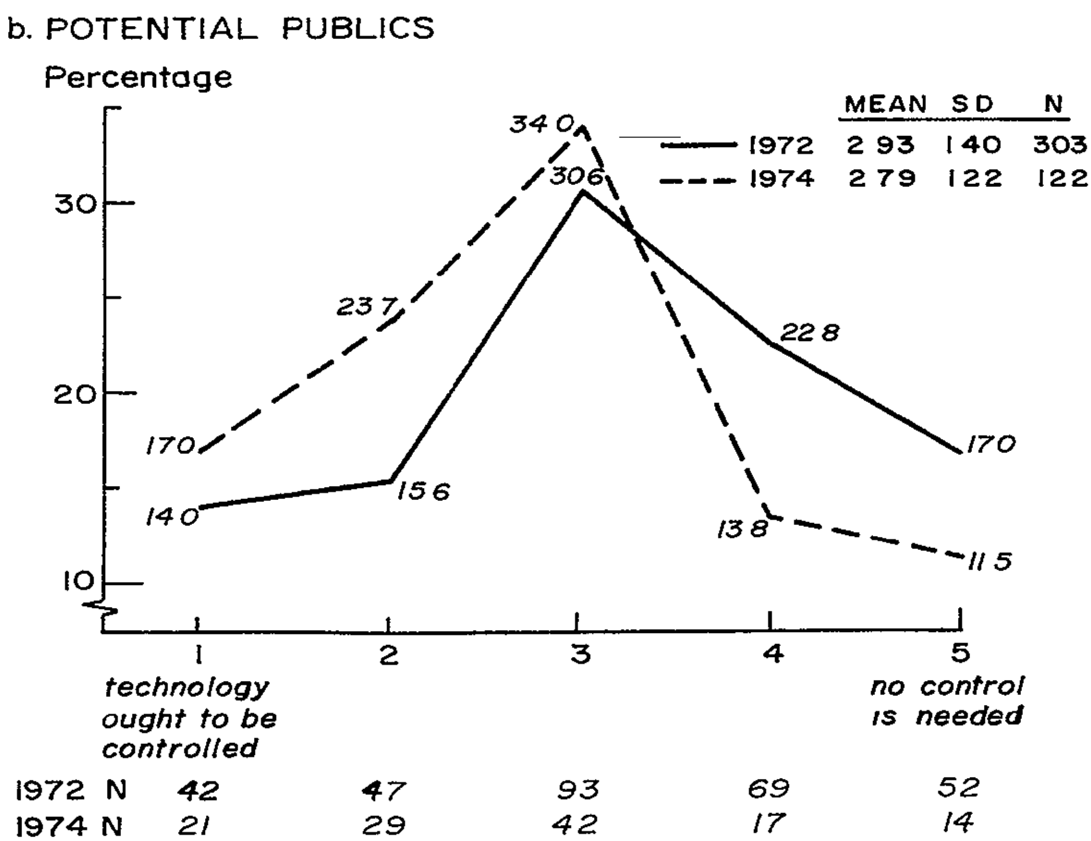
In order to summarize data on the stability of attitudes within the larger samples on the control of technology dimension, items which cluster within it were aggregated to form a scale. Responses to items 1, 4, and 5 (see Figure 3-1) comprised the scale for determining the 1972 sample's degree of consistent agreement on this attitudinal dimension, items 6 and 7 were added to the scale for measuring agreement within the 1974 cross-section sample The scales in Figure 3-2 are bell-shaped about the mean and show somewhat more stability than is found in responses to the individual items from which they were constructed Roughly as many people approve of current levels of regulation or want more of it as agree that less regulation is in order These feelings, as we might expect, were quite stable over time. The fraction of responses from the panel which fell into the same opinion category plus or minus one in 1974 as in 1972 is 75% for the entire panel and 78% for its potential public. The over-time correlations are .37 and 45 respectively. The difference in mean score was not significant at the 5% level.

Attempts to associate attitudes toward regulating technology with demographic characteristics were generally unsuccessful There was some indication that those in the upper income brackets within the potential

FIGURE 3-2

CONTROL TECHNOLOGY SCALE: DISTRIBUTION OF SCORES





public of the 1972 cross section were somewhat more in favor of regulation (r = .20). These relationships are small, however It would be safe to say that neither demographic nor political variables are good indicators of generalized attitudes toward the regulation of technology One's income, political beliefs, age or education level do not seem particularly to influence his or her attitudes toward the control of technology. Rather, variant views are distributed quite broadly in the population and have not yet become associated with particular socioeconomic positions or political ideologies

From these data, it seems clear that among the public generally and among those of its members who are more likely to be involved in the politics of technology there is considerable ambivalence about the suitability of existing levels of regulation of the uses of technologies There is some evidence, however, to support the conclusion that, if pressed, the public would opt for more rather than for less control of technological development. The indications, though not strong, seem to suggest a deepening sense of uneasiness about the present patterns of control and regulation But do these indications of uneasiness extend to attitudes toward scientific activities as well?

VALUE OF SCIENTIFIC ACTIVITY

We argued in Chapter I that the public perceives scientific activity differently from technological activity The results of the factor analyses reported in this chapter lend some support to that argument What are some of the characteristics of this difference in perception?

Implicit in the concept of scientific enterprise is the notion of unrestricted freedom to pursue research in any direction which may seem fruitful. Recent attempts by scientists themselves to limit voluntarily research on plasmids has attracted much attention precisely because the move is so exceptional Clearly, scientists would be likely to consider attempts by persons outside the scientific community to control the direction of research extremely threatening to the effectiveness of scientific activity. We have seen that, while no strong consensus exists, a substantial fraction of the public accepts control of technological activities as legitimate and that many wish it to be increased By contrast, there is a very strong consensus that scientific activities are intrinsically beneficial (9, Figure 3-1) and should not be controlled (8, 10) The data summarized in Table 3-4 show that these sentiments are quite strong and consistent over time and that in each case the potential public is considerably more intense in these feelings than are the total cross-section samples. Additionally, we find considerable confidence in scientific thinking as a means for solving social problems (12) Finally,

TABLE 3-4

DISTRIBUTIONS OF RESPONSES TO ITEMS COMPRISING VALUE-OF-SCIENTIFIC-ACTIVITY DIMENSION (cross-section sample and potential public, '72; '74)

ITEM	TECH*	STRONGLY AGREE (5)	AGREE (4)	AGREE-DISAGREE (3)	DISAGREE (2)	STRONGLY DISAGREE (1)	(N)
(8) Stop scientific study unless beneficial	I	12.1%[a]	11.5%	5.6%	22.4%	48.4%	946
		9.8	4.8	3.5	19.0	62.8	299
	II	8.0	11.8	6.0	20.2	54.0	310
		4.1	5.5	4.6	9.8	75.9	121
(9) Allow scientific study for beneficial discoveries	I	51.8	33.5	4.6	6.2	3.9	948
		57.7	29.7	4.0	4.8	3.8	301
	II	54.0	37.7	3.0	3.7	1.6	308
		62.0	32.1	2.2	1.7	2.0	121
(10) Stop scientific study of harmful things	I	5.4	10.7	5.8	29.8	48.3	945
		3.1	4.9	4.2	30.0	57.8	298
	II	5.1	6.6	6.0	29.9	52.4	306
		2.7	3.3	1.3	21.8	70.8	120
(11) Scientific thinking cannot appreciate beauties	II	11.5	18.9	6.6	22.2	40.8	306
		6.5	14.6	1.5	19.5	58.0	119
(12) Scientific thinking cannot solve society's problems	II	14.4	32.2	3 5	32.6	17.3	301
		11.8	31.9	4.1	31.4	20.8	120

[a]Top figure for total cross-section samples; lower for potential public.
*I = TECH I, 1972; II = TECH II, 1974.

both the public-at-large and the potential public reject the stereotype of the scientific man so wrapped up in his equations and paraphernalia that he is oblivious to the world around him. Strong majorities disagree that thinking in a scientific manner precludes one's appreciation of "most of life's beauties" (11).

These attitudes stand in sharp contrast to those expressed about technological activities. Respondents' attitudes about "science" suggest strong support for the scientific enterprise, acknowledge its potential for social benefit, and exhibit a modest vote of confidence in both the men and women of science and their way of thinking. Now is there evidence that these attitudes are continuing and stable ones?

As was the case with the attitude dimension encompassing responses about the control of technology, the distributions of percentages for responses to items clustering as "value of scientific activity" indications also suggest stability over time. At the level of individual change, we find an astonishing level of consistency As indicated in Table 3-5, we see that on the average for the three items making up the scientific activity scale (8, 9, 10, Figure 3-1), the percentage of responses within one category of what they had been in 1972 was 82% for the entire panel and 89% for its potential public On the aggregate cross-section level, for both the two whole cross sections and their respective potential publics, an even greater degree of stability is evident here than was seen to obtain for attitudes about technological activities No statistically significant differences (at the 5% level) emerge in the mean scores of responses.

In attempting to discover if demographic characteristics accounted for an individual's stable or unstable attitudes or for the degree of attitude change, the results, again, were generally fruitless. Only education level in the entire cross-section sample was much of a predictor--and that in the expected direction consistency in responses to the "harm from studying" (10) and "stop studying" (8) variations. (r = 19 and .21 for the cross section and the potential public, respectively)

In order to summarize the data relating to attitudes about the value of scientific activity, a scale was constructed combining distributions

TABLE 3-5

STABILITY OF RESPONSES ALONG VALUE-OF-SCIENTIFIC-ACTIVITY DIMENSION

ITEM	PANEL: (Percentage of Respondents within ± One Category of Original Response)	CROSS-SECTION SAMPLES: MEAN		STANDARD DEVIATION		N	
		'72	'74	'72	'74	'72	'74
(8) Stop scientific study unless beneficial	77.5%[a]	2.26	2.00	1.44	1.34	946	310
	86.9	1.80	1.52	1.31	1.09	299	121
(9) Allow scientific study for beneficial discoveries	86 9	4.23	4.39	1.06	0.84	948	308
	90.0	4.33	4.50	1.02	0.80	301	121
(10) Harm results from scientific study	80.4	1.95	1.82	1.20	1.13	945	306
	89 1	1 65	1.45	0.99	0.90	298	120

[a]Top figure for cross-section sample; lower for potential public.

-----

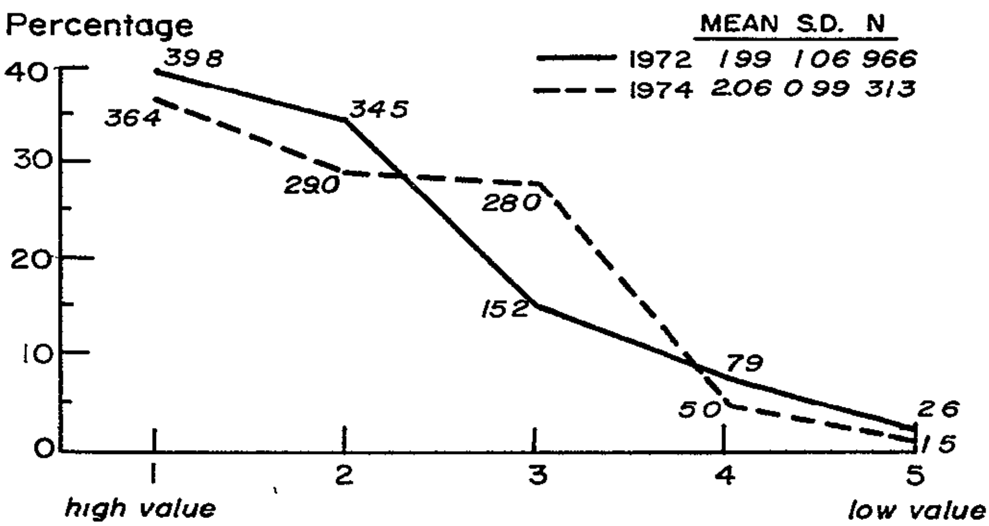
of responses to items (8), (9), and (10) for the 1972 sample and adds items (11) and (12) for the 1974 sample. As expected, the scale is highly skewed in the positive direction The distributions of the index for the two whole cross-sections and for their potential publics appear in Figure 3-3, it shows somewhat more stable responses over time than the scale's component items and reveals that the percentage of responses from the entire cross section which did not shift more than one category was 82%, 88% from the potential public The cross time correlations were 32 and 35 respectively No significant differences at the 5% level were found in mean score comparisons.

Demographically, the scale scores were associated with education (r = .26 for the 1972 cross section and r = .33 for the 1974 cross section), race (r = 20 for both years), and income (r = .17 and 27). Higher income, more education, and being white all were associated with enthusiasm for scientific activities. Since these three characteristics

FIGURE 3-3

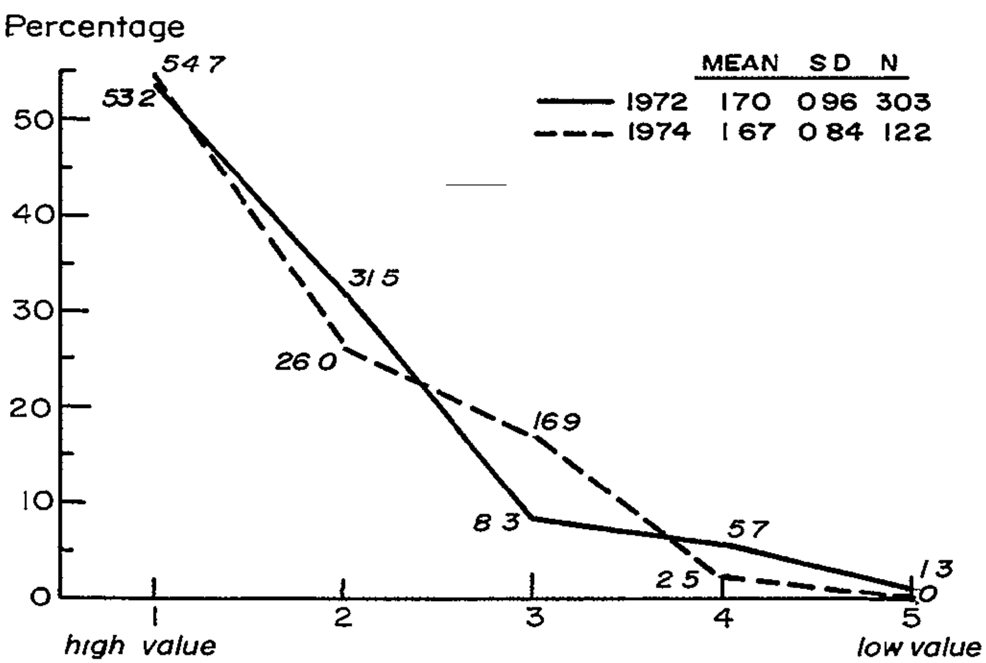
VALUE-OF-SCIENTIFIC-ACTIVITY SCALE: DISTRIBUTION OF SCORES

a CROSS-SECTIONS



	1	2	3	4	5
1972 N	384	333	148	76	25
1974 N	114	91	88	16	5

b. POTENTIAL PUBLICS



	1	2	3	4	5
1972 N	161	95	25	18	4
1974 N	67	32	21	3	0

are highly intercorrelated, regressions were run to determine the independent effects of each. Education accounts for the greatest amount of variation, but both race and income respectively also produce statistically independent, significant effects Table 3-6 summarizes both 1972 and 1974 data on these matters

TABLE 3-6

STANDARDIZED REGRESSION ESTIMATES FOR EDUCATION, INCOME, AND RACE IN PREDICTING SCORE ON VALUE-OF-SCIENTIFIC-ACTIVITY SCALE
(cross section, '72; '74)

	1972		1974	
Education	0.21	(0.03)+	0.27	(0.06)
Race	0.17	(0 03)	0.16	(0.05)
Income	0.09	(0.03)	0.15	(0.06)
R	.32		.41	

+ Sigma beta

To convey a feeling for the degree of covariation between education and the Value-of-Scientific-Activity Scale of 1974 responses, cross tabulations are presented in Table 3-7

TABLE 3-7

EDUCATION VS. VALUE OF SCIENTIFIC ACTIVITY SCALE
(1974 cross section--vertical percentage)

VALUE	EDUCATION						
	>8th	9-11th	12th	1-2 yrs Col.	3 yrs Col.	4 yrs Col.	Col.+
Low	0%	9.2%	0.9%	1.3%	0%	0%	0%
	19.0	11.9	5.0	3.1	4.1	1.4	0
Med	38.3	26.2	38.6	27.8	6.6	18.6	11.7
	35.7	18.4	32.8	30.7	25.2	29 0	18.5
High	7.7	34.3	22.7	37.2	64.2	51.0	69.7
(N)	(17)	(30)	(103)	(78)	(19)	(46)	(20)

What do the data on responses to the ideas of control of technology and control of science allow us to say about the nature of public attitudes toward these issues? First, a strong consensus exists in favor of scientific activities. This enthusiasm is stable over time and represents a deep-seated confidence in scientific enterprise. Second, when compared to the relatively uneasy responses to technological activity, positive attitudes toward science may imply that the public-at-large does not view its activities as threatening, that, rather, the *outcomes of technological activity* are the source of concern. This interpretation is reinforced in the typology of data presented in Table 3-8, a cross-tabulation of attitudes along the control-of-technology and control-of-science dimensions.

TABLE 3-8

TYPOLOGY OF RESPONSES ACROSS TWO DIMENSIONS. CONTROL OF SCIENCE AND CONTROL OF TECHNOLOGY*
(cross-section sample and potential public, '72; '74)

	DON'T CONTROL EITHER	CONTROL TECH., NOT SCIENCE	CONTROL SCIENCE, NOT TECH.	CONTROL BOTH	N
TECH I, 1972:					
Cross section	43.6%	44.6%	7.1%	4.8%	736
Potential public	43.6	50.4	3.2	2.8	250
TECH II, 1974:					
Cross section	49.4	41.7	5.8	3.2	156
Potential public	60.3	35.6	1.4	2.8	73

*Excludes neutral responses to items from either or both dimensions.

It is quite clear that our total samples and their respective potential publics were broadly in favor of unrestrained scientific activities, equally clear is the strong proportion of people who were not so generous toward technological activities [7] It is notable that both the

1972 and 1974 potential publics were somewhat more prone than the larger group to seek control of technology, this tendency was detectable in a little over half of the total respondents to both surveys [8] A plausible corollary to these findings is that if the public comes to see "science and technology" as indistinguishable on the practical level, the very large consensus favoring unregulated scientific activities could diminish rapidly

OUTCOME OF TECHNOLOGY

The third attitudinal dimension we probed encompasses perceptions of technology's outcomes. Writers like Charles Reich and Theodore Rosack have painted a picture of public disenchantment with the fruits of technological development [9] Uneasiness about technology has often seemed to take on a nearly Luddite character--the belief that further techno-industrial advance will result in a net social loss Expressions of longing for a return to nature or to a more simple life unemcumbered by machines typify that troubled attitude as, to a lesser extent, does reduced confidence in technology's power to solve man's problems People most disenchanted with technology tend to accept such notions.

We hoped to discover how prevalent in fact such disenchantment with the outcomes of technology might be The results of responses clustering in the outcome-of-technology dimension appear in Table 3-9 It is evident that the more extreme forms of disenchantment, the urge to go back to nature (15, Figure 3-1) and a belief that technology makes life too complicated (13), are held by only about one-third of the total population The notion that technology induces a debilitating materialism is subscribed to by only about a quarter of the sample (16) Yet, over two-thirds of those interviewed agreed with the somewhat less extreme statement that we have become too dependent on machines (14) These results hold for both the cross-section samples and their respective potential publics [10]

A great deal of stability is evident in responses comprising the outcome-of-technology dimension Table 3-10 reports that in 1974 on the average the percentage of those responses within one category of what they had been in 1972 was about 70% for both the entire panel and for

TABLE 3-9
DISTRIBUTION OF RESPONSES TO ITEMS COMPRISING
OUTCOME-OF-TECHNOLOGY DIMENSION
(cross-section sample, potential public, '72; '74)

ITEM	TECH*	STRONGLY AGREE (5)	AGREE (4)	AGREE-DISAGREE (3)	DISAGREE (2)	STRONGLY DISAGREE (1)	(N)
Technology makes life too complicated	I	10.1%[a]	26.4%	8.7%	31.4%	23.3%	947
		9.2	23.8	7.8	32.1	27.1	298
	II	11.7	23.7	6.5	32.0	26.2	306
		9.3	24.1	4.4	29.9	32.3	122
Overdependence on machines	I	39.4	33.5	6.3	13.3	7.5	959
		32.9	35.3	7.1	16.8	8.0	299
	II	35.9	33.9	4.1	15.7	10.3	310
		32.5	35.1	4.4	15.4	12.6	122
Go back to nature	I	11.9	21.1	10.2	25.0	31.8	948
		8.9	20.2	5.9	29.8	35.3	297
	II	14.7	23.7	9.8	25.3	26.5	304
		11.5	21.4	8.8	25.3	33.0	116
Technology leads to materialism; is debilitating[b]	II	11.0	16.3	3.2	41.0	28.5	313
		11.5	15.4	4.7	45.2	23.0	122

*I = TECH I, 1972; II = TECH II, 1974.
[a]Upper figure for cross-section sample; lower for potential public.
[b]One half of a forced-choice question; see Figure 3-1 for exact wording.

TABLE 3-10
STABILITY OF RESPONSES ALONG OUTCOME-OF-TECHNOLOGY DIMENSION

ITEM	PANEL: (Percentage of Respondents within ± One Category of Original Response)	CROSS-SECTION SAMPLES: MEAN '72	MEAN '74	STANDARD DEVIATION '72	STANDARD DEVIATION '74	N '72	N '74
(13) Technology makes life too complicated	67.5%[a]	2.69	2.63	1.35	1.39	947	306
	68.1	2.56	2.48	1.35	1.40	298	122
(14) Too dependent on machines	75.6	3.84	3.70	1.28	1.39	959	310
	73.9	3.68	3.60	1.30	1.40	299	122
(15) Go back to nature	72.6	2.56	2.75	1.42	1.49	948	304
	72.9	2.38	2.53	1.37	1.43	297	116

[a]Upper figure for cross-section samples; lower for potential publics.

its potential public Similarly, there were no statistically significant changes at the 5% level in the mean scores of the responses to constituent items along this dimension from the (four) other groups.

In attempting to enrich interpretation of these data, we found that responses regarding too great a dependence on machines were disproportionately more consistent among the young and among Democrats in the potential public than among older and Republican respondents within that group (r = 21 for age and .16 for party). Continued agreement over time that technology makes life too complicated was found disproportionately among liberals (r = .17). Stable responses about going back to nature were found disproportionately among the young (r = 15) and among the poor (r = 16)

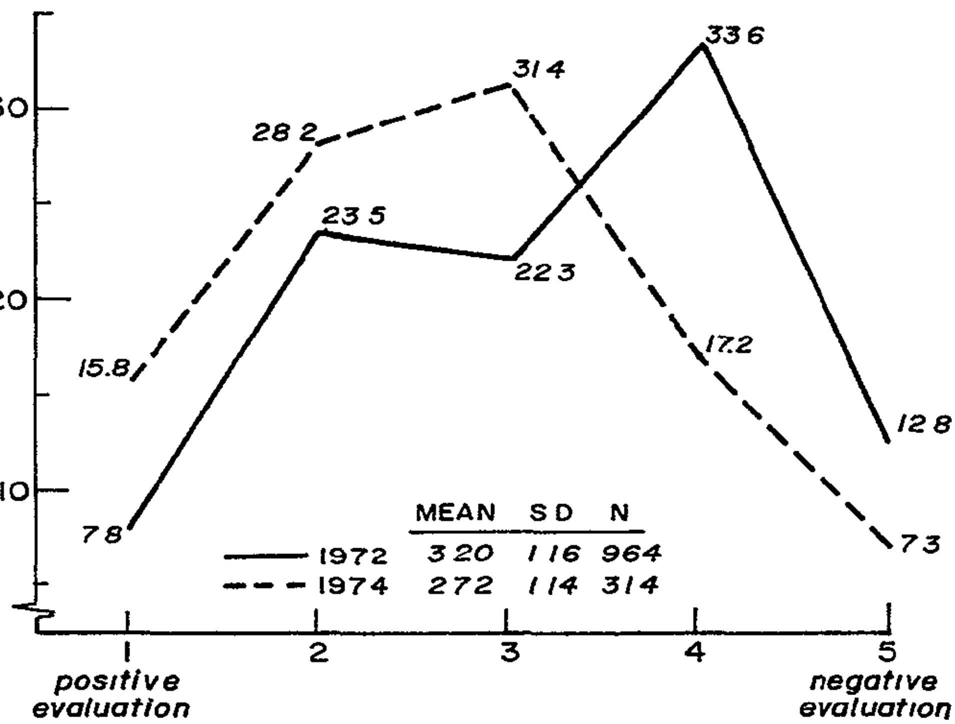
A scale was constructed aggregating the items just discussed which comprise the attitudinal dimension encompassing perceptions of technology's outcomes. For 1972, it included items (13), (14) and (15); in 1974 item (16) was added Figure 3-4 presents the results The distribution in 1972 was slightly skewed in the negative direction, while in 1974, it was somewhat skewed in the positive direction This shift is statistically significant at the 5% level The panel data, not shown in Figure 3-4, revealed a great degree of stability on this index. The percentage of respondents in 1974 falling within one category of their 1972 response was about 79% for both the entire panel and for its potential public The over-time correlations were 47 and 51 respectively

Two demographic correlates to responses along the outcome-of-technology dimension were detected In the cross-section samples, the young were somewhat more negative toward technological outcomes than their elders (r = 15 in 1972 and 16 in 1974), and the poor were more negative than the rich (r = .17 and .30) In the potential public, this relationship intensified for age (29 and 25 respectively for the two years), for income the relationship remained virtually the same (12 and .29 for the two years) A significant relationship between party/ideology and attitudes about outcomes of technology emerged from the 1972 sample liberal Democrats were more negative about them than conservative Republicans (r = 19 for the cross section and r = 35 for its potential public) Inexplicably, this relationship disappeared in the 1974 sample, with a

FIGURE 3-4

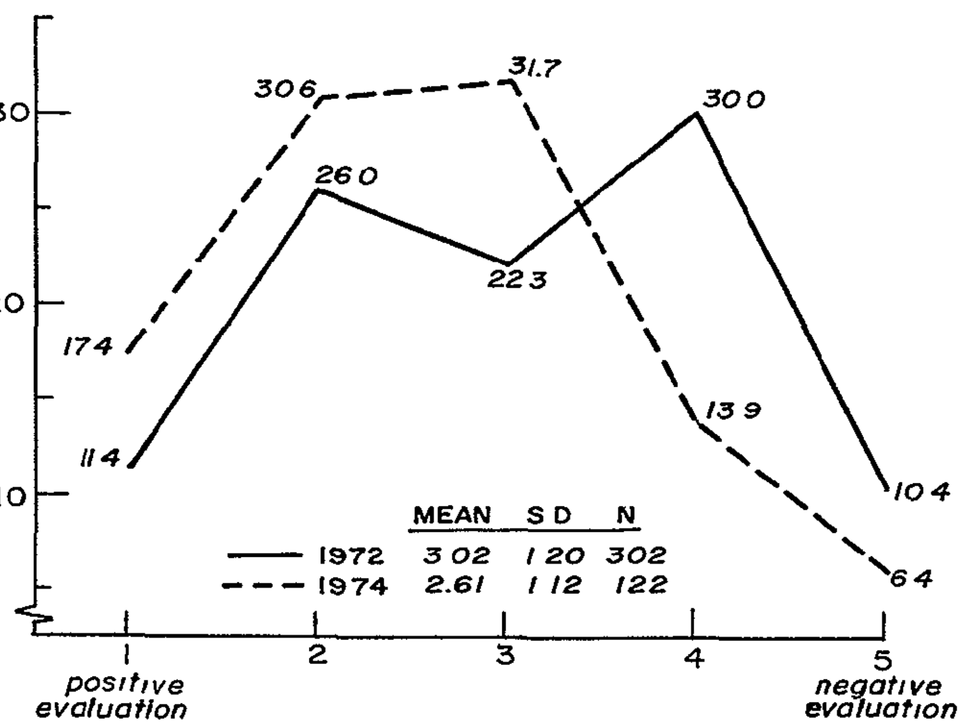
OUTCOME OF TECHNOLOGY SCALE: DISTRIBUTION OF SCORES

a CROSS-SECTIONS



1972 N	75	226	215	324	123
1974 N	50	89	99	54	23

b. POTENTIAL PUBLICS



1972 N	34	78	68	91	31
1974 N	21	37	39	17	8

correlation for the cross section of only 0.08 and for the potential public a mere 0 04.

Thus overall a pattern of mildly positive response to technological outcomes appears, within which one sees a public that feels much too dependent upon machines, with members believing "technology makes life too complicated"; but it is a public neither ready to forsake urban industrialized life and "go back to nature," nor to consent to the indictment of technology as leading to debilitating materialism There are hints that more often than not younger people, the poor and liberal Democrats have greater sympathy with these attitudes of technological disenchantment. But these signs, though they may be recent, are not strong.

THE OUTCOME OF SCIENTIFIC ACTIVITY

It seems evident now that our respondents' attitudes toward the intrinsic value of technological activity differed distinctly from their attitudes about the intrinsic value of scientific activity. The distinction is most clearly seen in their responses about the social control or regulation of the two enterprises. Comparing data implicitly relating the potential public's perceptions of technological activity to their perceptions of the outcomes of scientific activity further substantiates this difference

Table 3-11 reports distributions of responses to the two items which fell along the outcome-of-science dimension They show strong agreement that scientific discoveries are good and only their use is problematical (2, Figure 3-1). On the other hand, we see that our samples were nearly evenly divided about whether or not scientists, when left alone, can be counted on to discover things which will make our lives better (3)[11]

Expectedly now, responses about outcomes of science show a high degree of stability over time. Table 3-12 reports that between two-thirds and three-quarters of both the panel and the panel's potential public differed no more than one opinion category in their responses to the items in question over the two-year period. This indication of stability is reinforced by the fact that no significant differences in mean

TABLE 3-11

DISTRIBUTION OF RESPONSES TO ITEMS COMPRISING OUTCOME-OF-SCIENCE DIMENSION
(cross-section sample and potential public, '72; '74)

ITEM	TECH*	STRONGLY AGREE (5)	AGREE (4)	AGREE-DISAGREE (3)	DISAGREE (2)	STRONGLY DISAGREE (1)	(N)
(2) Discoveries good, use bad	I	49.0%[a]	28.2%	5.4%	11.1%	6.3%	957
		50.1	24.2	5.6	13.5	6.3	300
	II	47.8	29.8	3.7	10.5	8.3	302
		53.9	23.0	2.6	8.6	11.9	118
(3) Leave scientists alone; life made better	I	13.8	27.9	12.3	28.3	17.6	943
		11.2	25.1	11.3	32.1	20.3	297
	II	15.5	31.0	10.8	27.8	14.9	302
		12.1	29.8	10.8	26.3	21.0	118

[a]Upper figure for cross-section sample; lower for potential public.

TABLE 3-12

STABILITY OF RESPONSES ALONG OUTCOME-OF-SCIENCE DIMENSION

ITEM	PANEL: (Percentage of Respondents within ± One Category of Original Response)	CROSS-SECTION SAMPLE: MEAN '72	MEAN '74	STANDARD DEVIATION '72	STANDARD DEVIATION '74	N '72	N '74
(2) Discoveries good; use bad	75.5%[a]	4.03	3.98	1.25	1.30	957	302
	75.3	3.99	3.93	1.29	1.37	300	133
(3) Leave scientists alone; life made better	66.7	2.92	3.04	1.35	1.34	943	302
	69.1	2.75	2.86	1.33	1.37	297	118

[a]Upper figure for cross section; lower for potential public.

-----

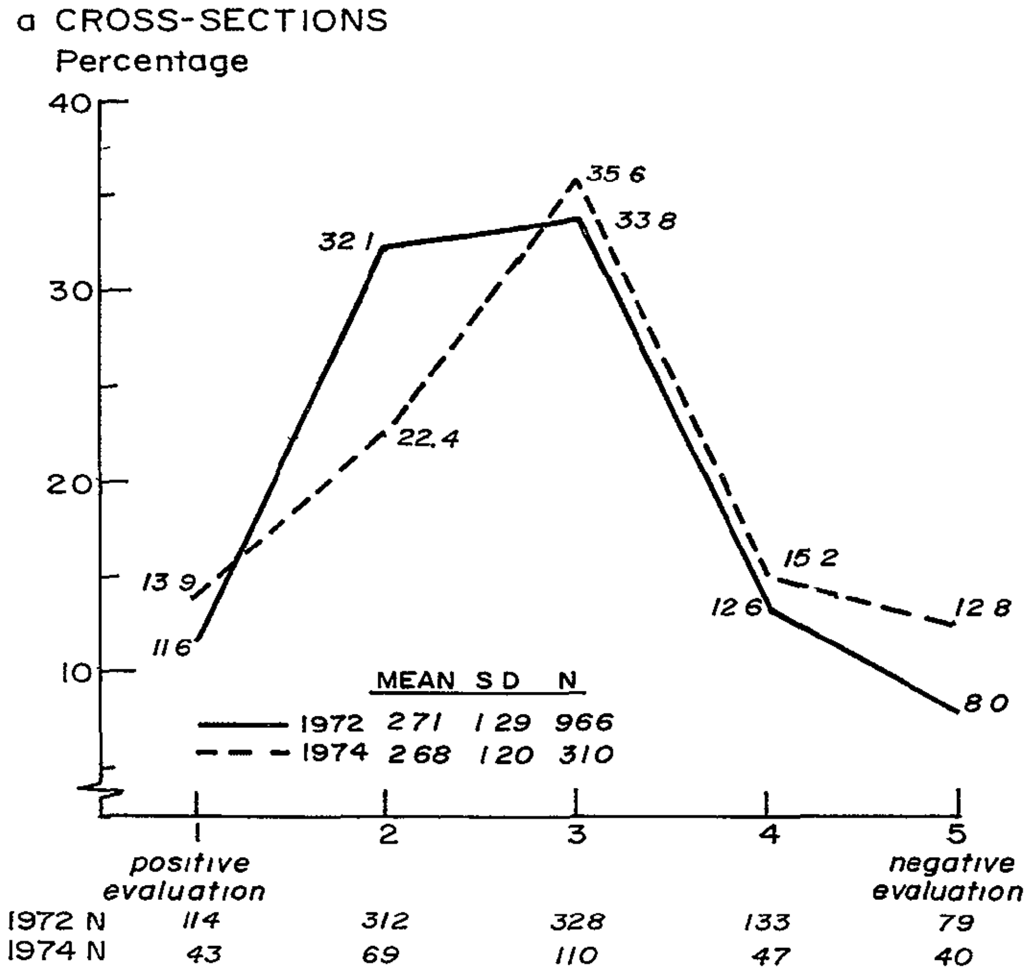
scores at the 5% level emerged for the independent cross-section samples or for the potential publics. Party/ideological identification was the only demographic correlate associated with consistency. Republican conservatives were more likely to be consistent in their views of scientific outcomes than Democratic liberals (r = .18).

Distributions of the responses to the two items tapping underlying attitudes about the outcome of science combine to form an index which is positively skewed. See Figure 3-5. That there is no statistically significant difference in the mean scores at the 5% level is indicative of the index's stability. Moreover, about 66.9% of the entire panel changed their response by no more than one category, the corresponding percentage for the panel's potential public was 66.3%. The over-time correlations for the entire panel and the panel's potential public were .32 and .31 respectively. No demographic variables were observed to be associated with a respondent's score on this index.

<u>Technological imperative</u>. A question was included in the 1972 survey which attempted to measure whether there was widespread agreement on the efficacy of a technological fix. This concept has at its core the notion that unanticipated problems arising out of technological development can always be, and ought to be, solved by additional doses of technology. This notion is one and the same with the "technological imperative" pessimistically foreseen by Jacques Ellul.[12] To test whether people accepted this notion, the respondents were asked to agree or disagree with this statement: "People shouldn't worry about harmful effects of technology because new inventions will always come along to solve the problems." We found that an overwhelming majority rejected this statement. The data bearing on this appear in Table 3-13. In the entire cross section, we found that those who agreed with this question also tended to favor decreased regulation of technology (r = .27) and to evaluate more positively the outcome of scientific activity (r = .30). Finally, those who disagreed were disproportionately younger (r = .25) and had more education (r = .21) than those who agreed.

FIGURE 3-5

OUTCOME-OF-SCIENCE SCALE: DISTRIBUTION OF SCORES



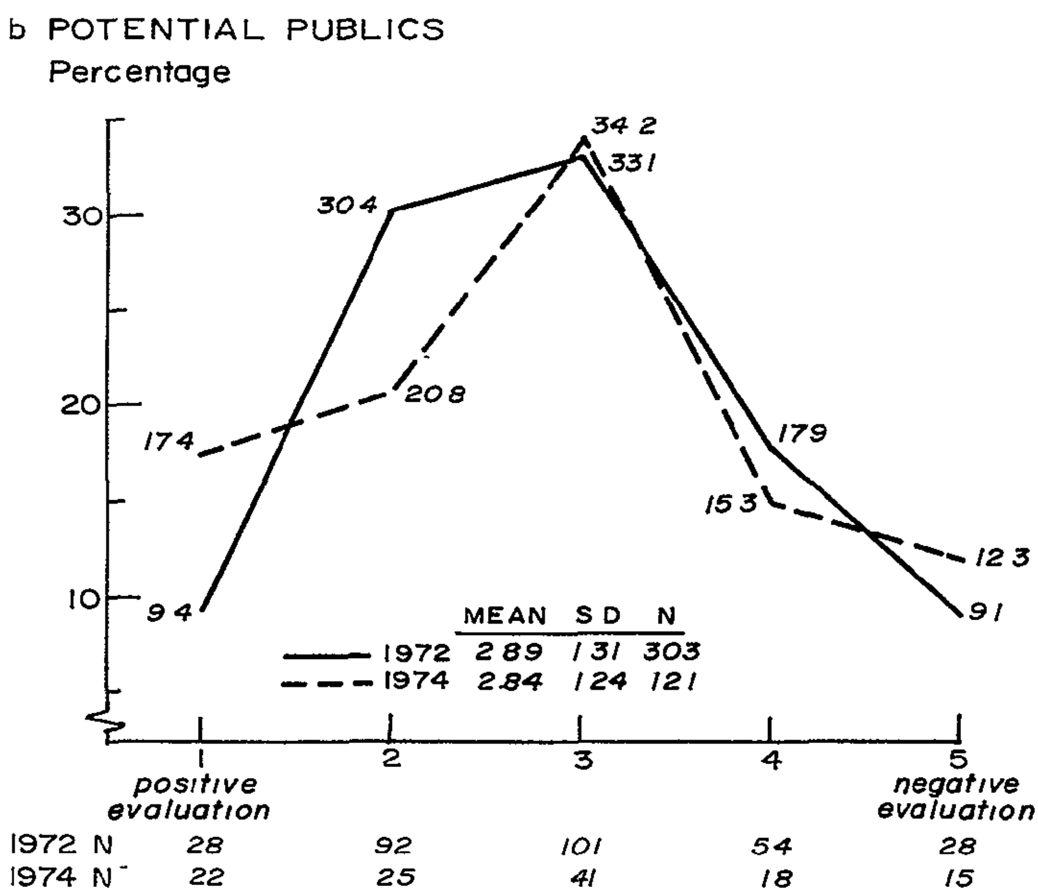


TABLE 3-13

BELIEF IN A 'TECHNOLOGICAL FIX'
(cross-section sample and potential public; 1972)

	STRONGLY AGREE	AGREE	AGREE-DISAGREE	DISAGREE	STRONGLY DISAGREE	N
Cross Section	6.4%	12.2%	6.5%	29.9%	45.1%	945
Potential Public	5.1	6.4	3.5	28.1	56.9	297

SUMMARY AND CONCLUSIONS

The major finding of this chapter is that the public does make a distinction between activities which can be characterized as scientific and those which are considered technological This distinction is maintained despite the continual blurring which appears in the popular media and in the statements of scientific notables Separate cognitive structures can be identified with the value of scientific activity, the control of technology, and the outcomes of science and of technology These cognitive dimensions are stable over time and appear, for the most part, in the entire cross section as well as in the potential public

The distinctions between technological activities and scientific activities were characterized by considerable confidence in the intrinsic value of the outcomes of scientific activities and the belief that the work of scientists should not be controlled Perceptions of the outcomes of technological activities were not so generous, goodly portions of the public were wary of technological activities and a substantial fraction accepted control of technological activities as legitimate, many respondents wishing it to be increased As we noted earlier, public tolerance of relatively unregulated scientific activity might change to a demand for greater control if science and technology come to be seen as indistinguishable on the practical level. Such a caveat runs somewhat counter to other survey research.

A second major finding is that the value the public places on scientific activities is very much a function of their education. Less than 1% of the sample that has completed college place a negative value on scientific activity compared to 21% of those who failed to graduate from high school. Clearly, the degree to which a person has been exposed to scientific knowledge does affect his evaluation of the activity The implications of this finding for NSF and AAAS Public Understanding of Science Programs are obvious

A third major finding, one which will be reinforced in the following chapter, was the increased cleavage between rich and poor This cleavage appeared both in respect to the value-of-scientific-activity indicator and the generalized outcome-of-technology indicator In each case, the differences of opinion between the rich and the poor in 1972 were increased by 1974 Perhaps attitudes toward technology and science are becoming more akin to attitudes toward traditional social welfare issues

In the next chapter we will begin to consider that question as we move to inquire into attitudes toward specific present technologies.

NOTES

[1]From United States Information Agency, *Seminar on Technology and Social Change,* mimeo., (March, 1975). Kranzberg's assertion is essentially the null hypothesis of our own argument.

[2]See Herbert Simon, "Relevance: There and Here," *Science* 181: 4100 (August 17, 1973), 613.

[3]Items 7 and 16, however, depart somewhat from the agree-disagree format, in that they are from "forced choice" questions. The numbering of the questionnaire items listed in Figure 3-1 does not, of course, represent the sequence--purely random--in which they were presented to respondents, but an analytically derived grouping.

[4]The definitive work on factor analysis is H. Harmon, *Modern Factor Analysis* (Chicago: University of Chicago Press, 1967). See also Johannes Van de Geer, *Introduction to Multivariate Analysis for the Social Sciences* (San Francisco: W.H. Freeman, 1971), 128-155.

[5]In an article based on the 1972 data--"Technology Observed. Attitudes of a Wary Public," *Science* 188:4184 (April 11, 1975), 121-127--we argued that items (13) and (15) clustered apart from item (14) when a fourth question dealing with the sensibleness of a "technological fix" was included. Due to an oversight on our part, that question was not included in the 1974 survey. Therefore, we left it out here in doing the factor analysis. Items (13), (14), and (15) then clustered together in both 1972 and 1974. Interestingly, even when the fourth item was included, the 1972 potential public yielded a response cluster containing (13), (14), and (15). The excluded question is discussed in the final section of this chapter. Another deviation of the present analysis from that presented in the *Science* article should be noted: marginals given there were *unweighted*; in this monograph, all analysis is based on *weighted* variables. (See Appendix D, part 4.)

[6]See David Heise, "Separating Reliability and Stability in Test-Retest Correlation," *American Sociological Review* Volume 34:1 (February, 1969) 93-101; David Wiley and James Wiley, "The Estimation of Measurement Error in Panel Data," *American Sociological Review* Volume 35:1 (February, 1970), 112-117; M. Hannan et al., "The Causal Approach to Measurement Error in Panel Analysis: Some Further Contingencies," in *Measurement in the Social Sciences*, H.M. Blalock, Jr., Ed. (Chicago: Aldine, 1974), 293-323.

[7]These claims are supported in other writings. See Appendix F, Section I.

[8]Excepting education and income, no demographic variables were found to be associated with the issue of controls.

[9]Especially trenchant is Charles Reich's *The Greening of America* (New York: Bantam, 1971).

[10]These findings are consistent with other studies on the effects of technology. See Appendix F, Sections II and III.

[11]In general, our findings about the public's attitudes toward the outcome of scientific activity are consistent with materials published elsewhere. See Appendix F, Section III.

[12]See *The Technological Society*, tr. J. Wilkinson (New York: 1956).

CHAPTER IV

ATTITUDES TOWARD PRESENT TECHNOLOGIES

In the first chapter we argued that technology is socially experienced Data were presented in Chapter III which delineated, in a general way, the public's perception of an aspect of that experience In order to confirm our understanding of technology as social experience, this chapter will explore attitudes toward widely implemented and well known technologies. Three major propositions are examined that technological change is perceived by the public to be central in contrast to other types of changes in society, that the public has a positive overall evaluation of presently available technologies with regard to their social benefits, and that technology is perceived to have substantial utility for solving social problems

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 1972 survey 980 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% noting one, 42% two and 35% three or more. In all respondents mentioned forty kinds of change, ranging from 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% mentioned two or more.

Some of the changes mentioned by respondents are duplicates. For ease of presentation, we have combined responses into twenty-five types of change, organized within the four comprehensive areas listed in Table 4-1. In overall emphasis, the frequency of mention of technological changes challenges various social changes, with economic and political changes drawing less attention then either. Many of the responses listed in Table 4-1 are to be expected; changed life styles and moral standards, increased cost of living, and new forms of political behavior are experienced first hand Technological advances, too, appear to be quite directly experienced by many people Changes linked to science and technology in general and to increased industrialization combine for 25% of the total responses for the whole sample and 38% for the potential public A number of specific technologies elicited special comment the space program, medicine, transportation, and communications (including television)

The degree to which our sample associated science and technology, in a more or less spontaneous manner, with important social changes marks the relative centrality of the topic to them We found that no demographic or social characteristics relate systematically to people mentioning changes in the science/technology category or to those who did not Neither does party identification appear to have any bearing on the number of mentions of science/technology in the context of social change

Our analysis suggests, then, that the public perceives general technological advance as an aspect of overall social change occurring since 1945. But this is *not* to say that the benefits of technological advance are necessarily perceived as being delivered equally to all people nor that the implicit beliefs of our statesmen of science about technology's beneficence and social promise are shared by the public-at-large We turn now to a consideration of the extent to which it does perceive that promise to have been realized

TABLE 4-1

DISTRIBUTION OF PERCEIVED IMPORTANT CHANGES IN SOCIETY SINCE 1945
(cross-section sample and potential public, 1972)

	CROSS SECTION	POTENTIAL PUBLIC
I. SOCIAL CHANGES (n=556; 165)[a]	(56.9%)[b]	(53.6%)[b]
1. Changes in life style generally and among the young	21.7%[c]	21.3%
2. Improvements in education, interpersonal relations, leisure time	10.9	14.0
3. Life less settled; more pressures	8.9	8.6
4. Breakdown in education, family life and interpersonal relations	12.5	13.8
5. Change, or decline, in moral standards, more crime	19.3	16.2
6. Population explosion and environmental deterioration	4.7	4.1
II. TECHNOLOGICAL CHANGES (n=475; 172)	(47.8)[b]	(56.8)[b]
1. General scientific and technological change	14.9%	15.8%
2. Increased industrialization and mechanization	9.2	12.4
3. New Products and inventions	5.4	6.7
4. Medical advances	9.2	9.9
5. Space program	10.0	14.0
6. Advances in TV and communications	6.7	10.2
7. Advances in transportation	8.3	12.6
8. Increased pollution	4.1	5.0
III. ECONOMIC CHANGES (n=377; 108)	(38.6)[b]	(35.6)[b]
1. Improved standard of living, more employment	15.1%	18.0%
2. Increased cost of living, more unemployment	23.4	15.1
3. Increased taxes	7.2	5.5
4. Growth of large business enterprises	3.8	6.9
IV. POLITICAL CHANGES (n=310; 113)	(31.8)[b]	(37.4)[b]
1. General social and political change	5.7%	6.8%
2. More radical politics	4.9	6.2
3. Increased political involvement	8.3	9.8
4. Increased governmental control	4.2	4.1
5. Politics dirtier, less trustworthy	4.3	5.1
6. Improved race relations	4.8	7.8
7. More liberal court and prison systems	5.0	5.1

[a]Indicates sample size for cross section and potential public.
[b]Percent indicates the fraction of the sample mentioning one or more of the items in designated area of change.
[c]Fraction of the sample mentioning particular change.

PRESENT TECHNOLOGIES EVALUATED

One series of questions used in both surveys probes individual perceptions of benefits associated with 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 They were selected as representative of a wide range of presently employed highly visible technologies that are widely implemented and therefore familiar to the public. Three more technologies were added to this list in the 1974 survey birth control pills, computers, and television Table 4-2 shows that both the 1972 and 1974 samples varied considerably in their estimation of these technologies for good or ill. Overall, however, results of both surveys indicate that the public judges most of these technologies quite positively The one clear exception is in attitudes toward the atomic bomb The data show that less than half of the 1972 sample believed the atomic bomb to have resulted in better social conditions; in 1974 this proportion declined sharply to only 26% of the sample

Of particular interest is the stability of the responses evaluating the technologies. Table 4-3 presents evidence that the attitudes recorded in Table 4-2 are not transient Consider first the responses from the panel of respondents who were reinterviewed in 1974 (see the first column of Table 4-3) At least two-thirds of the responses to four of the questions remained stable, i e., were within one opinion category of their 1972 response.[1] Even in the case with the greatest change, attitudes toward the atomic bomb, over half of the reinterviewed sample did not stray far from their original position Not only did individual beliefs hold firmly, but in aggregate the population has maintained fairly steady attitudes. This constancy is borne out by comparison of the means and standard deviations computed for 1974 cross-section responses with those from the 1972 sample

TABLE 4-2

PRESENT TECHNOLOGIES EVALUATED
(cross-section sample and potential public, '72; '74)

Technology	As Making Life Very Much Worse to Slightly Worse		"In Between"		As Making Life Slightly Better to Very Much Better		N	
	'72 (1-3)	'74 (1-3)	'72 (4)	'74 (4)	'72 (5-7)	'74 (5-7)	'72	'74
Appliances	3.5%[a]	8.5%	3.4%	5.0%	93.2%	86.5%	974	314
	3.0	5.9	4.5	6.0	92.5	88.1	302	122
Automobiles	15.9	16.4	11.4	12.0	72.9	71.6	974	314
	19.1	17.6	10.5	17.6	70.4	64.7	302	121
Automation	19.2	18.5	17.7	14 1	64.2	67.4	969	306
	11.0	20.2	17.0	6.7	72.0	73.0	301	118
Space Program	19.6	16.2	19.6	18.5	60.8	65.2	972	314
	15 4	7.7	16.8	15.7	67.8	76.6	301	122
Atomic Weapons	45.7	55.8	5.4	21.7	48.9	25.6	966	306
	48.1	58.7	23.0	17.3	28.9	24.1	299	120
Computers[b]	---	14.5	---	12.1	---	73.3	---	314
	---	12.2	---	6.2	---	81.6	---	122
Birth Control Pills[b]	---	11.8	---	12.6	---	75.5	---	311
	---	5.6	---	6.0	---	88.4	---	120
Television[b]	---	12.9	---	12.6	---	74.6	---	314
	---	15.9	---	11.1	---	72.8	---	122

[a]Top figures for total samples; lower for respective potential publics.
[b]In 1974 survey only.

TABLE 4-3

THE STABILITY OF ATTITUDES TOWARD PRESENT TECHNOLOGIES
(cross-section sample and potential public, '72; '74)

Technology	PANEL:[b] (Percentage of Respondents within ± One Category of Original Response)	CROSS-SECTION SAMPLES: MEAN '72	MEAN '74	STANDARD DEVIATION '72	STANDARD DEVIATION '74	N '72	N '74
Appliances	81.1%[a]	6.15	6.05	1.14	1.37	974	314
	80.5	6.01	6.02	1.08	1 28	302	120
Automobiles	64.0	5.26	5.27	1.61	1 71	974	313
	63.3	5.08	5.00	1.67	1.79	302	121
Automation	65 6	5.01	5.04	1.61	1.72	969	302
	71.3	5.19	5 16	1.54	1.77	301	118
Space Program	66.3	4 91	5.16	1.87	1.74	972	308
	65.7	5.09	5.55	1.79	1.50	301	122
Atomic Weapons	56.6	3.57	3 12	2.02	2.01	966	314
	61.6	3.47	3 01	2.14	1.93	299	122

[a]Top row indicates figures for cross-section sample; lower for potential public

[b]Panel sample were those respondents in TECH I reinterviewed for TECH II, 1974.

Are any demographic or political characteristics associated with evaluations of particular present technologies? Findings related to this question, summarized in Table 4-4, are rather spotty and fail to conform to any systematic pattern. Consider first the entire cross section.

TABLE 4-4

THE EFFECT OF INCOME AND IDEOLOGY ON
ATTITUDES TOWARD PRESENT TECHNOLOGIES
(Pearson's r; cross-section sample and potential public, 1972; 1974)

	INCOME		IDEOLOGY	
	'72	'74	'72	'74
Appliances	.06[a]	.21	-.11	-.12
	.08	.09	-.23	-.22
Automobiles	.01	.04	-.10	-.21
	.11	-.10	-.23	-.19
Automation	.19	.17	-.12	-.19
	.19	.13	-.20	-.31
Space Program	.22	.24	-.09	-.07
	.24	.12	-.26	-.22
Atomic Weapons	.06	.00	-.25	-.21
	.10	.02	-.42	-.23
Computers[b]	---	.18	---	-.01
	---	.05	---	-.19
Birth Control Pills[b]	---	.19	---	.08
	---	.22	---	.08
Television[b]	---	.07	---	-.06
	---	.11	---	-.05

[a]Figures in top row for cross-section sample; lower for potential public.
[b]In 1974 survey only.

Income had a somewhat greater relationship to differential evaluation in 1974 than it had in 1972. In the first survey only evaluations of automated factories and of the space program were even modestly associated with income level In 1974, in addition to those two technologies, appliances and two technologies added to our list in 1974--birth control pills and computers--all were associated with differences in income In much the same way, political differences have slightly increased over time Whereas in 1972 only the evaluations of atomic weapons were related to political ideology, in 1974 evaluations of automobiles, industrial automation, and atomic weapons were, in part, associated with political ideology In each case, the more "liberal" the respondent, the less likely he/she was to evaluate the technology in question positively. Younger respondents had disproportionately more positive evaluations of contraceptive pills and of computers. Males tended to favor computers more than females did. Finally, the more highly educated respondents in the 1974 survey seemed to favor the space program more than did less educated respondents. The only difference between demographic associations in the entire cross section and those in the potential public exists in the political indicators. While increased differences in ideological associations appeared between the two cross sections, differential liberal and conservative associations did not increase in the 1974 potential public Indeed, in two instances, attitudes toward atomic weapons and the space program, such differences had been greater in 1972

How do the more general attitudes toward technology and science discussed in Chapter III relate to evaluations of specific present technologies? Several attitudes toward the outcomes of technology consistently combined with a number of specific evaluations--the more disenchanted with technology, the less positive the particular evaluation. These relationships were generally stable over time Table 4-5 presents the various associations for the two years The only other general attitude toward technology or science appearing to be consistently associated with specific evaluations was that measured by the value-of-scientific-activity index Those less positive toward scientific research tended to make more negative assessment of the space program This correlation remained stable over the two years between surveys. Moreover, the degree of association was roughly the same for both the entire cross section and the potential public (r = -.23).

In an effort to determine whether an underlying attitude toward current technology *in general* rather than toward *particular* technologies was present in evaluations of those technologies, we applied a scalogram program to the individual evaluations Because these formed a Guttman scale, we are confident that general underlying evaluative attitudes exist

TABLE 4-5

RELATIONSHIP BETWEEN OUTCOME-OF-TECHNOLOGY SCALE AND COMPONENTS AND EVALUATIONS OF PRESENT TECHNOLOGIES

(Pearson's r; cross-section sample and potential public; '72, '74)

EVALUATION OF	OUTCOME OF TECHNOLOGY SCALE		TECHNOLOGY COMPLICATES LIFE		TOO DEPENDENT ON MACHINES		GO BACK TO NATURE	
	'72	'74	'72	'74	'72	'74	'72	'74
Appliances	-.18[a]	-.21	*	*	*	*	*	*
	-.31	-.20	*	*	*	*	-.34	-.23
Automobiles	-.23	*	*	*	*	---	---	---
	-.38	*	-.28	*	-.26	---	.36	---
Automation	-.26	-.28	*	*	---	-.22	-.28	-.21
	-.38	-.33	-.31	-.23	-.20	-.25	-.42	-.34
Space Program	-.26	-.23	*	-.20	*	*	*	-.27
	-.36	-.32	-.27	-.26	-.25	-.19	-.34	-.28
Atomic Weapons	*	*	*	*	---	---	*	*
	-.24	*	-.25	*	---	---	-.23	-.23
Computers[b]	---	-.23	---	-.19	---	*	---	*
	---	-.34	---	-.20	---	-.34	---	*
Birth Control Pills[b]	---	*	---	*	---	*	---	*
	---	*	---	*	---	*	---	*
Television[b]	---	*	---	*	---	*	---	*
	---	*	---	*	---	*	---	*

[a]Top figure for cross-section sample; lower for potential public.
[b]Asked only in 1974.
*Not significant at $p < .05$.

in the data from both the 1972 and 1974 surveys.[2] In addition, a Likert scale--formed by assigning scores to various responses on the questionnaire and adding them--was highly correlated with the Guttman scale (r = .87 for 1972 and r = .88 for 1974) Because the Likert scale technique produced distributions with better statistical properties, it has been used exclusively for this phase of the analysis It is referred to throughout as the "present technology evaluation index "

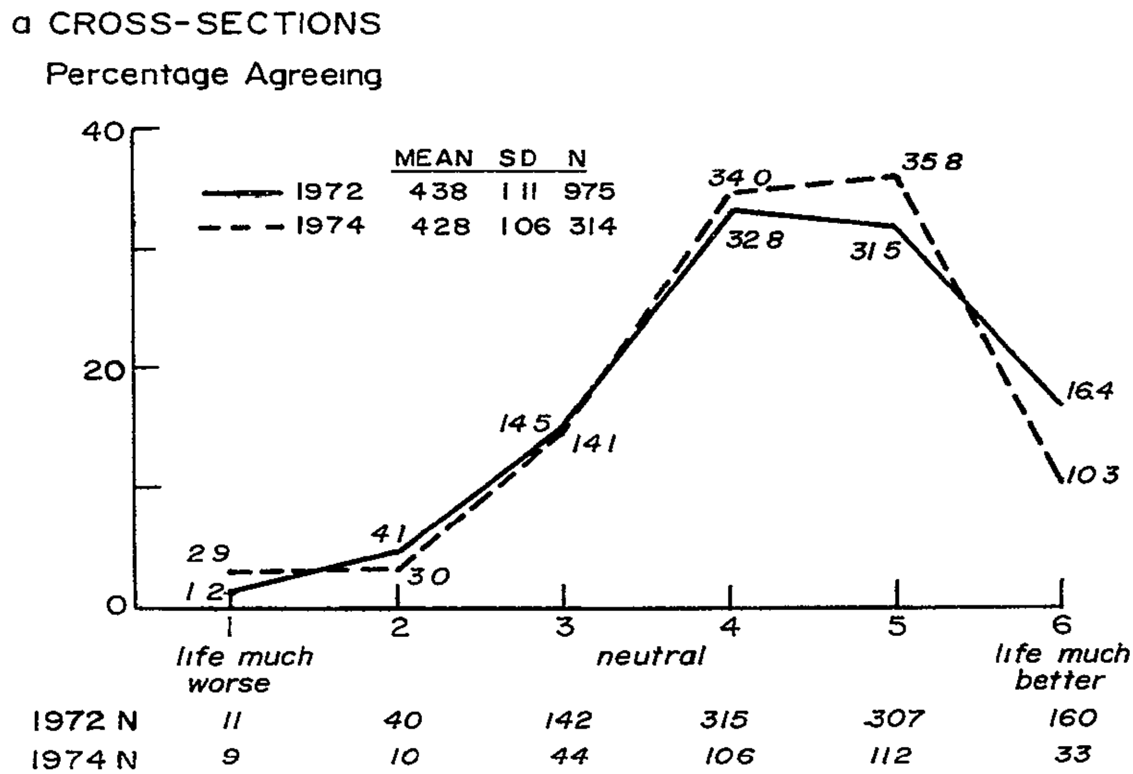
Figure 4-1 presents the distributions measured by that index of evaluative responses from the cross sections and potential publics. For ease of presentation, the continuous scale was collapsed at six equal intervals. Favorable attitudes toward existing technologies predominate in the whole samples and the potential publics of both 1972 and 1974.[3] The average values of the distributions for the two cross sections and the potential publics are remarkably close Data from the panel of reinterviewed respondents complement that finding. Over 86% of the panel's responses were within one opinion category of what they had been in 1972. The over-time correlation was a healthy .35 for the entire panel and .42 for the potential public within the panel

When the present technology evaluation index is analyzed in terms of demographic and political characteristics, very few systematic differences are found to be associated with occupation, education, sex, or race Political orientation and income seem to make some difference, however. Figure 4-2 indicates that a minority of strongly liberal citizens form the core of those who question the overall benefit of the technological developments they were asked to evaluate. Figure 4-3 shows that the more affluent Californians find greater benefits in present technologies than do the State's poorer citizens In each case, despite some dips and bumps in the graphs, the general monotonic relationship stands

Not surprisingly, evaluations of present technologies are highly correlated with attitudes about technology's social outcomes Again, the more disenchanted a respondent is with those outcomes, the more generally negative his evaluation of present technologies. Table 4-6 presents data on this relationship derived from associations found

FIGURE 4-1

EVALUATIONS OF PRESENT TECHNOLOGIES AS MAKING LIFE BETTER OR WORSE



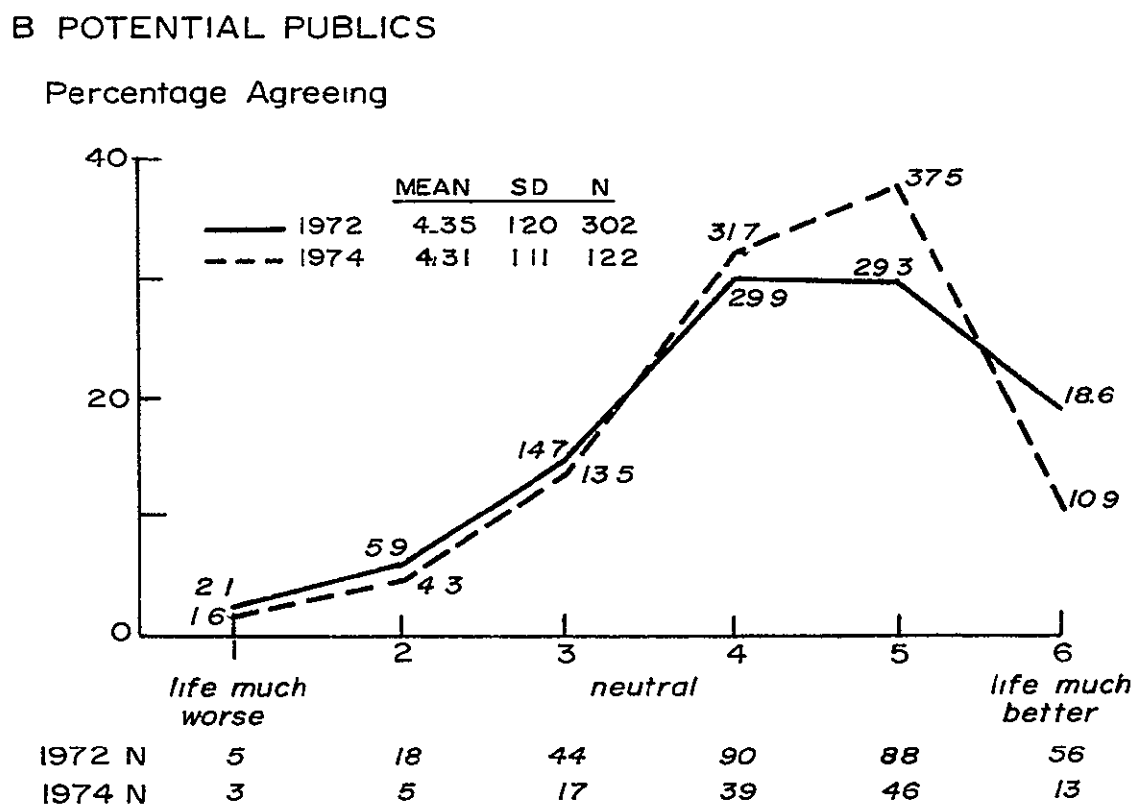
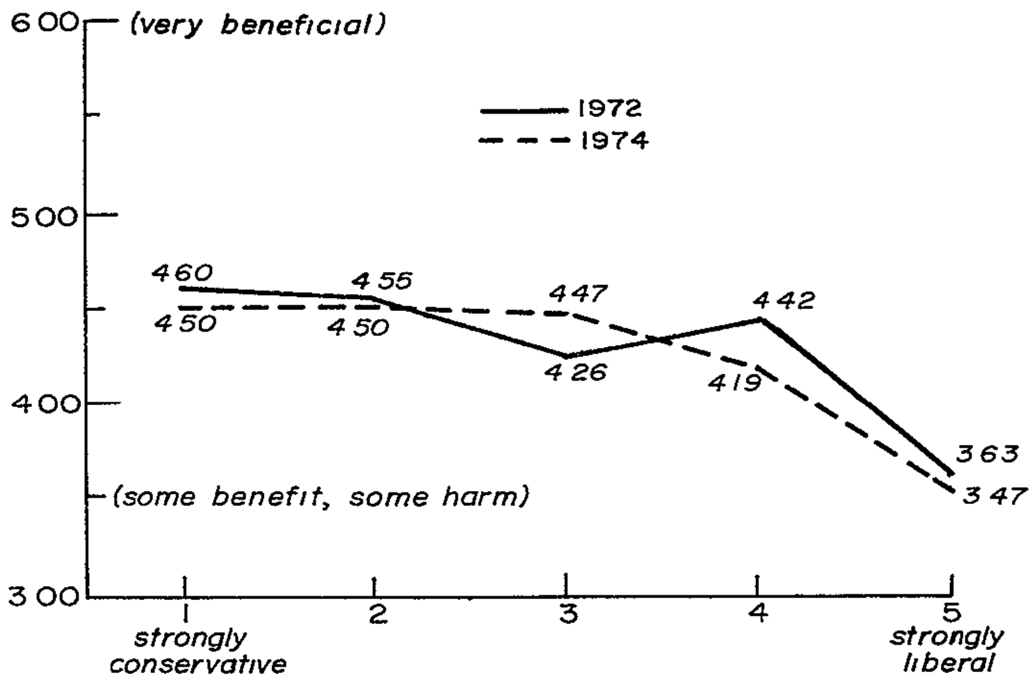


FIGURE 4-2

 POLITICAL IDEOLOGY AND PERCEPTIONS OF TECHNOLOGY'S BENEFIT/HARM

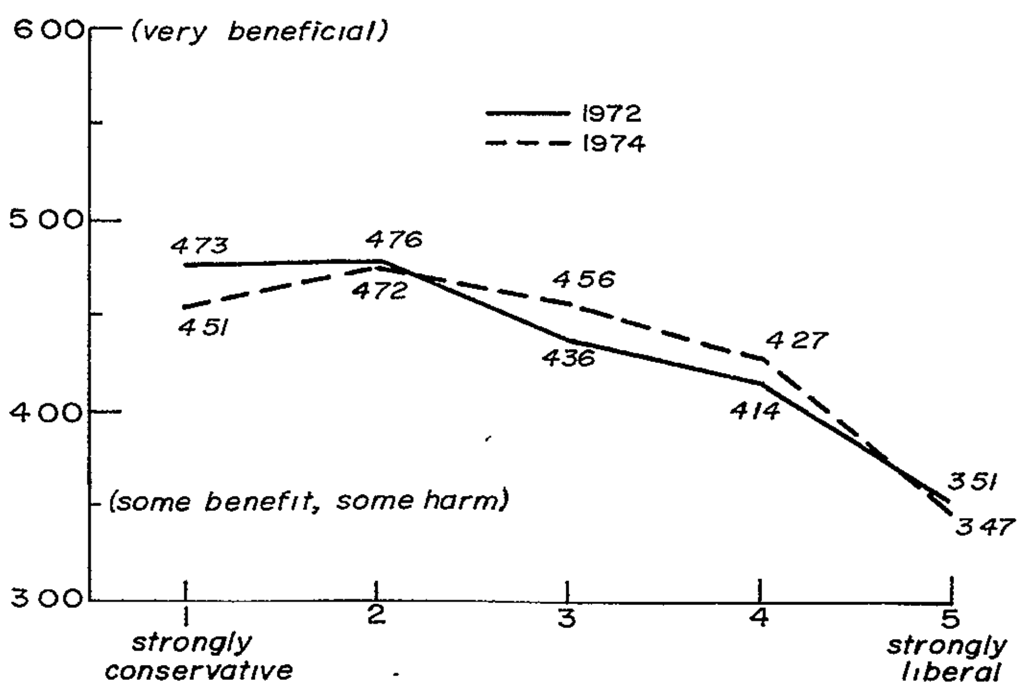
a CROSS-SECTIONS

Present Technology Index



		1	2	3	4	5
1972	N	96	307	156	245	88
	SD	0 97	1 09	1 14	1 10	1 13
1974	N	30	92	53	90	35
	SD	0 92	0 95	1 16	0 99	1 41

b POTENTIAL PUBLICS

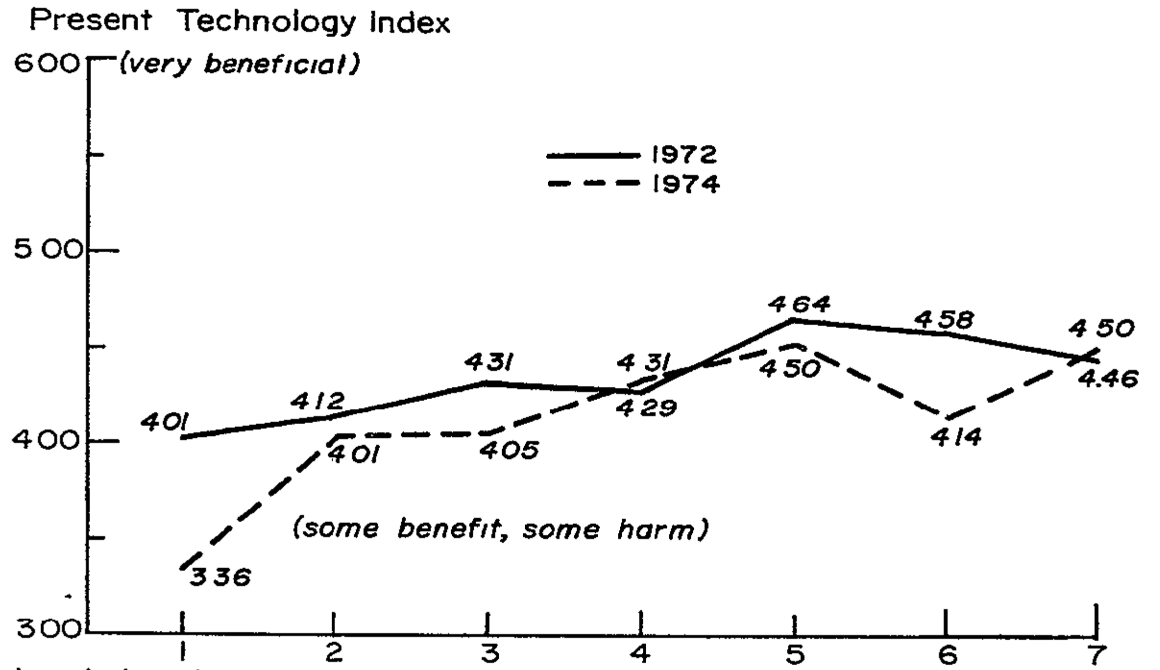


		1	2	3	4	5
1972	N	27	98	52	72	46
	SD	0 79	1.10	1 25	1 24	1 03
1974	N	11	33	15	39	20
	SD	1 05	0.93	0 90	0 85	1 48

FIGURE 4-3

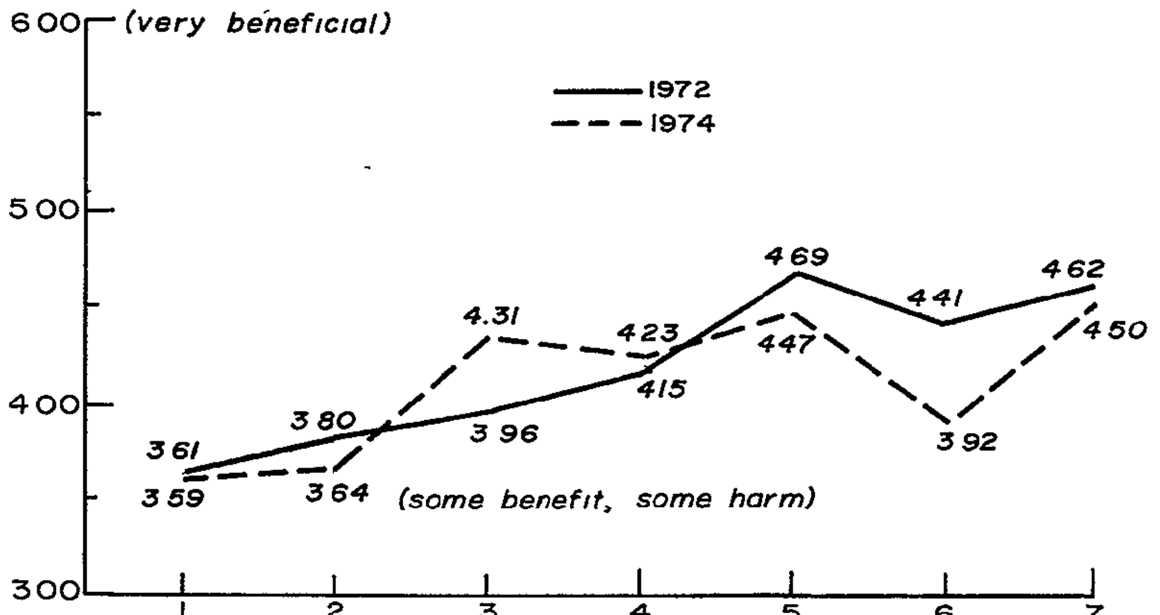
INCOME AND PERCEPTIONS OF TECHNOLOGY'S BENEFIT/HARM

a CROSS-SECTIONS



		1	2	3	4	5	6	7
Income Level (U.S. Dollars)		less than 3,000	3,000-4,999	5,000-6,999	7,000-9,999	10,000-14,999	15,000-19,999	20,000+
1972	N	99	95	113	171	257	104	70
	S D	103	1 08	1 17	1 19	1 10	102	099
1974	N	22	24	18	36	104	43	45
	S.D	1 40	1 07	1 38	0 93	0 95	1 32	0 93

b POTENTIAL PUBLICS



		1	2	3	4	5	6	7
Income Level (U S.Dollars)		less than 3,000	3,000-4,999	5,000-6,999	7,000-9,999	10,000-14,999	15,000-19,999	20,000+
1972	N	15	16	27	46	90	47	45
	S D	0 98	1 31	1 25	1 45	1 10	1 07	102
1974	N	3	2	3	11	46	23	33
	S D.	1 30	166	0 57	100	0 90	1 53	0 97

between the present technology evaluation index and the outcome-of-technology scale--overall and with respect to responses to particular items collated on it. A definite change in the strength of the relationship is evident For 1974 respondents, the present technology evaluation index is less related to the outcomes scale than for respondents in the 1974 survey. It may be that the change is a result of the same factors which attenuated the relationship between party-ideology associations with evaluations and the outcomes index Those causative factors, unfortunately, are not understood

TABLE 4-6

ASSOCIATION BETWEEN PRESENT TECHNOLOGY EVALUATION INDEX AND OUTCOMES-OF-TECHNOLOGY SCALE AND COMPONENTS (Pearson's r, cross-section sample and potential public; 1972, 1974)

	Outcomes of Technology Scale	Technology Complicates Life	Over-dependence on Machines	Go Back to Nature
1972 Cross Section	-.33	- 26	-.19	-.31
1972 Potential Public	-.45	-.37	-.27	-.45
1974 Cross Section	-.28	-.17	-.14	-.29
1974 Potential Public	-.31	-.25	-.08	-.36

ATTITUDES ABOUT THE SOCIAL UTILITY OF TECHNOLOGICAL DEVELOPMENT

In the 1974 survey a series of questions was asked to determine how helpful people thought increased technological development would be in solving a range of important social problems A list of ten areas of public concern was presented to the respondent who was then asked to indicate which of them he thought or talked about often. In addition, the respondent was asked to give his opinion as to whether additional uses of technology would improve, aggravate, or have no effect on chances of solving the particular problem Table 4-7 presents the results of this inquiry Solid majorities saw technology aiding in half of the problem areas presented--the development of mass rapid transit, solving

TABLE 4-7

HOW USEFUL IS FURTHER TECHNOLOGICAL DEVELOPMENT IN SOLVING SOCIAL PROBLEMS?
(cross-section sample and potential public, 1974)

PROBLEM AREA	% ACTIVELY CONCERNED WITH IT	DEGREE OF USEFULNESS OF TECHNOLOGY: POSITIVE	NEUTRAL	NEGATIVE	MEAN	STANDARD DEVIATION	N
Mass Rapid	36.5%[a]	84.2%	11.6%	4.2%	1.20	0.50	262
Transit	44.5	57.1	8.6	4.3	1.17	0.48	111
Energy Crisis	72.5	78.4	15.1	6.6	1.28	0.55	286
	79.1	84.1	8.8	7.0	1.23	0.57	114
Environment	66.8	71.9	16.2	12.0	1.40	0.69	284
	76.1	74.4	8.7	16.9	1.45	0.77	116
Population	40.7	59.3	37.0	3.7	1.44	0.57	280
Growth	47.8	62.4	36.8	0.9	1.38	0.51	113
Education	59.6	66.3	21.9	11.7	1.45	0.65	280
	67.1	64.4	19.9	15.7	1.51	0.75	111
Crime Rate	67.3	49.6	42.6	7.8	1.58	0.63	283
	62 3	47.1	44.7	8.2	1.61	0.64	111
Providing Jobs	41.6	48.7	26.9	24.4	1.76	0.83	281
	44.0	43.8	25.5	30.8	1.87	0.86	113
Drug Abuse	58.9	30.2	60.2	9.7	1.80	0.60	286
	54.6	21.4	65.6	13.1	1.92	0.58	112
Cost of Living	92.7	33.6	42.9	23.5	1.87	0.75	288
	91.4	32.5	41.6	25.9	1.93	0.77	112
Privacy of	39.9	32.0	25.8	42.2	2.10	0.86	278
Personal Records	49.9	18.5	24.7	56.9	2.38	0.78	115

[a]Upper row is cross section based on n of 312; lower row is potential public based on n of 122.

the energy crisis, protecting the environment, curbing population growth, and education But this belief in technology's social usefulness did not extend to a number of other areas of public concern On both pocketbook issues--employment and the cost of living--almost one quarter of the sample expressed the opinion that further use of technology would only aggravate the problems. Significantly, reducing the cost of living was important to virtually all of the people interviewed that year It is interesting that in only three of the six issue areas drawing expressions of greatest concern from over 50% of the sample--the energy crisis, the environment, and education--was technology believed to be of considerable assistance. Concern about maintaining the privacy of individual personal records led to the sharpest dissent against the uses of technology. Over 40% of the whole sample and 55% of the potential public felt that here technology poses a definite threat to an essential civil liberty The "invasion of privacy" issue was the only one asked about which generated such heavy public consensus that technology's potential usefulness is definitely outweighed by its possible adverse effects. No relationship was discovered between how important an individual believed a problem to be and how useful he thought technology would be in solving it [4]

SUMMARY AND CONCLUSIONS

The data examined above lead to several conclusions. First, the public considers technological developments to be among the most significant aspects of social change This view runs through all segments of the California population People consider technology to have played a key role in shaping the texture of the society they live in While we did not seek to measure affect with regard to technology-induced change, it is notable that the examples of change mentioned in response to an open-ended question eliciting them are neutral or positive in tone.

The public's positive evaluation of technology is seen even more clearly when it is measured directly Assessments of particular technological innovations, as well as an index measuring more general evaluations, are highly skewed in the positive direction Within this overall positive bias, differences do emerge between liberals and conservatives and rich and poor.

Finally, the data suggest that the California sample retains a high degree of confidence in the utility of technology for dealing with social problems In seven out of ten areas, the fraction of people believing that additional doses of technology would be beneficial ranged from nearly 85% to just under 50%. In only one case, the issue of maintaining the privacy of personal records, did more people feel that increased technological development boded ill than well

Yet these enthusiastic assessments of technology must be more finely scrutinized. For in a democratic society technological development presupposes an end and a set of values to be achieved. To place technology's high marks in a context of the public interest, we need to look at the values to be sought and who will have a say in seeking them Chapter V offers just such a look

NOTES

[1]See Chapter III, pp. 51-53 for explication of the use of the panel responses as a gauge of attitude stability.

[2]In 1972 the coefficient of reproducibility was .93; in 1974 it was .94. Menzel's coefficient of stability was .67 in 1972 and .66 in 1974.

[3]This finding is quite similar to that presented in the National Science Board Study. See Appendix F, Section 4 for details.

[4]Nor, on a scale constructed by aggregating the individual problem areas, could any systematic differences be detected by cross tabulating them with a host of demographic and political variables. A relationship (r = .28) was found between perceptions of technology's utility and evaluation (summarized in Table 4-2) of presently available technologies.

CHAPTER V

TECHNOLOGY, SOCIAL VALUES, AND THE POLITICAL PROCESS

The particular ways in which the consequences of technology's implementation are distributed most often result from political decisions Generally, a range of options is available to decision makers, some of which would spread the costs and benefits widely, others of which would narrow their dispersion A rapid transit system may speed suburbanites into downtown districts quickly and inexpensively but produce high levels of noise and congestion for inner city residents as trains roar through their neighborhoods. The same transit system can be built underground at greater expense so that such negative effects will be reduced. A choice between values is always part and parcel of decisions about how a technology is to be implemented This chapter will address two questions: first, what important values do people hold with respect to the implementation of technology? Second, what groups do people perceive as legitimately participating in decisions affecting those values, particularly when one value conflicts with another?

SOCIAL VALUES AND TECHNOLOGICAL DECISIONS

In both the 1972 and 1974 surveys, a series of questions was asked which probed the structure of values held by California citizens. Respondents were asked to consider a number of social values--ranging from highly utilitarian to more humanistic and egalitarian concerns--and to indicate the importance they should be given in evaluating technology's impact Nor surprisingly, there was no strong consensus on what values should be given priority. Yet a relatively high degree of support was expressed for a wider range of priorities than simply the economic values of employment and taxes which are often the basis for decisions on technology-related public policy. These data are presented in Table 5-1.

TABLE 5-1

IMPORTANT VALUES IN ASSESSING TECHNOLOGY
(cross-section sample and potential public, '72; '74)

	1972					1974				
Effect On	Very Import.	Somewhat Import.	Slightly Import	Not at all Import.	N	Very Import.	Somewhat Import.	Slightly Import.	Not at all Import.	N
Employment	60.6%[a]	27.6%	8.6%	3.2%	934	59.5%	29.2%	9.5%	1.8%	302
	51.5	34.9	9.2	4.3	298	53.9	31.0	12.2	2.9	121
The environment	72.3	19.8	6.8	1.0	940	61.6	29.5	7.4	1.5	308
	72.4	20.2	6.6	0.8	299	64.7	25.8	8.7	0.7	121
Making life more enjoyable	47.0	39.3	12.2	1.4	944	46 7	37.9	13.3	2.1	308
	47.4	42.2	10.1	0.3	299	43.1	42.1	13.3	1.5	122
Taxes	56.3	31.0	9.4	3.3	934	53.0	28.9	13.5	4.6	297
	52.7	30.3	12.3	4.7	297	47.8	38.0	13.0	1.3	117
Condition of poor people	59.7	26.6	9.2	4.5	941	60.7	31.3	6.0	2.0	299
	56.8	27.7	11.0	4.4	299	60.9	31.5	6.1	1.5	118
U.S. international prestige	32.8	30.4	21.8	15.0	926	32.1	27.6	21.6	18.7	304
	20.2	28.6	27.1	24.1	292	24.9	28.3	30.1	16.7	121
Leisure time	17.8	34.4	30.7	17.1	927	(Not Asked)				
	17.6	33.2	29.4	19.7	297					
The individual's right to privacy	(Not Asked)					66.3	23.6	6.6	3.5	299
						69.8	24.2	4.4	1.6	119

[a]Top figure for cross-section sample; lower figure for potential public.

Perhaps the most significant finding from these data is that over half the respondents believed a multiplicity of values to be extremely important criteria for evaluating the consequences of technical development. Only two values which respondents were asked to rate failed to strike a responsive chord in the public--in both years the importance of the U.S international image (often used by policy makers as a rationale for large scale projects) and in 1972 the importance of increasing leisure time. The wide ranging combination of public values complicates both the activities of technologists and the task of policy makers, for some values seem clearly to be in tension.

In general, the structure of values in the potential public is similar to that present in the entire sample Some intriguing exceptions are evident, however. In both 1972 and 1974, about 7% fewer of the potential public considered the effect of technology on employment as "extremely important" in assessing technology Moreover, in 1974 the potential public evinced less concern for the impact of technological implementation on tax rates than did the entire cross section What accounts for these indications of greater economic sanguinity on the part of the potential public is unclear. Indications of value preferences remained generally stable across time. The only exception here is the drop in the cross-section sample's concern for the environment from 70% assessing it as "extremely important" in 1972 to about 62% in 1974.

Because values are often somewhat contradictory, an individual may experience conflict when he must choose between them To explore this response, we asked respondents to *rank* the values, thus making trade-offs explicit. While it is methodologically impossible for us to measure precisely the intensity of respondents' commitment to the various values, an approximate estimation can be made by examining the distributions of the responses. Data bearing on trade-offs made are presented in Table 5-2 (for 1972) and in Table 5-3 (for 1974).

According to the 1972 data the most highly valued condition was employment, followed very closely by environmental protection and by enjoyment of life. Although relegated to fourth and fifth place, the beliefs that taxes ought to be reduced and that the poor ought not to be

TABLE 5-2

VALUE TRADE-OFFS--1972
(cross-section sample and potential public)

Effect On:	Most Importance 1	2	Moderate Importance 3	4	5	Least Importance 6	7	Mean	Standard Deviation	N
Employment	17.7%[a]	27.4%	19.9%	16.2%	11.5%	5.6%	1.8%	3.00 (1)[b]	1.55	933
	16.0	27.3	17.8	18.7	13.1	5.2	2.0	3.09 (3)	1.55	299
Environment	20.9	21.5	19.6	12.8	13.4	7.8	4.1	3.16 (2)	1.74	931
	23.8	21.1	20.5	11.2	12.1	7.1	4.3	3.05 (2)	1.76	299
Making life more enjoyable	28.7	13.1	11.8	13.4	14.0	13.6	5.3	3.30 (3)	1.99	929
	33.7	12.9	14.8	13.5	14.5	7.7	3.0	2.97 (1)	1.83	295
Taxes	13.3	13.8	18.0	20.4	17.2	13.0	4.4	3.71 (4)	1.71	933
	13.4	11.0	15.0	22.1	15.8	17.3	5.5	3.90 (5)	1.77	299
Poor	10.6	14.6	21.2	19.1	17.0	11.5	6.0	3.76 (5)	1 69	929
	9.2	17.6	22.7	17.4	16.3	11.1	5.7	3.70 (4)	1.67	297
U.S. prestige	7.6	7.3	6.9	10.1	16.2	23.1	28.8	5.05 (6)	1.91	931
	3.3	6.4	5.6	8 7	13.5	25.7	36.7	5.47 (6)	1.71	298
Leisure time	1.4	2.8	2.8	8.1	10.7	25.1	49.2	5.96 (7)	1.41	929
	1.1	4.1	3.9	8.8	14.8	25 2	42.1	5.76 (7)	1.47	296

[a] Top figure for cross-section samples; lower for potential public.

[b] Figure in parenthesis indicates relative priority rank of the particular value.

TABLE 5-3

VALUE TRADE-OFFS--1974
(cross-section sample and potential public)

Effect On:	Most Importance 1	2	Moderate Importance 3	4	5	Least Importance 6	7	Mean	Standard Deviation	N
Employment	15.4%[a]	23.3%	18.1%	17.9%	18.1%	4.9%	2.3%	3.24 (1)[b]	1.58	307
	12.6	17.0	17.7	24.1	23.5	3.8	1.4	3.46 (3)	1.49	120
Making life more enjoyable	30.3	14.5	8.9	13 8	10.6	13.1	8.6	3.34 (2)	1.09	307
	30.3	12.4	11.4	17.2	14.6	8.5	5.7	3.22 (1)	1.94	120
Privacy	15 8	16.2	15.8	16.8	10 8	14.0	10.4	3.74 (3)	1.95	307
	17.6	19.2	15.0	14.8	9.5	14.5	9.3	3.60 (4)	1.97	121
Environment	14.0	16 4	15.7	12.5	18.6	11.8	11.0	3.85 (4)	1.93	308
	20.2	20.5	18.3	12.1	10.8	14.2	4.0	3.31 (2)	1.85	121
Poor	10.7	12.0	22.0	17.6	17.0	13.8	6.4	3.85 (4)	1.72	308
	8.0	13.6	22.0	18.7	16.4	13.3	8.1	3.94 (5)	1.71	121
Taxes	7.3	13.2	12.7	15.5	15.2	25.3	10.7	4.37 (6)	1.82	306
	6.8	13.0	12.3	9.7	17.6	30.2	10.4	4.51 (6)	1.83	120
U.S. prestige	6.8	4.7	6.6	5.7	9.4	16.7	50.7	5.57 (7)	1.92	307
	4 8	4.5	3.5	3.2	7.5	15.4	61.0	5.95 (7)	1.75	120

[a]Top figure for cross-section samples; lower for potential public.

[b]Figure in parenthesis indicates relative priority rank of the particular value.

disadvantaged were still close to the three highest ranked values in terms of mean scores. Concern for U.S. prestige and for leisure time dragged a good deal behind in terms of mean scores The cross section and the potential public agreed closely with each other on values, although the potential public expressed more preference for an enjoyable life than for high employment levels

The two most important values ranked in 1974 were employment and enjoyment of life. Behind them, in close approximation, were concerns for privacy, the environment, and the poor. Trailing a considerable way behind that second group were concerns over taxes and U.S. international prestige The potential public in both 1972 and 1974 mirrored the value concerns of the cross-section sample quite well. Only one major departure was observed: whereas the cross section lost a great deal of its formerly expressed enthusiasm for protecting the environment, that goal remained highly important to the potential public (See the analysis in Chapter VIII)

How stable were these value priorities over time? In order to answer that question, we had to control the data to eliminate the influence of the values of leisure time and privacy which were asked about in only one year. By assuming that the presence of an alternative given in only one year will not affect preferences among alternatives present in both years, we can calculate what the ranking would be if the leisure time and privacy values were excluded from our calculations These data appear in Table 5-4 Although some moderate shifts in ordering occur, no substantively or even statistically significant changes are observed in the mean scores This evidence of stability is reinforced by the high percentage of 1974 responses matching, or within one opinion category of, the rankings made in 1972

The choice of a ranking for a given value criteria may have no systematic effect on the ranking of any other one, or it may systematically indicate what the ranking of the second choice will be. The correlation between two value rankings is the measure of how systematic those trade-offs may be considered to be The higher the correlation, the greater the systematic relationship between a score on one value and the score

TABLE 5-4

THE STABILITY OF THE VALUE TRADE-OFFS

EFFECT ON	PANEL: PERCENTAGE OF RESPONSES WITHIN ± ONE OPINION CATEGORY OF ORIGINAL RESPONSE	CROSS-SECTION SAMPLE: MEAN '72	MEAN '74	STANDARD DEVIATION '72	STANDARD DEVIATION '74	N '72	N '74
Employment	61.4%[a]	2.89(1)[b]	2.79(1)	1.30	1.19	929	305
	64.8	2.97(2)	2.95(3)	1.28	1.22	295	120
Environment	58.1	3.03(2)	3.37(4)	1.51	1.52	928	308
	55.9	2.94(1)	2.87(2)	1.55	1.59	294	121
Making life more enjoyable	53.9	3.23(3)	2.86(2)	1.72	1.46	928	306
	62.8	2.98(3)	2.73(1)	1.62	1.65	295	120
Taxes	63.0	3.56(4)	3.78(5)	1.45	1.30	929	306
	63.6	4.01(5)	3.87(5)	1.40	1.50	295	120
Condition of poor people	56.3	3.62(5)	3.36(3)	1.42	1.41	926	307
	56.9	3.53(4)	3.39(4)	1.43	1.51	294	121
U.S. prestige abroad	64.6	4.67(6)	4.85(6)	1.35	1.28	928	306
	71.5	5.00(6)	5.17(6)	1.12	1.45	295	120

[a]Top figure for cross section; lower for potential public.

[b]Figure in parenthesis indicates relative priority rank of the particular value.

on the other. Such correlation behaves somewhat differently from other correlations. A perfect negative correlation (r = -1.0) may exist, in which case a *top* score on one value would imply a *bottom* score for the other. A perfect positive relationship (r = 1 0), however, cannot exist because a *top* score for one value cannot imply a *top* score for another. Smaller positive correlations may exist whereby a *high* score on one value implies a *high* score on the other

Not surprisingly, we found both systematic and non-systematic trade-offs to be present in responses. The correlations are shown in Table 5-5. Many of the trade-off patterns are not particularly stable over time, and it is difficult to infer anything from them. Some general statements, however, can be made First, no systematic trade-off exists between

(1) concern about the environment and concern about the poor,

(2) concern about taxes and concern about U.S. prestige

(3) concern about employment and concern about U.S prestige

Second, a moderately systematic trade-off exists between

(1) concern about an enjoyable life and concern about i] pollution; ii] U S. prestige; iii] taxes, and iv] employment

(2) concern about taxes and concern about the poor

The data indicate that in every instance but one a trade-off was in fact made. That is, the correlations between values, regardless of magnitude, are negative, except that holding in the 1972 data between taxes and employment For those values, a small *positive* relationship was observed which remained positive and grew in size in 1974 Thus, for that case, a high ranking of the one value implies a high ranking for the other.

In examining the relationship between these values and the demographic and attitudinal variables considered previously, the most significant associations were found among the potential public. In general, relationships existing in 1972 grew stronger in 1974 Moreover, some additional associations which had not been present in 1972 appeared in 1974

TABLE 5-5

SYSTEMATIC TRADE-OFFS BETWEEN PREFERENCE FOR VARIOUS VALUES*
(Pearson's r; cross-section sample and potential public, 1972; 1974)

EFFECT ON:	Enjoyment of Life '72	Enjoyment of Life '74	Employment '72	Employment '74	Taxes '72	Taxes '74	U.S. Prestige '72	U.S. Prestige '74	Environment '72	Environment '74	Poor People '72	Poor People '74
Enjoyment of Life	- -	- -										
Employment	-.24[a] -.19	-.24 -.25	- -	- -								
Taxes	-.37 -.37	-.23 -.19	.08 .00	.22 .36	- -	- -						
U.S. Prestige	-.20 -.08	-.21 -.21	-.14 -.11	-.05 -.03	-.04 -.02	-.12 -.07	- -	- -				
Environment	-.20 -.27	-.18 -.13	-.19 -.16	-.27 -.42	-.19 -.16	-.29 -.42	-.26 -.32	-.19 -.10	- -	- -		
Poor People	-.16 -.21	-.32 -.30	-.11 -.21	-.12 -.14	-.25 -.21	-.18 -.26	-.28 -.23	-.12 -.20	-.04 -.05	-.05 -.01	- -	- -
Leisure Time[b]	.02 .06	- -	-.27 -.24	- -	-.15 -.25	- -	-.20 -.27	- -	-.10 -.06	- -	-.11 -.09	- -
Right to Privacy[c]	- -	.00 -.05	- -	-.33 -.37	- -	-.30 -.33	- -	-.31 -.38	- -	-.06 -.00	- -	-.09 -.03

*A negative correlation indicates that a high ranking of one value is associated with a low ranking of the other value.

[a]Top figures for cross section, lower for potential public.

[b]Not asked in 1974.

[c]Not asked in 1972.

Relationships between value rankings and generalized attitudes toward science and technology appeared to have crystallized. For example, people who discounted the value of scientific activity and tended to be concerned about taxes did so to a greater degree in 1974 than in 1972 (r = - 18 for 1972, r = -. 25 for 1974). Respondents who in 1972 questioned the outcomes of technology and were concerned with maintaining a clean environment were moreso in 1974 (r = 13 in 1972 and .20 in 1974) Similarly, the relationship between concern about a number of values and particular evaluations of present technologies grew over time. For instance, the correlation between concern about the environment and the index of evaluations of present technology grew from - 19 in 1972 to -.24 in 1974. Concern about the U S international prestige and the evaluative index was correlated 16 in 1972 but rose to .26 in 1974 The relationship between some value rankings and evaluations of *specific* technologies increased even more dramatically These data appear in Table 5-6.

TABLE 5-6

CORRELATIONS BETWEEN VALUE RANKINGS AND
EVALUATIONS OF PARTICULAR PRESENT TECHNOLOGIES
(Pearson's r; potential public, 1972; 1974)

EFFECT ON:	AUTOMOBILES		ATOMIC WEAPONS		SPACE PROGRAM	
	1972	1974	1972	1974	1972	1974
Employment	.18	.27	.24	.24	*	*
Environment	-.17	-.25	-.19	-.30	*	*
U.S. Prestige	*	*	*	.32	*	.25

*Not significant at p > .05.

These correlations form a definite pattern which suggests that value priorities have increasingly become associated with judgments about technology Whereas in the past a person's value framework provided no information about such attitudes, it now seems apparent that those values have become determinants of evaluation and opinion vis-à-vis technological development. Cleavages have emerged in which opposition and support, enthusiasm and disenchantment, are predicated on value concerns. Such differences in the importance given social values have often developed into political disagreements Can we find any evidence that such a trend looms in this case?

We discovered that the same crystallization of relationships that occurred between value rankings and attitudes toward technology also took place between the value rankings and political ideology Conservatives and liberals have come to disagree more over what values should be given priority in the implementation of technology. While the increase in associations may simply be due to sampling variability, the systematic increases in the correlations summarized in Table 5-7 would suggest otherwise In short, we believe that over the period 1972-1974, the previous consensus over what values were considered important broke down Such an emerging discensus provides further evidence that attitudes toward technology have taken on an increasing political coloration over the last few years

TABLE 5-7

CORRELATIONS BETWEEN VALUE RANKINGS AND POLITICAL IDEOLOGY
(Pearson's r; potential public, 1972; 1974)

EFFECT ON:	POLITICAL IDEOLOGY	
	1972	1974
Employment	*	-.22
Making life more enjoyable	*	-.22
Taxes	*	*
Environment	*	.36
U.S. Prestige	-.26	*

*Not significant at $p < .05$.

Ideology is scored "high" for liberal.

PUBLIC PERCEPTIONS OF DECISION MAKERS IN TECHNOLOGY-POLICY PROCESSES

The values which the public holds can be incorporated into the implementation of technology, or they can be ignored A number of groups and institutions hold the power to choose which way to go How does the public-at-large perceive this influence to be apportioned among decision makers, and how satisfied are they that the apportionment is legitimate? To probe these questions, respondents were asked which of eight actors participating in decision making about technology *actually* has the most and which the least say--technical experts, business leaders, government officials (executive branch), Congressmen, the courts, organized consumer groups, and the individual himself (i e , the public-at-large), or no one Additionally, respondents were asked which of those groups *ought* to exert the most and which of them the least influence These questions probing perceptions of the *degree* and *legitimacy* of decision makers' influence were asked in six specific contexts, described as follows to respondents

(1) Our demands for power such as electricity are growing so fast that we may not be able to produce as much of it as we want In deciding how this limited power is to be used .

(2) Too great a use of automobiles may cause congestion in the cities and increase pollution In terms of deciding how a public system of mass transit which would reduce problems caused by cars would be put into use

(3) Medical science has given us the ability to predict the sex, some of the physical characteristics, and to alter the genes of infants before their birth In terms of deciding if such information is to be put to use. .

(4) Space stations manned by military personnel who can aim rockets and missiles at targets on earth can be designed. In deciding whether they should be built.

(5) Large amounts of information about the characteristics of the public can be collected, stored and analyzed by computers. In deciding how this information should be used

(6) Rockets to take astronauts and scientists to other planets such as Mars can be designed. In deciding whether we should build those space ships....

From responses to those sets of questions, two indices were constructed: the first assigned a ranking for each actor on the basis of the perceived degree of his *actual* influence; the second, a ranking for each on the basis of opinions as to how much influence that actor *ought* to have. By substracting the first "score" from the second, it is possible to estimate the degree to which the respondent felt that those actors whom they saw as actually making the decisions were, in their opinion, entitled to do so The degree to which respondents saw illegitimate exertion of influence in these decision processes can similarly be estimated.

The data presented in Table 5-8 provide estimates of how much power each decision maker is perceived actually to exercise in each of the six decision situations, the lower the numbers, the higher the perceived actual influence of the particular decision maker. In the areas of the military use of space and of the programming of future manned interplanetary space travel, for example, executive branch officials are seen to be exercising maximum decision making power. It is extremely provocative, from a political point of view, that in *none* of the six policy areas is the individual and/or the public-at-large believed to exert any significant influence over decisions Table 5-9 presents estimates of public perceptions of who *ought* to exercise power in technology-centered decisions. Again, the lower the particular decision making group's score, the more power the public believes it ought to have. Significantly, respondents' desires did not in this instance color their view of the world, no relation was generally found between the amount of power which they thought a group rightfully should hold and the amount which they saw it actually exerting

TABLE 5-8

ESTIMATES OF PUBLIC PERCEPTIONS OF DEGREE OF DECISION MAKING POWER *ACTUALLY* EXERTED BY VARIOUS GROUPS
(mean scores; cross-section sample and potential public, 1972; 1974)

	IN DECISIONS CONCERNING.											
	Power Rationing		Mass Transit		Genetic Engineering		Military Uses of Space		Data Banks		Space Travel	
	'72	'74	'72	'74	'72	'74	'72	'74	'72	'74	'72	'74
Technical Experts	7.02[a]	8.05	7.87	7.64	6.04	6.27	7.49	7.88	7.92	8.16	7.13	6.82
	7.03	8.35	7.18	8.11	5.60	6.31	7.45	7.70	7.89	8.20	6.75	6.91
Business Leaders	7.68	7.01	7.64	7.86	9.62	9.96	9.03	9.03	7.91	7.72	8.88	8.87
	6.97	6.29	6.98	7.37	9.91	10.03	8.91	8.93	7.37	7.06	8.82	8.79
Executive Branch Officials	7.12	6.10	7.10	6.44	8.87	8.62	4.27	3.52	6.20	5.88	4.56	4.11
	6.95	6.11	6.67	5.69	9.09	9.01	3.72	3.50	5.79	6.06	4.36	4.28
Congressmen	8.70	8.61	8.47	8.36	9.06	9.23	8.08	8.17	8.65	8.99	8.06	8.29
	8.62	8.68	8.50	8.08	9.17	9.15	7.82	7.91	8.12	8.99	6.72	7.91
Courts	9.38	9.32	9.46	9.63	8.73	8.38	9.56	9.28	8.72	8.34	9.58	9.48
	9.37	9.56	9.77	9.95	8.65	8.30	9.72	9.27	8.71	8.12	9.98	9.67
Consumer Groups	9.27	9.44	9.19	9.25	9.56	9.35	9.80	9.62	9.19	9.04	9.72	9.50
	9.75	9.33	9.51	9.30	9.78	9.50	10.31	9.95	9.84	9.11	9.72	9.58
Individual/Public	12.77	13.69	11.84	13.10	10.42	10.88	13.36	14.34	13.35	14.49	13.32	14.22
	13.35	13.92	12.11	13 34	10.02	10.70	13.61	14.57	13.45	14.93	13.33	14.21

[a]Top figures for cross section; lower for potential public.

TABLE 5-9

ESTIMATES OF PUBLIC PERCEPTIONS OF DEGREE OF DECISION MAKING POWER *RIGHTFULLY* EXERTED BY VARIOUS GROUPS (mean scores, cross-section sample and potential public, 1972; 1974)

	IN DECISIONS CONCERNING:											
	Power Rationing		Mass Transit		Genetic Engineering		Military Uses of Space		Data Banks		Space Travel	
	'72	'74	'72	'74	'72	'74	'72	'74	'72	'74	'72	'74
Technical Experts	6.70[a]	6.64	6.93	6.86	7.73	8.12	7.84	7.41	8.49	9.08	7.47	7.05
	6.58	6.85	6.31	6.79	7.48	10.04	7.75	7.90	8.54	8.99	7.21	6.56
Business Leaders	10.26	10.65	10.25	10.43	10.20	10.67	10.65	10.92	10.12	10.55	10.52	10.72
	10.50	10.89	10.62	10.88	10.55	12.45	11.11	10.87	10.45	11.19	10.70	11.63
Executive Branch Officials	9.12	9.63	9.29	9.31	10.41	11.16	7.92	7.98	9.93	11.04	8.32	8.70
	9.40	10.50	9.39	10.02	10.69	13.75	8.16	9.57	10.40	11.48	8.87	8.98
Congressmen	8.18	9.19	9.16	9.17	9.38	9.30	8.55	8.14	8.95	9.03	8.82	8.55
	9.04	9.56	9.29	9.23	9.38	11.37	8.63	8.15	8.72	9.07	8.71	8.37
Courts	10.03	9.44	10.19	9.98	9.44	9.01	9.72	9.38	8.92	8.26	9.80	9.70
	10.06	9.57	10.33	10.40	9.38	10.88	10.05	9.39	8.86	8.14	9.99	9.90
Consumer Groups	8.87	8.14	8.92	9.02	9.35	9.07	9.60	9.63	8.96	9.04	9.45	9.51
	8.57	7.77	8.71	9.12	9.44	11.05	9.71	9.75	9.16	8.70	9.48	9.56
Individual/ Public	6.58	7.09	6.18	6.48	5.30	4.59	6.84	7.25	6.15	5.17	6.49	7.32
	6.33	6.66	6.23	5.26	5.17	6.55	6.15	6.27	5.67	5.34	6.33	6.98

[a]Top figures for cross section; lower figure for potential public.

We also sought to measure the disjuncture between perceptions of actual and of legitimate decision making power. As noted above, one way to do so would be simply to subtract the estimate of the decision maker's perceived power from the estimate of his perceived rightful influence However, because of the methodological problems associated with quantifying such data, we elected to present the disjunctures by an alternative means Accordingly, we trichotomized the range of scores for both estimates of decision makers' perceived actual power (Table 5-8) and for estimates of the perceived legitimacy of that power, i.e , of their "normative" influence (Table 5-9) a score of 0 00 to 7 99 on either range gave the decision maker a "high" ranking (he is perceived as exercising considerable influence in decisions about technology, as entitled to exercise it, or as both); a score of 8.00 to 9 99 accorded him a "neutral" position (he is perceived as not exercising much influence, as not entitled to, or as both), finally, a score between 10.00 and 14 00 assigns "low" ranking to the decision maker (he is believed to be without influence, to be rightfully excluded from influence, or both) A typology constructed from those ordinal relationships serves to illustrate the instances of accord and of disjuncture between our sample's perceptions of actual and of normative decision making power Groups which fall along the main diagonal in Figure 5-1 (high-high, neutral-neutral, low-low) were thought to be exercising roughly the *appropriate* amount of decision making power Groups lying in the three squares *below* the main diagonal were believed to be exercising *more power than they should,* conversely, those lying in the three squares *above* the main diagonal were felt by our respondents to be exercising *less power than they ought to have*, that is, to be illegitimately excluded from decision making about various issues related to technological development.

Findings related to the public's view of the influence wielded by the different decision makers varied somewhat from one technical area to another, but several consistent patterns emerged

(1) *Technical experts* rated quite highly, they were seen as legitimately exercising a great deal of influence over decisions in each of the technical areas

FIGURE 5-1

DISTRIBUTION OF PERCEIVED ACTUAL AND NORMATIVE INFLUENCE IN TECHNOLOGY-RELATED DECISION MAKING

ACTUAL DECISION MAKING POWER (columns) / NORMATIVE DECISION MAKING POWER (rows)

Power Rationing

	High	Neutral	Low
High	Techni- cal experts		Public
Neutral	Execu- tive branch	Congress Courts Consumer	
Low	Business leaders		

Mass Transit

	High	Neutral	Low
High	Tech		Public
Neutral	Exec	Congress Consumer	
Low	Business	Courts	

Genetic Engineering

	High	Neutral	Low
High	Tech		Public
Neutral		Congress Courts Consumer	
Low		Business Exec.	

Military Uses of Spaces

	High	Neutral	Low
High	Tech.		Public
Neutral	Exec.	Congress Courts Consumer	
Low		Business	

Data Banks

	High	Neutral	Low
High			Public
Neutral		Tech. Courts Congress Consumer	
Low	Business Exec.		

Space Travel

	High	Neutral	Low
High	Tech.		Public
Neutral	Exec	Courts Congress Consumer	
Low		Business	

(2) *Executive branch leaders* drew considerably less support. Those interviewed perceived government leaders to be involved in all six areas, but in only two, space travel and military uses of space, was their presence seen as warranted

(3) *Business leaders* received little or no expression of confidence from our sample While they were perceived to be influence in four of the six areas, they were not welcomed in *any* of them

(4) *The public* saw *itself* as the "actor" most entitled to be involved in *all* decision areas in question At the same time it saw itself as accorded least access to them, again in all areas.

(5) *Congress, the courts, and organized consumer groups* were generally viewed as not playing any significant role, nor does the public desire them to.

These data are consistent with a number of recent findings Certain Harris Poll results have shown that the public places "a great deal of confidence" in scientists and engineers; the NSF-sponsored study indicates that a substantial minority feels that "the degree of control which society has over technology should be increased " And many polls show a significant increase in the public's distrust of all public and private institutions Apparently the institutions established to represent the values which people want used as criteria in decisions to be made about technology's use do not draw public confidence that they will do so. At least thus far technical experts, scientists and engineers, have been able to maintain public confidence, even in the face of apparently substantial mistrust of decision making processes related to policies governing technical development

That confidence seems a signal accomplishment for the scientific and technological communities It may rest on the public's perception of the technical expert's role as a man of knowledge, he is viewed as competent [5] Likewise, people's distrust of business and government could be a reaction to what they perceive as the inability of these groups to get things done correctly, what they consider failure on the part of business and politicians to meet public commitments they may attribute simply to incompetence

A complementary explanation can be found in noting the distinctions that may be made between *factual* and *valuational* components of decision making.[1] The ability to render a competent decision requires factual knowledge A person's knowledge about a decision situation legitimizes his involvement in it; hence, the trusted stature of technical experts in the public's mind. But valuational elements also are an integral part of any decision process Political and business leaders claim the right to participate in decisions on technological issues by their advocacy of certain social values By so doing--by setting goals and establishing priorities--they are expected to reflect the public's value interests If they do not, they lose that right and their involvement in technological decision making can then be seen as invalid Respondents in our survey evinced just such a mistrust of business leaders and government officials--open doubt that these decision makers were really representing the public's value preferences At the same time the public clearly accorded itself legitimacy to participate in decisions on technological matters, while feeling far removed from any access to that decision making process.

As indicated on Tables 5-8 and 9 by the mean scores of responses from the two independent cross sections, these assessments of decision makers have remained remarkably stable over time However, two *substantively* significant changes did take place during the two-year interval between surveys First, the public saw technologists as losing authority in decision making with respect to rationing power in times of shortages (see Table 5-8). Given the nature of the "energy crisis" in early 1974 that shift is not at all surprising More unexpected was the growing feeling among the potential public in 1974 that none of the institutional decision makers *ought* to be involved in the implementation of any genetic engineering scheme (see Table 5-9) Technicians, hitherto accorded respect and confidence, suffered a drop from perceived legitimacy as decision makers in this area to perceived illegitimacy, Congress and the courts dropped similarly in public esteem in this regard Clearly, the potential public has become increasingly sensitive to the implications of genetic engineering for their personal lives They are saying, in no uncertain terms, that such decisions are theirs alone to make

To provide further information on the character of public attitudes toward decision making about technology, attitudinal, demographic, and political correlates of our measures of perceived legitimate decision making power held by business, government officials, and the public were examined The associations among the three indices remained stable over time. Those who saw the public as being illegitimately excluded from decision making tended to regard business and government influence as excessive The correlations for the potential public were -.28 in 1972 and - 23 in 1974 for the first relationship and -.54 and - 58 for the second

The political correlates of the indices evident in 1972 dropped sharply in 1974 Among the potential public, the significant differences which had existed between liberals and conservatives and between Democrats and Republicans in 1972 virtually disappeared by 1974 That attenuation was paralleled by a reduction in the association between the measures of perceived legitimacy in the decision making power exercised by government officials and the public's evaluations of present technologies Tables 5-10 and 5-11 display those sets of correlations

TABLE 5-10

CORRELATION BETWEEN PERCEIVED LEGITIMACY OF DECISION MAKING ROLES OF SELECTED ACTORS AND POLITICAL VARIABLES
(Pearson's r; potential public, 1972; 1974)

	LEGITIMATE DECISION MAKING ROLE OF:					
	Business Leaders		Government Officials		Public/ Individuals	
	'72	'74	'72	'74	'72	'74
Party	*	*	-.21	*	.29	*
Ideology	- 28	*	-.30	*	.27	*
Party/ideology	-.20	*	-.28	*	.33	*

*Not significant at $p < .05$.
Democrat, liberal, and liberal-Democrat scored high.

TABLE 5-11

CORRELATION BETWEEN PERCEIVED LEGITIMACY OF DECISION MAKING ROLES OF SELECTED ACTORS AND EVALUATIONS OF PRESENT TECHNOLOGIES (Pearson's r; potential public, 1972; 1974)

	LEGITIMATE DECISION MAKING ROLE OF:			
	Government Officials		Public/Individuals	
	'72	'74	'72	'74
Appliances	.31	*	*	*
Automobiles	.24	*	-.23	*
Automated Factories	.28	.20	-.25	*
Atomic Weapons	.28	.29	-.24	*
Space Program	.28	*	-.26	*
Present Technology Index	.38	.25	-.32	*

*Not significant at $p < .05$.

Such findings stand in sharp contrast to the political and social cleavages which grew in size along other dimensions over this period The public's reaction to the Watergate scandals and the energy shortage may provide one possible explanation of that difference Those occurrences could have so massively eroded public confidence in the decision making institutions of the country that traditional political indicators no longer provide the dimension along which variation takes place It is uncertain, of course, whether the impact of those two events which took place in early 1974 will be a permanent one We may simply be measuring a transient phenomenon which will disappear in the short term.

One final point needs to be made We were unable to discover any demographic, attitudinal, or political correlates to our measure of legitimate influence for technicians. That we could not may suggest that the confidence accorded those experts pervades the entire public, no group appears to trust or distrust them significantly more than any other group does.

The findings of this chapter can be summarized quite succinctly First, the public believes that a wide range of values ought to be accorded weight in decision making with respect to the implementation of technology. Those values and the trade-offs which they imply have remained stable over the two years for which we have data. We found, however, emerging political cleavages separating liberal from conservative with respect to the importance accorded some of the values probed Second, the public expresses a great deal of dissatisfaction with the institutions which hold decision making power over the implementation of technology While technical experts are held in high regard, public bodies such as executive branch offices, Congress, and the courts are either dismissed or distrusted The public perceives itself as a significant actor whose role has been wrongfully ignored. Those attitudes, extant *before* the Watergate and energy "crisis," have remained strong in their aftermath

This concludes the foundations of the study We now turn to the future and to public attitudes toward technologies which are yet to be implemented. In the next part of this report we shall see how the attitudes considered in this part inform evaluations of those advanced technological systems

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[1] Herbert Simon, *Administrative Behavior* (New York: Free Press, 1957), 45-60.

PART THREE

PATTERNS OF PUBLIC RESPONSE TO FUTURE TECHNOLOGICAL DEVELOPMENTS

An individual's judgments about future-oriented technologies are undoubtedly influenced by his attitudes toward science and technology in general and by his attitudes toward particular current technologies and the conditions apparently affected by them. Collectively, these judgments are important because a good deal of the stimulus for technological development in the future is likely to come from the federal government in effect, "the people" will be asked through their representatives to support a wide variety of technical innovations. Citizen perceptions of and support for such ventures are part of the political milieu within which decisions will be made to commit public funds for implementing new technical capacities.

Chapter VI reports the public's respective estimates of the potential impact of twelve technological developments which could become increasingly consequential in the near future and the overall pattern of implied public support for them.

Chapter VII presents a provisional model predicting public responses to new technological development, it discusses the various social correlates of support or opposition, and takes special notice of the anomaly apparent in responses to space technology. Attitudes toward the energy technologies and the recent "energy crisis" of 1973-74 are taken up in Chapter VIII.

CHAPTER VI

SUPPORT AND OPPOSITION OF FUTURE TECHNOLOGIES

Shifting our attention from attitudes toward past and present experience to attitudes about future experience raises the interesting question of the future as an object of subjective judgment Individuals confront a high degree of uncertainty when they consider what *will* happen and what meaning unfolding events hold in store for them Unlike past events, future ones do not have the property of having been experienced, so anyone asked to treat them as objects of personal sentiment becomes engaged in a much more ambiguous cognitive operation The more familiar grounds for attitude formation--direct encounter with events or vicarious witnessing of them--cannot be invoked as they are for the evaluations people impose on experience on, for example, the performance of the President, the consequences of a particular public works project or industrial development, the aftermath of a military action, a municipal election, or a family decision Attitudes about such events are focused on their consequences By contrast, future actions have not yet triggered any consequences, so, judgments about projected public works projects, about the success or failure of newly elected officials or of newly announced public policies can be based only on estimates of probable consequences, of outcomes *yet to happen*. Accordingly, the reasoning underlying those portions of the two surveys which deal with future technological development had to take into account both cognitive/phenomenological problems inherent in people's feelings about the future as well as the more specific problems associated with future technology as an object of those feelings

PROJECTED TECHNOLOGIES AND QUESTION STRATEGY

In neither survey were we interested in determining the adequacy of our samples' knowledge about technological matters Rather, we wished to determine whether, whatever their level of information or ignorance, people would make systematic distinctions and assert preferences with regard to future technical development Specifically, would our samples display systematic preferences for particular future technologies, preferences based on distinctions they have made in terms of those technologies' probable consequences? If, as past studies in the public opinion literature have intimated, the public-at-large is not able to deal very well with complex matters, it would not be very useful for their collective opinion on technology to be taken seriously into account any pattern we might discern would be a weak one, reflecting nearly random responses, subject to fickle change, from people not certain enough of their own minds to make systematic judgments about technology's future effects. If, however, we should find that opinions about future technological developments are systematically distributed across a population and are fairly stable over time as well, it would be hazardous for policy makers to proceed as if public opinion on the future of technology were disorganized and incoherent How seriously such collective expression of opinion should be taken, then, would depend on its substantive character Any examination of the substantive character of public attitudes toward future technologies must of course take into consideration the particular technologies which people have been asked to consider and the type of questions asked about them

Technologies of interest In selecting the specific technologies about which questions were to be asked, we sought a set which had properties which would be "representative" of technologies of political interest. The twelve technologies listed in Figure 6-1 are likely, first, to pose problems of public policy Second, they vary in the degree to which the public sector would be likely to be involved in their promotion or production The government itself may be the main sponsor and producer of a technical development, particularly a large scale one, and even where a development is financed entirely by private interests, the government at the very least may be involved in its regulation Finally, since people use analogous experience as a basis for forming opinions, the technologies chosen accordingly offer a range extending from more or less familiar operations to potential capacities quite remote in concept

FIGURE 6-1
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)

BIOMEDICINE

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)

The selection criteria for the technologies to be studied ensured a representative mix of future-oriented technologies, without necessarily implying social properties which would systematically affect the character of public attitudes about them The twelve technologies are listed according to functional type transport, energy, biomedical innovation, information/communications, national defense, and developments calculated, among things, to enhance national prestige The language used in Figure 6-1 to describe the twelve technologies is the same as was used to describe them to the respondents in our survey. We had to be very careful to delineate them in a way that made sense to those asked to answer questions about them We reasoned that the social meaning of a technology inheres not in its machinery or system as such, but in the functional capacity it makes available to people [1] The related survey questions, therefore, focus directly on that capacity on what the technology is designed to do The significance of an urban rail transit system, for example, is not its automated trains, but the fact that it can transport large numbers of people rapidly from one part of a metropolitan area to another. Similarly, the significance of a nuclear generating plant is that it can produce electricity to be used by people and industry Each of the twelve specific technological potentials, then, was described, to both 1972 and 1974 respondents, in terms of its promised functional capacity. Implicit in each description are consequences of implementing the technology which might be a matter of policy interest.

Our estimations of how the twelve technologies fit the other two criteria guiding selection--the proportion of public to private sources behind the particular technical innovation, and its relative familiarity or remoteness--is presented in Figure 6-2 [2]

FIGURE 6-2

DEGREES OF PUBLIC/PRIVATE DEVELOPMENT AND OF FAMILIARITY OF TWELVE TECHNOLOGIES

PUBLIC/PRIVATE SPONSORSHIP	DEGREE OF FAMILIARITY: Familiar	Unfamiliar	Exotic
Private	Cable TV	STOL	Brain Drugs
Mixed	Data Banks	Nuclear Energy SST Organ Transplant	Genetic Eng.
Public	Urban Rails	ABM Space Travel	Solar Energy

Question formats Several types of interview questions were used to probe various aspects of the publics attitudes toward future technological development. Here we believed that an individual's sense of certainty--or, if you will, the *subjective probability* of future consequences--was important in determining his preferences or objections to the technology Thus, for each potential technical development listed in Figure 6-1, questions were asked concerning the degree to which the respondent was certain about its potential consequences--first its beneficial effects; then its harmful ones Also, we reasoned that when people are questioned about their support or opposition to a projected technology, their responses would be linked to their perceptions of whether or not that technology would affect their own lives or those of people around them. Therefore, respondents were first asked to indicate the degree of change they thought would occur in their own lives if each of the future technologies were implemented Then they were asked to estimate the degree of change "most people" would experience. Finally, each respondent was asked about the degree to which he/she would support or oppose the development of various technologies [3] This "support" variable became a major *dependent* variable in our analysis of survey results, the "certainty" and "impact" factors noted above were treated mainly as *independent* variables--antecedent conditions to degrees of support or opposition

These variables make up five of six elements in a "causal model" of predicted support/opposition, to be elaborated and discussed in the next chapter

VARIATIONS IN RESPONSE· AN OVERVIEW

Even at the first stages of analysis, using measures of central tendency, the data concerning attitudes voiced toward future-oriented technologies quickly reveal a partial answer to questions about the public's willingness to make estimates of the impact of particular technologies upon experience--both individual and general Had our samples been confused or very uncertain about these technologies, their responses would be nearly random, with little systematic variation overall or among particular component social groups This was not the case, clear patterns emerged, as can be seen in the data arrayed in Table 6-1, which ranks the twelve technologies in terms of mean levels of support indicated by 1972 sample, that is, in descending order, from the technology most favorably received to the one drawing the most opposition [4]

Patterns of support Considerable variation is evident in the degree to which the total samples, both in 1972 and in 1974, and the respective potential publics within them supported some technologies, such as urban rail transit and solar energy, and opposed others, such as genetic engineering and large data banks Responses for the cross-section varied 49 5% within the six point maximum range, with responses from the potential publics showing more variation (over 60%) than responses from the whole samples And, as we have come to expect from data already presented in earlier chapters, these attitudes remained remarkably stable over the two years bracketed by the surveys Both the relative magnitudes of support and opposition as well as the relative standings of the technologies remained more or less intact, although some apparent drift toward less overall support for the technologies is evident (In the eight instances of significantly different means reported between the two sets in Table 6-1, for 1972 and 1974 only two showed significantly *increased* support--the 1974 potential public's enthusiasm for space travel technology and for solar energy.[5])

TABLE 6-1

PATTERNS OF EVALUATION AND PERCEIVED IMPACT OF FUTURE-ORIENTED TECHNOLOGIES
(mean scores; cross-section sample and potential public, '72; '74)

			IMPACT ON[b]			
	EVALUATION[a]		Self		Others	
TECHNOLOGY	'72	'74	'72	'74	'72	'74
Urban rails	1.83**	1.60	3.10*	2.77	4.09	3.87
	2.12†	1.43	3.26	3.02†	4.20†	3.99
Solar energy	1.42*	1.50	2.97*	3.47	3.67	3.82
	1.50	1.95	3.03	3.69	3.62	3.85
Organ	1.35	1.35	2.74	2.79	3.89	3.95
transplants	1.13	1 34	2.55	2.96	3.45†	3.83
Nuclear	1.23*	1.37	3.16	3.38	3.51*	3.83
energy	1.94†	1.36	3.40†	3.58	3.71†	3.84
Cable TV	.99**	.76	2.76	2.74	3.33	3.51
	1.06	.87	2.82	2.79	3.26	3.54
STOL	.88	.87	2.51	2.60	3.58	3.68
	.86	.76	2.68†	2.72	3.49	3.64
ABM	.87	.67	2.94	2.87	3.31	3.34
	.26†	-.09†	2.66†	2.75	3.05†	3.14†
SST	.50	.17	2.20*	2.62	3.58	3.57
	.12†	.14	2.39†	2.66	3.26	3.22
Brain drugs	.30* **	-.23	1.97	1.87	3.23	3.27
	16	-.61	2.14	1.72	3.24	3.13
Space travel	-.25*	-.16	2.07	2.11	2.87*	3 02
	-.19	.69†	2.15	2.39†	2.85	3.05
Genetic	-.70**	-1.08	2 04	2.18	3.34	3.69
engineering	-.96	-1.65†	2.08	2.07	3.62†	4.02†
Data banks	-.79*	-1 38	2.92*	3.14	3.07*	3.95
	-1.12†	-1.46	3.03	3.15	3.66	3.80

[a] Range from +3 to -3, a +3 indicating maximum support; top figures for cross-section sample; lower for potential publics.

[b] Range from 5 to 1, with a 5 indicating maximum impact; top figures for cross-section sample, lower for potential publics.

* Difference between means for '72 and '74 significant, $p < .05$.

** Difference between means for '72 and '74 significant, $p < .01$.

† Difference between potential public and sample minus the potential public: significant, $p < .05$.

A more detailed discussion of the social and political correlates to support for or opposition to future technologies occupies a good deal of the following chapter. For now suffice it to say that public opinion concerning a number of rather complicated technological capacities appears to be consistent and markedly discriminating This finding is an initial indication that we are likely to find rather more refined public attitudes toward these matters than past studies of the public's reactions to public policy issues might lead us to expect

Estimates of impact The familiar pattern of stability between 1972 and 1974 holds for the data concerning estimates made by our respondents concerning the likely impact of these technologies on their lives Only a few instances of significantly different means are discernible However, the spread of variation noted between the extremes of *support* for or opposition to these technologies was not repeated in respondents' estimates of the *impact* of the various technologies on their personal lives or the lives of most people While some variation in these estimates of impact does occur, it is much less than was found in judgments supporting or opposing various technologies.[6]

Several other interesting findings are evident For one thing, people seem to view technology as less specific to their own experience than to the experience of others in society *each of the twelve technologies* was believed more likely to change the lives of "other people" than the respondent's own life Also, various differences between mean estimates show that certain technologies were seen as more likely than the rest to effect changes which the respondent himself would experience nearly as much as "others" would Table 6-2 summarizes these differences, both for the total samples and their respective potential publics. The smaller the differences in means, the more the degree of change foreseen for "others" experience accorded with that foreseen for the respondent himself, that is, the more generalized the perceived impact of the technology.

As shown in Table 6-2, then, the potential impact of nuclear generation of power was perceived as the most "generalized " Overall, respondents believed that the impact of this technology on others' lives

TABLE 6-2

COMPARISON OF IMPACT ON OTHERS; ON SELF
(mean differences; cross-section samples and potential publics, '72; '74)

TECHNOLOGY	Mean Difference* '72	Mean Difference* '74
Urban rail	.99[a]	1.10
	.94	.97
Solar energy	.70	.35
	.59	.16
Organ transplants	1.15	1.16
	.90	.87
Nuclear energy	.35	.45
	.31	.26
Cable TV	.57	.77
	.44	.75
STOL	1.07	1.08
	.81	.92
ABM	.37	.47
	.39	.39
SST	1.38	.95
	.87	.58
Brain drugs	1.26	1.40
	1.10	1.41
Space travel	.80	.91
	.70	.66
Genetic engineering	1.30	1.51
	1.51	1.95
Data banks	.15	.81
	.63	.65

*Mean estimates of impact on Self subtracted from mean estimate of impact on Others.

[a]Top figures for cross-section sample; lower for potential publics.

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would match most closely the impact on their own. The mean differences in perceived impact derived from responses by the cross-section samples in both surveys were quite small-- 35 for 1972 and .45 for 1974 Genetic engineering, on the other hand, although seen as having a marked potential impact on the lives of "most people," was perceived to have only weak potential effects on the respondents' "personal" experiences. Mean differences were high 1.30 and 1 51 for the 1972 and 1974 samples respectively. Thus people differ in the degree to which they see themselves or only "other people" as potentially subject to the effects of certain technologies. Configured schematically (Figure 6-3) data reflect considerable variation in judgments about such impact potential among the twelve technologies

FIGURE 6-3

ESTIMATED IMPACT OF TECHNOLOGIES UPON INDIVIDUAL AND OTHERS, WITH INDICATIONS OF OVERALL SUPPORT

DEGREE IMPACT ON SELF	DEGREE IMPACT SHARED WITH OTHERS: Strong	Moderate	Weak
Strong	Nuclear power (+) Solar energy (+) ABM (0) Data banks (-)	Urban rail (+)	
Moderate	Cable TV (0)	STOL (0)	Transplants[a] (+) SST[a] (0)
Weak		Space travel[a] (0)	Genetic eng. (-) Brain drugs (-)

[a]For these technologies the potential public's response shifted to the next higher degree of shared experience in 1974.

+,0,- indicate most favored to most opposed categories on Table 6-1.

The pattern suggested by Figure 6-3 is a rough correspondence between the degree to which respondents support the technology and the degree to which they perceive its potential impact as affecting both themselves personally and most other people It is notable that those technologies most frequently judged as having the strongest potential for altering the personal life of the respondent himself include one--solar energy derived from orbiting satellites--which, while one of the most technically exotic, nevertheless drew strong public support Concerns over energy resources may have been sufficient even in 1972 to mitigate potential public disaffection stemming from confusion over the technology's somewhat improbable qualities Another technology also judged to have strong effects on both the respondent and on others was the most hostilely received Publicity about the widespread use of data banks apparently had been such as to influence respondents to view the effects of this technology as likely to have significant harmful consequences In any event, there is reasonable agreement within our sample on the intensity of the likely impacts of the respective technologies Estimates by the potential publics differed in only three instances from those of the whole sample--for organ transplants, the SST and space travel. That group estimated the impacts of these technologies to hold somewhat more personal consequences in store for them than did the whole samples, who tended rather to foresee little effects upon themselves.

SUBJECTIVE PROBABILITIES AND SUPPORT/OPPOSITION FOR NEW TECHNOLOGIES

By virtue of direct experience with analogous technologies and exposure to information in the media, individuals develop either a sense that a new technology is likely to produce attractive conditions or a sense that it is likely to produce quite unwanted conditions Positing the implementation of a given technology, the survey questionnaire asked respondents to estimate the likelihood, first, that beneficial consequences would result, then, that harmful consequences would result [7] Answers to these questions indicate the "subjective probabilities" our respondents assigned to beneficial or harmful outcomes of various technological developments. Table 6-3 orders the resulting data first in terms of the ratio of the number of respondents "absolutely sure" and "quite sure" that benefits would result to the number of respondents equally certain of harmful results The second array is the ratio of mean certainty of benefit to mean certainty of harm The two measures are not exactly similar, and, when taken together, add somewhat to the total sum of information about the "certainty" relationship The helpful to harmful ratio (H H) is based on a dichotomous division of the data, whereas the means ratio takes

TABLE 6-3

CERTAINTIES OF BENEFICIAL AND HARMFUL CONSEQUENCES*
(cross-section sample and potential public, '72; '74)

TECHNOLOGY	RATIOS OF[a] Helpful:Harmful '72	RATIOS OF[a] Helpful:Harmful '74	MEAN CERTAINTY[b] Harm:Help '72	MEAN CERTAINTY[b] Harm:Help '74
Urban rail	5.66[c]	3.77	1.67	1.45
	7.18	3.62	1.81	1.48
Solar energy	6.12	6.61	1.54	1.66
	7.25	7.00	1.55	1.99
Organ transplants	2.87	2.71	1.25	1.40
	2.56	2.33	1.23	1.20
Nuclear energy	2.69	2.83	1.35	1.35
	2.04	2.05	1.37	1.28
Cable TV	3.15	2.55	1.33	1.29
	2.36	2.15	1.34	1.24
STOL	2.26	2.44	1.05	1.04
	2.24	1.83	1.27	1.16
ABM	1.87	1.79	1.20	1.10
	1.17	.96	1.07	1.11
SST	1.83	1.51	1.14	1.09
	1.19	1.13	1.02	1.02
Brain drugs	1.16	.84	1.01	.93
	1.12	.73	1.00	.87
Space travel	.97	1.72	.95	1.07
	1.28	3.25	1.01	1.26
Genetic engineering	.71	.40	.88	.80
	.49	.24	.83	.72
Data banks	.55	.35	.82	.69
	.37	.21	.72	.62

*Table 2.2 in Appendix D lists correlation coefficients for relation between certainty of benefit and certainty of harm

[a]See Table 6-4 below for the percentages of the various samples who indicated uncertainty for *both* helpful and harmful results.

[b]Ratio here is calculated Harmful divided by Helpful so magnitude of numbers will have same meaning, i.e., descending order indicates less support, as ratio of Helpful:Harmful.

[c]Top figures for total samples, lower for respective potential publics.

into account varied degrees of certainty expressed by respondents Thus, the H H ratio gives a rough indication of how our respondents would summarize their judgments if they were to "vote" on the basis of their subjective estimates of the probability of harmful or beneficial results. The mean ratio of certainty, on the other hand, gives an indication of the degree of aggregate certainty of beneficial compared to certainty of harmful results.

Inspection of the data in Table 6-3 adds weight to other indications that the public-at-large and the potential publics have an unexpected propensity to express varied and systematically discriminating responses to these technologies There is quite a wide range in both the degree of mean certainty they expressed about the likelihood to benefit compared to harm and in the overall ratios of certainty to helpful to harmful outcomes For example, a much higher proportion of respondents perceived urban rail transit and solar energy produced by space satellite to have certainly beneficial consequences than perceived them to be harmful. In 1972, even before the public-at-large had experienced fuel shortages, the margin of those "absolutely sure" or "quite sure" of beneficial results over those equally sure of harmful results was 6 to 1 for the whole sample and 7 to 1 for the potential public Compared to the others in terms of the mean degrees of certainty expressed in 1972, future benefits attributed to solar energy were seen as somewhat less certain than benefits from urban rail transit. Then, in 1974, the positions of solar energy and urban rails were reversed, with a clear increase in ratios of benefit expected by both the whole sample and the potential public for solar energy Even so, urban rails maintained its top spot in overall support among the twelve technologies

At the other extreme, believed to be much more certainly harmful than helpful, genetic engineering techniques and storage of personal information in large data banks drew greatest opposition. About twice as many people believed these technologies would be certainly harmful as felt they would be helpful; and the mean certainty ratios indicate that our samples were as certain of harm coming from these technologies as they were certain of benefit coming from organ transplants and nuclear energy, two of the four most enthusiastically received technologies It is consistent that the patterns of certainty of benefit compared to harm followed almost precisely the order of overall public support for the various technologies even when it differed slightly between years. This parallel suggests that the logical association between an individual's subjective perception of the probability of a technology's benefit or harm and his or her support for or opposition to it holds fairly strongly throughout. We shall return shortly in Chapter VII to the relationship between support and estimate of benefit

Attention to another aspect of "subjective probability" deepens its meaning. As is to be expected, we also find a wide range in the percentages of respondents who felt uncertain about *both* the likely benefit and the likely harm to result from various technologies Table 6-4 summarizes this dual uncertainty by order of magnitude. It ranged from a low of about 12% in 1972 for urban rail transit to a high of over 40% in 1974 for the "far out" results of space travel and of behavior altering drugs (brain drugs in our shorthand) Such a wide range suggests considerable variation in the degree to which people felt themselves adequately enough informed about some technologies to hazard an estimate of their likely benefit or harm It should be noted, however, that many of the people who expressed this dual uncertainty about particular technologies nevertheless voiced support for or opposition to the same ones. We shall return to this point later. For now, simply note that both cross-section samples of California's population and the two potential publics for technological politics within them expressed systematically varied opinions about substantively complex matters. It now remains for us to explore the degree of stability and change across the two years separating the surveys and between the larger samples and the lesser potentially more politically active publics within them

Stability and change in perceptions of future technologies Analysis reported in earlier chapters has led us to expect considerable *diversity* in the public's responses to various technologies, it also indicates that these varied attitudes are likely to be continuous, to show a "stable" pattern over time The data in Table 6-3 shows that, for

TABLE 6-4

PERCENTAGES INDICATING UNCERTAINTY ABOUT *BOTH* BENEFICIAL AND HARMFUL RESULTS OF FUTURE-ORIENTED TECHNOLOGIES (cross-section sample and potential public, '72; '74)

TECHNOLOGIES*	'72	'74
Urban rail (+)	11.8%[a] 11.4	24.8% 25.0
ABM (0)	22.7 12.9	26.5 25.3
Nuclear energy (+)	24.5 9.4	22.2 19.6
Solar energy (+)	24 9 15.5	24.4 18.5
Organ transplants (+)	25.8 28.6	24.3 33.8
Cable TV (0)	26.5 17.6	31.4 25.9
STOL (0)	26.4 18.5	25.6 24.3
SST (0)	26.5 27.6	31.5 23.9
Data banks (-)	26.8 19.2	20.1 16.2
Brain drugs (-)	32.6 28.9	43.7 47.0
Genetic engineering (-)	36.1 29.4	33.8 26.5
Space travel (-)	36.9 38.8	45.7 34.3

*(+, 0, -) indicate top, middle, and lower thirds in ranked preferences in 1972.

[a]Top line data for whole cross-sections, lower line for potential publics.

most of the twelve technologies, the 1972 and 1974 Helpful Harmful certainty ratios are remarkably similar, as are both mean certainty ratios Evidence of stability is also found in the responses of the panel of people who were interviewed a second time About 90% of the responses they made in 1974 to questions regarding their certainty of the technologies' beneficial results remained the same or changed by only one "opinion category" from their response in 1972, about 87% to questions regarding their certainty of harmful results Similarly, in comparing the percentages of respondents in the two cross-section samples, reported in Table 6-4, who expressed dual uncertainty about both beneficial and harmful results, we find a high degree of stability from 1972 to 1974 In only a few instances were the differences 10% or more In effect, the public has expressed attitudes which are neither ephemeral nor chaotic, and they show considerable continuity But there is also some change within this continuity, change suggestive of a new-found awareness of technical developments and new information about their consequences

The most noticeable change in the pattern of support or opposition and certainty of helpful or harmful results is the overall softening of support, especially by the potential public, for most of the technologies and the decreased certainty of their beneficial character [8] Of the four technologies drawing the most support in 1972 (see Table 6-1)--urban rail transit, solar energy, organ transplants, and the nuclear generation of energy--urban rail transit fared least well in maintaining its high level of public esteem (though it still led the list), while support for the others and perceived certainty of their benefits (see Table 6-3) remained constant or increased a bit The greatest losses of support and decreases in certainty of benefit attached to three of the four technologies which had initially evoked the most opposition, the use of brain drugs, genetic engineering techniques, and large data banks all drew sharply increased opposition and increased public certainty of their harm These changes, we repeat, are more evident within the potential public, and they seem to signal a deepening fear of these technologies by the very people most likely to become involved in technological politics.[9]

Counter to the overall trend, the potential public in 1974 was significantly more supportive to development of interplanetary space travel than it had been in 1972 A substantial jump in the perceived certainty of this technology's benefit also occurred, along with less dual uncertainty about its effect It was almost as if the potential public was saying, in view of decreased governmental support of the ABM and the SST, that if the public sector is going to underwrite aerospace technology, let it be the very scientifically advanced developments in manned space flight. This recent upsurge of support for interplanetary travel, which runs counter to findings from the 1972 data was still not shared, however, by the broader cross-section of opinion in 1974. Findings related to space technology will be discussed more fully in Chapter VII.

Both the overall rankings of public preferences for the twelve technologies evidenced in 1972 and in 1974 and the relatively subtle changes recorded by the second survey argue that much of the discussion carried on in the media concerning the beneficial or harmful effects of these technologies has been picked up by both the larger audience and by the potential public. The technologies which our surveys show as enjoying a high level of public support--urban transit, solar and nuclear energy generation, and organ transplants--have been the objects of considerable expert attention as credible solutions to social problems of growing proportions Such attention has been particularly focused on the energy technologies and on the need for changing public policies to ensure adequate national energy supplies Likewise, those technologies which evoked the most negative public reaction are those which have aroused controversies in Congress and among both scientific elites and various public interest groups--the SST, the use of behavior altering drugs, genetic engineering and large data banks Such reactions strongly imply that people are receptive to information about controversial technology-related issues and more able than many leaders suppose to absorb it and make distinctions based on it. The implications for education and persuasion are obvious

PUBLIC PERCEPTIONS OF TECHNOLOGIES OF THE FUTURE: SUMMARY AND INFERENCES

From the reported experience of professional survey researchers with data from public groups similar to our samples, we could have expected the survey results to reflect little systematic variation in responses and thereby to convey evidence that public "attitudes" about technological development are too inchoate and ephemeral to be interesting to policy designers Such was far from the case, the data derived from probing the public's attitudes toward technologies of the future led us to several counter inferences that when presented with choices, individuals can make varied judgments about the degree to which different future-oriented technologies are likely to change their own personal lives and the lives of people in general and about the likelihood that such changes are certain to be beneficial or harmful, that they are discriminating in their support for or opposition to a number of potential technical developments which could become the targets of public decision making in the future Collectively and individually, these judgments were characterized by consistent, systematic variation The relative continuity of these varied judgments over a two-year period suggests organized and relatively salient public opinion in the important policy area of technological development We have elaborated these inferences throughout this chapter.

SYNOPSIS OF ATTITUDES TOWARD TWELVE TECHNOLOGIES

In summarizing here the patterns of opinion on which those inferences are based, we can construct no neat typology, no two technologies have been perceived similarly Subtle differences in perceptions *and in changes in perceptions* emerge among the groups into which we have analytically divided our respondents the 1972 and 1974 cross-section samples, the "potential publics" contained in them, and the panel of reinterviewed persons from both groups The potential public, the group most likely to be active in technological politics, takes on more definite attitudes than the public-at-large, it is more favorable to the technologies generally approved and more hostile to those drawing the most opposition In general, the potential public is more skeptical, and its members tend to envision technology's impacts as effecting nearly as much change in their own personal lives as in the lives of others. The broader cross-section samples, by contrast, tended to see their personal experience less affected by the technology-induced changes they foresaw for the lives of "most people." We have tried to capture the nuance of such differences in the following brief synopsis of perceptions of the twelve technologies, presented here in descending order of their support.

Urban rail transport--The public-at-large strongly supports this technology, although somewhat less in '74 than in '72. Certain that it will produce benefits, the later cross-section sample perceived them as having less personal implications than the earlier sample did.

The potential public supports this technology to about the same degree as the larger group, but was much more enthusiastic about it initially than they were in 1974 They continued to think of the consequences of rail transport as more important to individual experience than did the larger group

Solar energy from orbiting satellites--There was very strong support from the public-at-large, accelerating over the two-year interim between surveys. There also emerged an increased certainty of this technology's beneficial results, with an increased estimate of personal consequences in those results

The potential public's perceptions were virtually the same as the larger sample's

Organ transplants--This medical procedure drew continued overall public support. Results were clearly perceived as beneficial, but as affecting lives of "other people" much more than "personal" experience.

The potential public was increasingly supportive and continued to think of consequences of transplants as more likely to affect their own lives than did the larger group.

Nuclear generation of energy--There was continued overall public support for this technology Its impact was perceived as certainly beneficial and as effecting significant changes in personal experience and in the lives of others

The potential public, while still supportive, was less so than the general public

Cable television--Modest and slightly declining support was shown by the general public, though by and large it perceived cable TV as likely to bring beneficial results. It was viewed as moderately changing social life, but with decreasing estimates of its effect on "personal" experience

The potential public's perceptions agreed in general, but showed more sharply reduced support

Short take-off and landing aircraft (STOL)--This technology drew modest overall public support, with impacts seen as equivocal and as clearly more significant for "others."

The potential public was even less supportive and less certain of beneficial results than they had been in 1972.

Antiballistic missiles (ABM)--This technology drew only weak overall public support There was great uncertainty about whether impacts, seen to affect everybody moderately, would be beneficial or not

The potential public was just barely supportive, perceiving impacts as certainly being both beneficial and harmful; by 1974 they leaned toward greater certainty of harm.

Supersonic transport (SST)--Overall opinion conflicted about this technology. the public-at-large became increasingly skeptical of it, though still barely supportive in 1974. Uncertainty prevailed as to whether its effects would be, on balance, beneficial or harmful. Those effects, always perceived as modest, were estimated as increased for personal experience in 1974

The potential public's earlier uncertainty congealed in 1974 into mild opposition As with the larger group, uncertainty marked their perceptions of consequences, though the potential public leaned toward seeing them as harmful. They viewed impacts as stronger and more widely shared than did the larger group.

Behavior altering drugs--Earlier public uncertainty had by 1974 hardened into opposition The impacts of these drugs, though not perceived as "personally significant," were seen as harmful overall

The potential public concurred on all counts here

Interplanetary travel--Developments in this area were barely opposed by public-at-large, though in 1974 they saw more benefits in it than in '72 "Personal" impacts were perceived as very slight.

Counter to the overall sample, the potential public became modestly supportive, even though having expressed mild opposition in 1972 They increased their estimate of the certainty of this technology's beneficial consequences to a relatively high degree in 1974, although seeing consequences as affecting "others" more than themselves

Genetic engineering--Increasingly opposed by the public-at-large, this technology's effects were perceived as certainly harmful although not likely to be felt personally

The potential public had by 1974 become strongly opposed to this technology

Data banks--The public-at-large opposed this technology more than any other Its impacts were seen as pervasive--both "personally" and for "others"--and as overwhelmingly harmful.

The potential public was very strongly opposed to this development, with an increasing sense of certainty about harmful consequences which would have important effects for themselves personally as well as for others

NOTES

[1] We were urged to this stance, in part, by the results of a preliminary probe of public attitudes toward technology included by the Field Research Corporation in their *California Poll* of February, 1971. Two open-ended questions in that survey concerned technology: 1) "Considering developments in science and technology that have occurred during recent years, are there any in particular that you feel have been especially helpful to the people of this country? What have been the organizations or institutions responsible for doing this kind of research?" (2) "Are there any recent developments in science and technology that you feel, on balance, have not been helpful, or even have been harmful, to the people of this country? What organizations or institutions do you see as mainly responsible for doing this kind of research?" Thus, respondents were asked to name, without any prompting from interviewers, whatever technologies they believed to be helpful and harmful. Two results from this survey of 1,000 respondents caused us to re-evaluate the wording of questions that had been used. First, over 30% of the sample could not name even one technology which was "helpful" and 50% could not name a "harmful" technology. Furthermore, 60% could not name an institution and/or organization which was responsible for the development of substantive technologies. Thus, questions about technology framed at a relatively high level of semantic abstraction seemed to have limited salience. A second result intensified our attention to the wording of questions. While the responses of those who named "harmful and helpful" technologies did distribute over a considerably varied population, no *systematic* relationships were discernible between respondents' judgments of "helpful" or "harmful" technologies and any of the standard socioeconomic or demographic factors. Though some underlying factors were clearly influential, they did not point to the usual SES variables For a more detailed discussion of this preliminary venture in assessing the

public's attitudes toward technology, see Daniel Metlay, "Public Attitudes Toward Technology," in Todd R. La Porte, *et al.*, *A Perspective in the Assessment of Large-Scale Technology· The Case of the STOL Aircraft Transport System.* Progress Report to Ames Research Center, National Aeronautics and Space Administration. (Institute of Governmental Studies, University of California, Berkeley, November, 1971), pp. 91-102.

[2]Technologies are placed in Figure 6-2 based on our subjective estimates, assignments represent only informal evaluations and the usual compromises made when attempting to optimize several criteria simultaneously.

[3]The wording and sequence of questions about each technology was as follows: "If a development like [the one described above] were to be put into operation, how much would it change your own life?" "How much do you think it would change life for most people?" "How sure do you feel that this development would have drawbacks or bad results?" If the respondent was "absolutely" or "quite" sure, he was then asked, "What do you see as the most important benefit, or good thing (drawback, or bad thing) that might result if such a development were actually to take place? After respondents answered the above question, they were asked about each of *six* technologies, (see note 4 below): "How much would you like to see or how strongly would you be opposed to [the technology described as in Figure 6-1 above.]"

[4]Because questions about a total of twelve technologies generated from five different question sets would, along with numerous other items in the surveys, probably exceed respondent tolerance, each respondent was questioned on only six specific technologies. One of these six was common to all respondents; the other five were derived from random sorting of the remaining eleven technologies. For the 1972 survey, the "whole-sample technology" was the STOL aircraft transport; for 1974 it was nuclear generation of energy. The 1972 choice was due to the fact that NASA had supported the survey partly because of its interest in public responses to STOL innovations. The 1974 choice was due to the obvious importance to public policy of nuclear energy generation.

[5]See Chapter VII and VIII for a more detailed discussion of these developments.

[6]Ranges of variation of these "generalizations of impact" within the 4 point margin were from just over 25% for the total sample in 1972 to 35% for the potential public in 1974. Impact variables range from 5 to 5, with 5 meaning percent agreement on considerable impact, and 1 meaning percent agreement on no impact.

[7]See note 3 for exact wording.

[8]In the cross section, mean support declined for eight of the twelve technologies. One of these changes was statistically significant at $p < .05$. In the potential public mean support also declined for eight of the

technologies. Five of these changes were significant. Using the signs test, the distributions coded +, 0, and - were 2, 2, and 8 respectively for both the cross-section and potential public samples. Though the test is not rigorous, it does give an indication of the direction of change.

[9]The potential public also lost confidence in both behavior altering drugs and the ABM, shifting from being weakly supportive of them in 1972 to modestly opposed in 1974.

CHAPTER VII

CERTAINTIES AND SUBSTANCE. CORRELATES OF SUPPORT AND OPPOSITION

Both the public-at-large and the potential public--the group within it likely to contain the most vocal advocates or adversaries of technology--exhibit a strong and persistent propensity to view some technologies more than others as affecting people's lives. These publics also clearly judge some technologies to be quite certainly beneficial and others to be almost as certainly harmful. Perhaps in part as a consequence of these variations, our respondents also varied quite markedly in their support for or opposition to various technologies. It will be the business of this chapter to explore the substance behind these certainties--the personal characteristics and philosophies which may account for the evident differences in the public's evaluations of future-oriented technologies In Chapter VIII special notice will be taken of the energy technologies, along with data related to the recent "energy crisis." A very striking anomaly--the case of manned interplanetary travel--is also noted in that context

PRIMARY ATTITUDES AND DEGREES OF SUPPORT

In the discussion which follows, the "impact" variables and the "certainty" variables encompassing two primary behavioral dimensions which we have posited as likely to be important in shaping responses to future technological development[1] will be joined by a third attitudinal dimension the degree to which the public judges to be beneficial various widely implemented and generally familiar technologies This "evaluation" variable is based on the present-technology-evaluation index treated in Chapter IV above. We reasoned that one's overall evaluation of the consequences of past and present technological development would be likely to color his judgments about technology's future impacts and social consequences and would be an important factor influencing his support for or opposition to new technological possibilities

It is also sensible to suppose that a person's judgments about how much a new technology may affect himself and/or others would have some bearing on his support or opposition to implementing the technology Likewise, how certain beneficial or harmful results of the technology is judged to be is likely to sway a person's support for or opposition to a proposed technology

Each of these five attitudinal variables was correlated with the degree to which the cross-section samples and the respective potential public subsamples supported or opposed the twelve technologies Table 7-1 presents the array of Pearson's product moment correlations (r) for both surveys, TECH I, 1972, and TECH II, 1974. Initial scanning of the data reveals an uneven relationship between the three main attitudinal dimensions, "impact," "certainty," and "evaluation," and the degree of support for these various technologies; but each variable is clearly related to support for or opposition to many of them. The firmest conclusion from these data is that respondents' subjective sense of the certainty of future beneficial and harmful results is the factor most strongly and consistently associated by far with their support or opposition. That association is remarkably high and quite significant statistically for almost every technology.

The relatively high correlations summarized in Table 7-1 suggest that a single conceptual structure underlies the formation of judgments about supporting or opposing future-oriented technologies. From these correlations a causal model was developed for which the dependent variable is the expressions of support for or opposition to each of the twelve technologies Depicted in Figure 7-1, the model we constructed is based in part on the logic of relationships outlined above and in part on initial review of the correlation matrix Estimates for the direct influence of the primary attitudes upon expressions of support for or opposition to each of the twelve technologies are presented in Table 7-2 along with the total percentages of the variance explained by these relationships (R^2) Table E-2 in Appendix E summarizes the indirect influence of these primary attitudes upon the support for the technologies mediated through each other along the pathways indicated in Figure 7-1.

TABLE 7-1

CORRELATES OF THE PRIMARY ATTITUDES TO SUPPORT OF FUTURE-ORIENTED TECHNOLOGIES[+]
(Pearson's r; cross-section sample and potential public, '72; '74)

TECHNOLOGY	PRESENT TECH. EVALUATION		IMPACT ON: SELF		IMPACT ON: OTHERS		CERTAINTY: HELPFUL		CERTAINTY: HARMFUL	
	'72	'74	'72	'74	'72	'74	'72	'74	'72	'74
Urban	*[a]	.18	.19	.11	.21	.15	.31	.53	-.30	-.29
Rail	-.10	.31	.28	.24	.25	.21	.42	.64	-.24	-.31
Solar	.19	.11	.29	.24	.36	.31	.61	.45	-.40	-.22
Energy	.24	.17	.34	.35	.42	.45	.67	.45	-.41	-.32
Organ	.12	.13	.32	.25	.34	.31	.57	.47	-.40	-.26
Transplant	.19	.24	.37	.20	.45	.31	.58	.53	-.41	-.16
Nuclear	.26	.33	*	*	*	.10	.20	.62	-.27	-.52
Energy	.45	.43	*	*	*	*	.54	.66	-.54	-.65
Cable TV	*	*	.42	.63	.29	.32	.56	.55	-.37	-.47
	*	.32	.46	.63	.35	*	.63	.50	-.40	-.53
STOL	.25	.24	.19	.35	.22	.28	.49	.60	-.43	-.58
	.35	.46	.18	.53	.29	.13	.56	.67	-.50	-.72
ABM	.33	.32	.23	*	.16	.13	.62	.65	-.61	-.70
	.49	.41	.30	*	.25	*	.77	.65	-.76	-.77
SST	.22	.29	.23	.18	.26	.11	.60	.55	-.42	-.45
	.25	.37	.18	.29	.21	.31	.70	.73	-.54	-.73
Brain	.26	.17	.14	*	.23	.17	.55	.57	-.47	-.50
Drugs	.38	.24	*	.19	.25	*	.62	.62	-.52	-.47
Space	.26	.28	.33	.42	.32	.42	.55	.61	-.40	-.26
Travel	.28	.49	.48	.41	.35	.49	.64	.67	-.34	-.40
Genetic	*	.18	.16	*	*	*	.60	.54	-.55	-.55
Engineering	.21	*	.19	*	*	*	.72	.67	-.55	-.46
Data Banks	.27	.16	.18	.18	.10	.17	.54	.52	-.56	-.56
	.49	.13	.16	.21	.10	.28	.71	.57	-.53	-.52

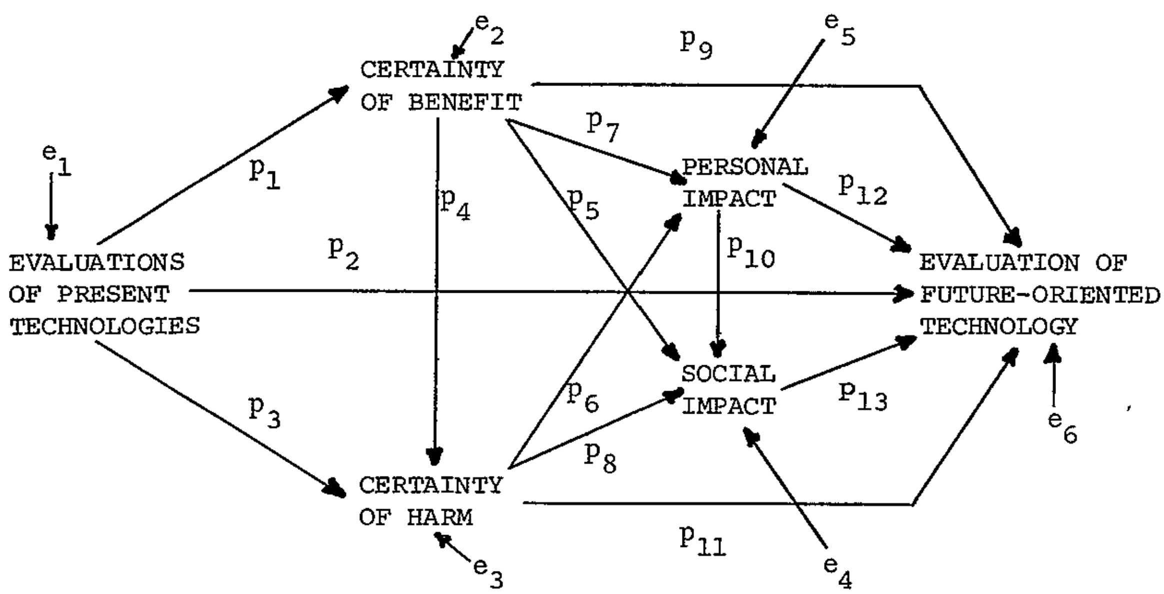
[a]Top row data for total sample; lower row for potential publics.

*r = < .10.

[+]See Appendix E for the matrix of correlations of the primary attitudes among themselves.

FIGURE 7-1

A CAUSAL MODEL OF EVALUATIONS OF FUTURE-ORIENTED TECHNOLOGIES



One way of evaluating this model is to consider how much of the variation in the dependent variables--support for each of the twelve future-oriented technologies--can be accounted for by the independent variables of the model. This will assist us in understanding the relative effects of the various factors which were included within the model [2] The amount of variation or variance accounted for by the model is indicated by the R^2 figures in Table 7-2 which are based on a measure of Multiple Correlation Coefficients, R, for the regression of the independent variables on the dependent variable support for the technology R^2 then represents the percent of variation accounted for by the sum total of the variables in the model. Table 7-3 summarizes the distribution of R^2 over the 12 technologies examined in 1972 and 1974 for the cross-section samples and the potential public

At least in terms of these twelve technologies, the model holds up extraordinarily well For only one case, the support of urban rail transport in 1972--the most intensely supported of the technologies--does the

TABLE 7-2
RELATIVE INFLUENCE OF FACTORS IN DECISIONS TO SUPPORT OR OPPOSE
SELECTED FUTURE-ORIENTED TECHNOLOGIES
(standardized regression coefficients-beta weights,
cross-section sample and potential public, '72, '74)

DIRECT RELATIONS TO SUPPORT[b]

Tech.	Present Tech. Evaluation		Certainty of Benefit		Certainty of Harm		Impact on Self		Impact on Others		R^2 (%)	
	'72	'74	'72	'74	'72	'74	'72	'74	'72	'74	'72	'74
Urban	.01*[a]	12*	.18	.56	-.22	-.07	-.08*	.02*	-.03*	.12*	14.1%	32.1
Rail	-.01*	.32	.33	67	- 12*	-.04*	.13*	.05*	.12*	.06*	20.2	51.5
Solar	.12	.02*	.49	.37	- 21	.06*	.04*	.06*	-.09*	-.17	44.8	22.2
Energy	19	.13*	.57	.32*	- 31	-.33	.14*	01*	.09*	- 26*	56.4	36.7
Organ	.18	- 06*	.42	.38	- 19	-.18	.08*	.02*	-.12	-.23	38.6	30.7
Transplant	.14*	.28	.36	.40	-.19	-.31	.10*	.07*	-.17*	-.20*	42.9	41 1
Nuclear	.11	.13	.38	.46	-.29	-.27	.05*	.07*	.02*	-.06*	35.7	46.9
Energy	17*	.14	32	42	- 31	-.41	.04*	-.01*	.08*	-.05*	42.4	60.1
Cable TV	.02*	- 01*	.40	.18	-.18	-.30	-.16	-.40	-.02*	-.05*	36.2	50.8
	.00*	-.03*	.45	.11*	-.19	-.37	-.08*	-.45	-.10*	-.09*	43.1	52.6
STOL	.13	.00*	34	.37	-.27	-.38	.06*	-.19	.06*	- 05*	34.0	51.9
	.16	.00*	.34	.38	- 27	-.40	-.05*	-.32	-.07*	.14*	41.3	72.6
ABM	.14	.07*	38	.37	-.39	-.46	-.13	.10*	.10*	-.14*	53.2	59.5
	.12	.10*	.43	.22*	-.43	-.65	-.05*	.11*	00*	.21*	73.0	62 1
SST	.09	.14*	.47	.46	-.23	-.24	.05*	.02*	-.07*	.12*	42.5	39.4
	.08	.05*	.55	.44	-.26	-.48	.06*	.11*	-.11*	.32	55.5	70.0
Brain	.12	.05*	.36	.40	-.33	-.38	-.04*	-.03	-.14	-.15	41 8	45.5
Drugs	.28	.04*	.37	.49	-.29	-.34	.05*	.01*	-.22	-.13*	54.1	48.0
Space	.07*	.16	.37	43	-.25	-.09*	-.12	-.12*	-.11	-.13*	39.6	44.0
Travel	.15	.24	.44	.45	-.22	-.08*	- 22	-.01*	-.16	-.24	56 1	56.4
Genetic	-.05*	.05*	.41	.38	-.34	-.45	-.10	-.10*	-.07*	.01*	44 1	45.7
Engin.	.07*	-.08*	.57	.56	-.23	-.27	-.04*	-.11*	.02*	-.11*	55.7	50.4
Data	.14	.05*	.37	31	-.36	-.41	.09*	.10*	-.02*	-.13*	45.8	39.5
Banks	.23	.02*	.54	.44	- 30	-.34	.10*	.05*	-.19	-.02*	65.4	41.1

*Regression coefficient not significant at p < .05, i.e., sigma beta < 5 beta weight.
[a]Top figure for cross-section sample, lower for potential public.
[b]See Table in Appendix D for regression coefficients for Indirect Relations to Support.

TABLE 7-3

DISTRIBUTION OF VARIANCE EXPLAINED BY MODEL OF SUPPORT FOR FUTURE-ORIENTED TECHNOLOGIES

	PERCENT OF VARIANCE EXPLAINED R^2				
	< 30%	30.0-39.0	40.0-49.9	> 50.0	Range
Cross-Section	8.4(2)	37.5(9)	41.7(10)	12.5(3)	14.1-59.5
Potential Public	4.2(1)	4.2(1)	16.7(4)	75.0(18)	20.2-73.0

variance explained drop below 30%. In most cases, the R^2 is above 40%; for the potential public almost two-thirds of the cases were above 50%. These figures are quite high and represent a very strong case for the power of the model to predict support for or opposition to future-oriented technologies.[3] The summary in Table 7-3 also suggests that the model's greatest predictive utility is for attitudes of the potential public, those most likely to become involved in technological politics On the basis of the available level of analysis what conclusions are justified?

First, people's certainty of benefit and certainty of harm clearly account the most for the degree of their support for a future-oriented technology. Second, the certainty of benefit was generally more important than certainty of harm; only seven times was this weight reversed--in 24 out of 48 possible cases certainty of benefit was clearly more important. But although the predictive value of certainty of harm ran second to certainty of benefit's, in only 8 out of a possible 48 instances was certainty of harm outweighed by any factor other than certainty of benefit.[4] Third, the pattern of contribution of the other predictive factors showed more variation The impact variables were by and large of quite modest importance, although when they did count highly, some interesting differentiations were evident, especially in the data for the 1974 potential public (see Table 7-2). In that year for both the cross-section and for the potential public data, the estimated effect of Cable TV on personal experience became the *most* important contributor to attitudes of opposition. And, for the potential public, the impact upon one's own experience rose in 1974 to become nearly as important as the certainty of harm in shaping attitudes toward the STOL aircraft technology. Also for the potential public in 1974, the impact of SST and space travel technologies upon "others'" lives became quite significant--in opposite directions. those who estimated considerable change in the lives of others were, in 1974, favorably disposed to the SST and opposed to space travel (32 and -.24 respectively). Finally, while the evaluation of presently implemented technologies contributed somewhat to specific attitudes toward most of the technologies, it rarely was on a par with either of the two certainty variables.

This pattern of coefficients strongly suggests that the power of the model of support for future-oriented technologies rests heavily on people's estimates of the probability of benefits and harms resulting from a new technology's implementation. In addition, evaluations of present technologies and estimates of the degree to which a new technology would affect one's personal experience or that of others came to bear selectively on evaluation of some technologies and not others. Further work is required to establish what the social properties of technologies are which evoke different patterns of associations with these other variables in judgments of support or opposition

THE SUBSTANCE OF CERTAINTIES

The degree to which individuals were certain about future benefit or harm consistently and strongly influenced their support or opposition to new technologies. Were those expressions of certainty based on vague feelings or were particular substantive concerns behind them? People who said they were "absolutely sure" or "quite sure" of a technology's beneficial or of its harmful consequences were asked to indicate what they felt would be certainly beneficial or certainly harmful if it were put into operation * In a sense responses to these questions indicate the hopes and fears which people associated with each technology.

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* It was not sensible to search for their hopes or fears of those who were not sure or who thought that there would be neglibible effect Presumably, there would be few, if any, connected with the technology

Expectations for future consequences, we now know, are very important to an individual's judgments favoring or opposing technical development, beliefs about what will result from technological developments form the underlying reasons for the public's attitudes of support or concern. As they are displayed in Table 7-4, hopes and fears about future technology obviously vary widely, and they have changed considerably in some interesting respects.

As might be expected, those who believed that benefits were certain to result from a technological development conceived of them in terms of its ostensible purposes, that is, consistent with our understanding of technology as improved capacity outlined in Chapter I, in terms of the technology's intended, direct results. For example, the nuclear and solar energy technologies were seen as providing needed new and more dependable supplies of energy for less cost and as possibly allowing conservation of petroleum resources Similarly, the biological technologies were seen as promoting the health of their recipients Interestingly, the information processing technologies drew hopes for improved efficiency in whatever it was they processed ("through-put" in the jargon of systems analysis).

In contrast to the way the technologies' benefits were perceived--in direct, functional terms--fears about them were expressed in terms of the unintended harms which might occur *indirectly* as the result of their implementation. These concerns often related to a technology's polluting effects--as with nuclear energy or the STOL and SST aircraft--and to fears about incursion on political rights--a possible consequence of cable TV, large data banks, brain drugs, and genetic engineering Also, many technologies simply seemed too dangerous. Less often they seemed too costly

At least one important implication stems from this difference between direct benefits and indirect harms perceived by the public. It is likely that the acceptance by the public of a new technology requires at minimum their acquiescence to both its direct and indirect effects Therefore, in the planning for the development of technological implementation, consideration of longer term, indirect effects should receive as much attention as is currently devoted to the direct benefits of new

TABLE 7-4

THE SUBSTANCE OF HOPES AND FEARS FOR TWELVE TECHNOLOGIES
(percentages, cross-section sample and potential public, '72; '74)

BENEFITS	1972	1974	HARMS	1972	1974
--I--					
URBAN RAILS					
Better, more	63	79	Too costly	25[a]	21
efficient	57	70		32	34
Reduce pollution	60	55	Too dangerous	16	23
	72	60		9	19
Reduce traffic,	56	50	(n)	(58)	(22)
parking	62	43		(17)	(11)
Safer	20	19	[H < 20%: taxes, crowding, too		
	12	10	fast, fewer jobs][b]		
Reduce gas usage	1	29			
	3	29			
(n)	(330)	(101)			
	(120)	(47)			
[B < 20% jobs]					
--II--					
SOLAR ENERGY					
Unlimited supply	43	44	Too costly	32	62
	43	39		60	61
Reduce pollution	38	36	Too dangerous	21	21
	40	44		5	39
Cheap source	26	32	Impractical	14	17
	22	27		34	0
Conserve resources	18	21	(n)	(37)	(12)
	22	32		(11)	(4)
Prevent shortage	16	33	[H < 20%. Don't like it; fewer		
	22	17	jobs]		
(n)	(248)	(85)			
	(77)	(35)			
[B < 20% --]					
--III--					
ORGAN TRANSPLANTS					
Prolong life	32	47	Too dangerous	40	40
	39	59	(rejection)	30	42
Saves lives	35	41	Determine death	14	38
	30	39		8	21
Fights disease	26	19	Not moral to do	28	17
	31	11		47	8
Replacement	19	20	(n)	(88)	(30)
	8	16		(30)	(12)
Enables fuller	9	19	[H < 20%: more population, too		
lives	12	16	costly]		
(n)	(257)	(79)			
	(81)	(27)			
[B < 20% advances medicine]					

[a]Top figure for cross-section; lower figure for potential public; (n) number indicating certainty.

[b]Residue of responses less than 20% of total.

TABLE 7-4, continued

BENEFITS	1972	1974	HARMS	1972	1974
--IV-- NUCLEAR ENERGY					
Need more power	54	69	Too dangerous	41	68
	61	61		40	61
No air pollution	40	30	Waste disposal	14	28
	48	40		11	43
Cheaper source	29	35	Pollution	28	16
	27	43		31	17
Conserve resources	19	26	Thermal pollution	15	15
	29	41		22	11
(n)	(250)	(198)	(n)	(90)	(65)
	(79)	(75)		(29)	(33)
[B < 20%. safe enough, jobs]			[H < 20%: too costly]		
--V-- CABLE TV					
Good for education	45	57	Used for persuasion	15	49
	45	69		20	70
Greater choice	26	21	Too costly	49	29
	20	25		45	33
More programs	15	32	Too much junk now	31	33
	17	39		21	17
More entertainment	17	14	(n)	(72)	(24)
	25	17		(33)	(12)
(n)	(220)	(65)	[H < 20%: electric power problems]		
	(76)	(29)			
[B < 20%: educate children, widen experience, better quality]					
--VI-- STOL					
Faster travel	40	48	Noise pollution	39	26
	38	45		41	30
Saves space	16	27	Pollution	34	35
	17	33		27	50
Convenience to airport	21	26	Too dangerous	20	21
	26	28		10	16
Convenience, to places	20	23	Too crowded now	15	22
	24	25		18	16
(n)	(551)	(88)	(n)	(233)	(35)
	(177)	(32)		(77)	(18)
[B < 20%: cost, for emergencies, for business, jobs, less noise, promote understanding]			[H < 20%: too much space, cost, too fast now]		

TABLE 7-4, continued

--VII--

A B M

BENEFITS	1972	1974	HARMS	1972	1974
Added protection	31	32	Violence wrong	24	37
	35	43		32	31
Deter aggression	19	32	Continue arms race	18	27
	17	37		19	30
Lessen tensions	21	20	Leads to war	19	29
	17	17		12	26
Intercept missiles	19	18	Too costly	20	13
	9	9		20	9
(n)	(214)	(69)	(n)	(114)	(42)
	(60)	(19)		(51)	(23)

[B < 20%: saves lives, need for defense, jobs]

[H < 20%: potential for error]

--VIII--

S S T

BENEFITS	1972	1974	HARMS	1972	1974
Saves time	70	67	Noise pollution	39	47
	58	55		62	46
Promote understanding	22	13	Pollution	33	48
	37	35		44	57
Good for travellers	3	19	Life too fast now	21	28
	9	14		24	33
(n)	(213)	(57)	Too dangerous	21	32
	(55)	(17)		9	17
			(n)	(118)	(38)
				(47)	(16)

[B < 20%: more travel, jobs, trade, save money, good for emergencies]

[H < 20% cost, skyjack, need for airports, too much fuel]

--IX--

B R A I N D R U G S

BENEFITS	1972	1974	HARMS	1972	1974
Rehabilitate mentally ill	57	75	Misuses of power	19	50
	61	78		28	68
Reduce mental illness	26	10	Not moral to do	10	32
	28	68		12	31
Reduce Crime	16	33	Side effects	27	16
	21	8		16	0
(n)	(161)	(41)	Loss of self control	8	23
	(55)	(14)		8	28
			Has to be controlled	20	4
				29	8
			(n)	(139)	(47)
				(49)	(21)

[B < 20%: fewer in institutions, aid problem children]

[H < 20% dependency, drugs not the answer, don't know enough]

TABLE 7-4, continued

BENEFITS	1972	1974	HARMS	1972	1974
--X-- SPACE TRAVEL					
Advance science	58	62	Cut funds elsewhere	32	40
	51	46		50	53
Relieve population	25	26	Too costly	22	21
pressures	19	25		25	14
Technological	17	21	Too dangerous	17	22
advance	21	22		14	33
(n)	(116)	(42)	God didn't mean us	20	0
	(37)	(26)	to	5	0
[B < 20%. medical advances, new resources, colonize]			(n)	(118)	(22)
				(28)	(7)
			[H < 20%: taxes, benefit only a few]		
--XI-- GENETIC ENGINEERING					
Improve future	31	29	Wrong, bad for	39	46
generations	31	46	people	21	45
Produce better	9	27	Can't control it	32	43
life	13	9		40	39
Prevent inherited	20	25	Make people robots	12	26
disease	23	24		15	33
Improve people,	22	22	Selective breeding	10	22
babies	13	44		17	24
(n)	(112)	(27)	(n)	(157)	(67)
	(32)	(9)		(63)	(33)
[B < 20%: prevent retardation, birth defects]			[H < 20%: unpredictable, could make things worse, infringe on freedom]		
--XII-- DATA BANKS					
Better, up to date	39	52	Invasion of privacy	45	58
services	52	75		36	66
Saves time, easy	34	50	Fear of misuse	21	43
	21	13		30	32
Help law enforcement	20	26	Too much control	31	23
	19	0		40	26
Help locate people	9	31	Infringement of	9	16
	12	0	rights	13	3
Good for people to	4	18	(n)	(191)	(85)
have	2	43		(80)	(38)
(n)	(99)	(29)	[H < 20%: dehumanizes, mistakes held against people, technology is unreliable]		
	(25)	(8)			
(B < 20%: better and more up-to-date information]					

technological capacities Of particular interest are those forecasts expressed by a goodly portion of each group, concerning which sharp changes occurred between 1972 and 1974 Grouping the technologies by type of capacity, we see that the transport technologies--urban rails, STOL, and the SST aircraft--were all thought by over half of the hopeful to improve the efficiency of travel, at the same time, the possibility that urban rail transit would result in reduced pollution was enthusiastically expressed Noise pollution and more general air pollution were significant aspects of opposition to the SST and increased by the time of the second survey. Over 20% of those anticipating benefits from the SST expected it to improve international understanding A relatively sharp decline in the percentages of those believing that noise pollution would result from the STOL aircraft also occurred

These changes, along with other indications related to other technologies, suggest that the public is aware of and digesting new information about the potential consequences of technical innovations. Clearly this was the case with responses to solar and nuclear energy technologies With regard to their benefits, expectations for their help in satisfying our need for power and preventing shortages increased considerably At the same time, very sharp increases were evident in the percentage of people expecting solar energy to be too costly and nuclear power development to be too dangerous and too problematic with respect to the growing volume of radioactive wastes Such changes signal a public awareness of impending critical energy shortages tempered by concern over some of the proposed solutions--a consciousness of the more subtle economic and environmental problems inherent in those solutions, subjects beginning to be aired in the popular press.[4] Together with the constant concern over the dangers of both proposed energy technologies, such qualms may account for the declining degree of certainty of benefit perceived for the two technologies by the potential public, as reported in the last chapter.

Expectations for the biological technologies show a divergence similar to that for the transport technologies Organ transplants were received warmly, with sharp increases in anticipated benefits for saving and prolonging life, though there was also greatly increased concern about problems in determining the moment of death for purposes of removing the organ to be transplanted Behavior altering drugs and genetic engineering, in contrast much less enthusiastically received, drew considerable opposition on the basis of greatly increased apprehension about the misuse of power over people inherent in such procedures For both these technologies general moral concern and the issue of the individual's threatened loss of control over his own life increased There were no expected benefits from genetic engineering which drew the interest of more than 35% of those certain of the technology's benefits, a very large increase, up to 75%, however, expected benefits from rehabilitating the mentally ill through the use of behavior altering drugs. Notably, there was a hint of concern for "law and order" in a doubling to 33% of those who expected the use of brain drugs to reduce crime

The two information dispensing and processing technologies--cable TV and large computerized data banks--were received quite differently An increasing percentage of people noted the improved educational and programming possibilities of cable TV At the same time there was a startling threefold increase to 45% of those worried about the problem of persuasion through the "tube " Whether this reaction was triggered by all the Watergate publicity is impossible to determine, but it represents a rapidly growing concern about incursions on political freedom enabled by technical development Computerized data banks evoked such concern with a vengeance Most hostilely received of all twelve technologies, virtually every anxious response was related to issues of invasion of privacy and misuse of information While there were some who valued the improved efficiency of the computer, especially from among the potential publics, there was overwhelming and increasing concern for its misuse

Finally, the two technologies related to international prestige and military defense--space travel and the ABM--evoked rather predictable reactions Space travel was seen by over half of the hopeful as contributing to scientific knowledge Those who were skeptical worried that the enormous costs of further efforts in space technology would result in cutbacks in funds for other programs. Interestingly, the proportion who were morally offended by the enterprise declined from about 20% in 1972 to none at all in 1974. The ABM, on the other hand, was met with more resistance than in 1972 because of increased agreement that the very act of violence is wrong. This response rose to include over a third of the sample. All of the attractions of the ABM were involved with its uses to deter aggression and provide protection, though such results were not mentioned by more than 30% of those "certain" of its benefits.

The hopes and fears specified in Table 7-4 suggest a public concerned with many aspects of technology's use, and they reflect a multiplicity of values important to the public. In Figure 7-2, these have been aggregated into ten areas of social concern, which are arrayed in terms of the number of specific benefits (coded +) or harms (coded -) that respondents attributed to each technology. Benefits and harms perceived for some technologies distribute across several of these value areas at once: for example, benefits attributed to urban rails include the values of supply and conservation, technical efficiency, environmental conditions, and the safety factor; harms attributed to it included the safety factor and excessive cost. Conversely, several specific benefits or harms are subsumed by a single value area: for example, nuclear energy was perceived to contribute positively in three separate ways to the assurance of adequate supplies and conservation and to bring with it two harmful and one hopeful environmental effects.

Some of these more general value concerns, such as the protection of the environment, are strongly evident here and reinforce the more general discussion of these values in Chapter V. Others lifted up there, such as the importance of employment and taxes, are not directly evident in these data, though they can be inferred from other responses such as those expressing concern for too costly development. The changes just noted add force to other data signifying a public watchful and aware of new information concerning the effects of various technologies. Given the clear relationship found between people's subjective certainty about a proposed technology's consequences and their support for or opposition to it, concurrent with the relatively large proportions of people *uncertain*

FIGURE 7-2

DISTRIBUTION OF TYPES OF EXPECTED BENEFICIAL AND HARMFUL CONSEQUENCES

Technology	Adequate supplies/ conservation	Technical efficiency	Health factor	Education/ knowledge	Environmental effect	Safety factor	Costs	Political Rights	Moral concerns	Technological saturation	Specific to technology	
Urban rail	1+	1+			1+	1+, 1-	1-				Reduce traffic	1+
Solar energy	2+	1+			1+	1-	1+, 1-				Impractical	1-
Organ transplant	2+		4+			1-			2-		Replace parts	1+
Nuclear energy	3+				1+, 2-	1-					Waste disposal	1-
Cable TV		1+		2+			1-	1-		1-	Entertainment	2+
STOL		3+			1+, 2-	2-	1-				—	
ABM						3+, 2-	1-		1-		Intercept missiles	1+
SST		2+			2-	1-				1-	Promote understanding	1+
Brain drugs			2+, 1-			1-		2-	1-		Reduce crime	1+
Space travel				2+		1-	2-		1-		Population dispersion	1+
Genetic engin.			4+					2-	1-		Selective breeding	1-
Data banks		3+		1+				4-			Locate people	1+

about either technology's good or its bad effects, programs of public information about the desirable vs undesirable aspects of new technologies are surely indicated. But what can be said about the relationship of more standard socioeconomic and political characteristics to attitudes toward these technologies? Can systematic relationships be found that would give us a clue about the more general social context of citizen responses? We now turn to this consideration

CONTEXTS OF RESPONSES TO FUTURE TECHNOLOGIES

Richer meanings in the whole samples' and potential publics' more-or-less-directed responses concerning the twelve future technologies are yielded by consideration of the larger context within which those responses were made. Some pertinent indicators within that context will be explored in the following sections of this chapter the perceived importance of various socially defined values, more comprehensive public judgments about the social implications of technological development, and information derived from the more standard indicators provided by the political, socioeconomic and demographic characteristics of our respondents Attention to these contexts affords a glimpse into cognitive associations held by members of the California public for different technologies.

Individuals, we argue, often have more or less definite ideas about what effects the implementation of particular technologies will have upon the conditions they wish to experience or to avoid Those conditions in turn are associated with the more general values people hold. That is, a reasonably high correlation coefficient (r) between a particular value or a belief about how a technology affects people and the support for or opposition to it may be interpreted as an indication that people tend to believe this technology will have a significant influence on producing or inhibiting that condition. For example, people who value environmental preservation will tend to favor solar energy generation more than those who do not, because solar energy is non-polluting Furthermore, liberal Democrats more than conservative Republicans will disproportionately favor technologies which advance social values such as redistributing costs and benefits within society. The same kind of expectation holds for the support for or opposition to a technology and the degree of agreement that it "complicates life," for example, or that it leads to too much "technological dependency", a relatively high correlation would reflect the belief that development of the technology in question would produce such an effect, in turn reflecting opposition to that technology. An absence of association or correlation would suggest, in this way of reasoning, that a particular technology was not connected in people's minds with affecting the value in question--an outcome which could be logically expected to hold for Cable TV and the need for controlling air pollution levels, for example.

Relating fairly complex matters such as technology to particular social effects and political values require relatively sophisticated causal reasoning We did not expect such reasoning to be dramatically evident within either the 1972 or 1974 cross-section samples, but thought it likely to be characteristic of members of the potential publics. Relatively high educational attainment and familiarity with technological processes can clearly contribute to the formation of an organized and systematic set of notions about the effects of technologies. This proved to be the case [5] Our subsequent discussion, therefore, draws mainly from the associations derived from the potential publics' responses. As we shall see, these responses are characterized by considerable variation and reveal some interesting changes and continuities.

SOCIAL VALUES AND SUPPORT FOR FUTURE TECHNOLOGIES

Our interpretation of the relationship between social values and support for future technologies is based on the following reasoning Individuals have some conception of what conditions represent the attainment of values they prefer. Also, they have come to expect those conditions to be sensitive to the implementation of new technologies Thus, if they believe that a particular technology is likely to advance conditions conducive to the attainment of their value preferences, they can be expected to support that technology.

The broad social and political values discussed in Chapter V in terms of the importance respondents accorded them as social priorities relate in particular ways to support for or opposition to future-oriented technologies. In Table 7-5, those values are reordered in terms of the degrees to which future technological developments are likely to enhance the conditions they represent or be detrimental to them The values so considered are the enjoyment of life, employment, U.S. prestige, the individual's right to privacy, the condition of the poor, taxes, and environmental conditions. Positive correlation coefficients (r) indicate the degree to which each of the twelve technologies is supported by those favoring each social value The correlation for the potential public, the most widely ranging, is the basis for the table. In preparing the table, the ranked weight of the values was reversed from that assigned to them earlier (see Table 5-1 , page 94), so that the most preferred value was numbered 7, the least preferred numbered 1. Thus a positive correlation in Table 7-5 indicates correspondence between strong support for the technology and strong preference for the particular value.

The emergent patterns of correlations between values and support give evidence of a remarkable variety in the degrees to which the potential publics associated different value conditions with particular technologies At one extreme, urban rails and cable TV were associated with *only one* of the seven social values respondents were asked to rank--urban rails negatively with taxes (that is, those concerned about taxes tended to oppose urban rails) and cable television positively with employment (those concerned about employment levels tended to support cable TV) At the other extreme, the STOL aircraft technology was associated in 1974 with *all but one* of the social values in question--U S international prestige, the value of least interest to the California public

Some interesting combinations are evident in the correlations recorded in Table 7-5, some, first of all, because of their absence or paucity Those in the potential public who highly valued the improvement of the condition of the poor as a social goal associated no technology positively with that goal in 1972 And those among them who ranked enjoyment of life as highly important in that year positively associated

TABLE 7-5

RANKED VALUES AND SUPPORT FOR TECHNOLOGIES[a]
(Pearson's r, potential public, '72, '74)

Technologies	TECHNOLOGY ENHANCES: Enjoyment of Life '72	'74	Employment '72	'74	U.S. Prestige '72	'74	Privacy[b] 1974	Condition of Poor People '72	'74	TECHNOLOGY DETRIMENTAL TO: Taxes '72	'74	Environmental Conditions '72	'74
Urban Rail										*	-.21		
Solar Energy					.21	*				– 33	*	*	-.35
Organ Transplant	*	-.26						*	-.15			*	31
Nuclear Energy	15	*			-.20	-.18	-.15						
Cable TV			*	.17									
STOL	*	.29	*	.34			.21	*	-.39	*	.47	-.18	-.54
ABM			.20	.34	.27	.34	-.45	-.26	*	*	.33	*	-.20
SST							.28					-.36	-.34
Brain Drugs					*	.33	-.19					*	-.27
Space Travel			16	-.30			28	*	25	*	-.39	-.21	*
Genetic Engin.			*	-.18	*	.27		-.22	*	.22	*		
Data Banks	*	.16	.25	*			– 42	*	.16				

[a]See Chapter V for a full discussion of value ranking.
[b]Asked once only, 1974.
*r < .15; blank slots indicate r's < .15 for both years.

with that value only *one* technology--nuclear energy--and that at the bare minimum of statistical significance (r = 15). Only *two* were positively associated in 1972 with a high valuation of U S prestige--solar energy and the ABM The picture changed somewhat in 1974 with respect to both positive and negative association between technology and the value-goal of enjoyment of life. A positive correlation appears with the STOL aircraft and, minimally, with data banks; a negative correlation with organ transplants emerges. The only sustained positive association was elicited by the ABM. In both 1972 and 1974 this technology was positively correlated with employment and with U.S. prestige (That is, those in the potential public who ranked employment and U.S prestige as important social goals tended also to support the ABM)

A second notable combination of correlations is related to high valuation of employment. Those who ranked employment as important associated only three technologies positively with it both years--in 1972 space travel, data banks, and the ABM, common also to 1974; in 1972 the two other positive correlations were cable TV and STOL. Whether or not it is actually true that developments in urban rail transit, nuclear generation of energy, and the SST can contribute to higher levels of employment, the potential public did not make a strong connection here.

The third pattern of preference centers around technology's effects upon the environment Not surprisingly, there was a sharp increase in the association between the importance of environmental effects and opposition to STOL aircraft, and a quite consistent negative association with SST development in this regard. These associations are consistent over time and represent an established relationship The magnitudes of the correlations could speculatively be interpreted to mean that there is an increasing recognition that STOL aircraft would be detrimental to the environment and a persistent conviction that the SST poses this threat. Other combinations of support for technologies and a high valuation of environmental conditions produced puzzling results. There were strong positive associations between high importance accorded this social value and support for organ transplants, conversely there was a strong negative association between that concern and solar energy (the technology most favored in 1974) and behavior altering drugs Again unaccountably, the importance of environmental conditions was related to opposition to space travel in 1972, while in 1974, this relationship disappeared. The associations for organ transplants and behavior altering drugs, not important in 1972, were relatively strong in 1974 These emerging associations suggest that those concerned about technology's effects on the environment may have general underlying attitudes toward nature which lead them to view dissimilar technologies in much the same way. Attitudes toward space travel technologies seem to have undergone a change in the direction of much reduced concern about the environmental effect of such developments, but further data is necessary to establish this conclusively

These data suggest opposition to development of a number of technologies on the basis of certain of these values. An aversion to data banks, nuclear power, the ABM and to behavior altering drugs was related to their potential effects on the right to privacy The connection with data banks and brain drugs is of course clear, but how the invasion of privacy issue is perceived to relate to nuclear energy and the ABM is not, though one can speculate. Those who value privacy are averse to things that intrude upon the individual conduct of life, whether the intrusions are in the form of information surveillance or of the ever conscious threat of global nuclear destruction. Support for solar energy by those valuing this nation's international prestige disappeared in 1974, though they had supported it two years earlier. This change appears a bit odd until one considers what that technology actually is--the collection by satellite of solar energy to be beamed to earth somehow It is possible that reactions to it have been colored by an increased sensitivity to the overwhelming difficulties of that technical task and to the danger to populations were such a device to malfunction

Finally perhaps the most important pattern to be noted in Table 7-5 is the increased number of associations in 1974 between these values and various technologies. There were more significant associations in 1974 than in 1972 for every value. This tendency to associate technology with social values was particularly evident in correlations between technologies and environmental conditions This pattern corroborates a point made in Chapter V above--that the public includes a wide range of values in its evaluation of technologies It seems plausible as well to infer that this range of values is expanding for specific technologies.

Thoughtful review of Table 7-5 will be useful to those interested in achieving or sustaining support for particular technologies. Searching for corresponding relationships between support and value ranking there reported and the expectations for benefits and harms summarized above in Table 7-4 is instructive, for often there is a clear connection between the two sets of data The best fits were for those values and fears related to a technology's effects on the environment and on taxes. But more interestingly, the *fears* expressed in conjunction with those benefits and harms often emerge from values quite different from those arrayed in Table 7-4. For example, the importance of effects on employment of STOL, the ABM, space travel, and genetic engineering, not evident in the open-ended responses summarized in Figure 7-2 above, emerged *in addition* to those particular fears What seems to be happening is that the public tends to associate the direct effects they expect from a technology with relatively immediate, often astonishingly innovative improvements, such as the twelve capacities spelled out in Figure 6-1, page 119 above. At the same time, they associate a technology's more indirect, negative effects with general values like enjoyment of life, employment levels, the environment, etc , listed in Table 7-4 Thus, specific hopes and fears seem to be undergirded by association with social values of larger dimension

SUPPORT FOR TECHNOLOGIES IN THE CONTEXT OF ATTITUDES TOWARD SCIENCE/TECHNOLOGY IN GENERAL

Individuals' beliefs about the more general effects of scientific work and its technological applications is another consideration in the cognitive context of their perceptions and judgments about particular technologies Table 7-6 displays the relationships between support for the twelve technologies and those beliefs as measured by the scales constructed to weigh the potential public's attitudes toward a number of

TABLE 7-6

ATTITUDES TOWARD THE GENERAL OUTCOMES OF TECHNOLOGY AND SUPPORT FOR FUTURE TECHNOLOGIES[a]
(Pearson's r; potential public, '72; '74)

	TECHNOLOGY BENEFICENT												TECHNOLOGY PERNICIOUS
Technologies	Outcome of Science		Standard of Living Depends on Technology		Technology's Social Utility[c]	Value of Scientific Activities Scale		Regulate Technology Scale		Outcome of Technology		Technological Imperative[b]	Technology Leads to Materialism[c]
	'72	'74	'72	'74	1974	'72	'74	'72	'74	'72	'74	1972	1974
Urban Rail												*	
Solar Energy										-.25	-.27	*	
Organ Transplant	.24	*			.30	-.27	-.25	*				-.19	
Nuclear Energy	*	.32				-.28	*			-.40	-.27	-.15	-.24
Cable TV												*	
STOL			.25	.19				*	.23	-.30	-.20	*	-.20
ABM	*	.32	*	.37	.21	*	26			-.30	-.29	-.36	-.45
SST										-.26	-.37	*	
Brain Drugs					.20	-.19	.21					*	
Space Travel			.25	*		-.24	*			-.25	*	*	
Genetic Engin.	.18	.25	.21	*				.23	*			*	
Data Banks			.22	*		*	-.20			-.31	*	-.33	

[a]See Chapter IV for a full discussion of the responses from which the scales weighing these attitudes were derived.
[b]Asked only once, 1972.
[c]Asked only once, 1974.
*r < .15; blank slots indicate r < .15 both years.

spinoff social effects of technical development. These scales were constructed and discussed in Chapter IV The most optimistic assertion weighed by these scales is that "technology makes life better",[6] the potential public's degree of agreement that it does comprised the Outcome-of-Science index, which we have used here to tally against support for the individual technologies. The correlations so discovered are indicated in the left-most column of Table 7-6, that is, under the most "beneficent" point on the implied spectrum of how the potential public views technology's social effects. At the other extreme, the potential public's degree of agreement with the pessimistic assertion that man has become entrapped in a debilitating materialism is weighed against support for or opposition to the technologies. The resulting correlations are indicated in the farthest column to the right--the "pernicious" end of the range of attitudes about technology's social effects Two summary scales, compiled from responses concerning whether or not scientific and technological work should be controlled--the Value-of-Scientific-Activity scale and the Regulate Technology scale--occupy the mid-range of Table 7-6.

Associations between the potential public's agreement with the assertions on which the scales weighing its attitudes toward technology's social effects are based and its support for or opposition to a particular future-oriented technology, then, would provide evidence for measuring its estimates about the contribution of that technology to various conditions projected in those attitudes Several patterns can be seen in Table 7-6 which bear generally on these relationships.

Some technologies more than others are perceived to be associated with the beneficial aspects of technology The likelihood of support or opposition for several--urban rail transport, solar energy, cable TV, and the SST--was not disproportionately influenced by beliefs in the positive outcomes of science translated through technology, concerns about technology's relation to the standard of living, or its social utility Only for the ABM did agreement with these three perceptions of a technology's effects seem to especially influence support for the technology Comparison of the data from two surveys seems to suggest tentatively that our future-oriented technologies in 1974 were less strongly associated with these three attitudes than they were in 1972. One puzzling question emerges here what are the properties of various technologies which prompt in the potential public perceptions of them that may be associated with preferences for or agreements with these three particular consequences of technological development?

The data also show that judgments about the less positive "outcomes of technology" are the most consistently associated with various of our twelve technologies. Those who supported the development of a number of technologies disagreed with assertions of the three items in the outcomes-of-technology scale that technology overly complicates life, is prone to make us too dependent upon machines or stimulates a desire to "go back to nature" There was some indication that, for four of the seven technologies, this scale was a bit less effective in 1974 than in 1972 as a predictor of support This development could be interpreted as an indication of a beginning decline in anxiety toward technology-in-general, with an increased propensity to focus upon specific technologies in a more discriminating way. Perhaps the most obvious example of this tendency was that support for or opposition to the ABM was related to the most factors--some quite highly, such as the association of opposition with the belief in general that "technology leads to materialism."

A third pattern emerges from the data concerning the summary scales of "Regulate Technology" and the "Value of Scientific Activities"--both concerned with the legitimate exercise of control Few future-oriented technologies were disproportionately associated with agreement that technology should be more closely regulated This lack of association may be a reflection of the quite even division in this regard within our samples. However, attitudes concerning the intrinsic worth of scientific activities and the appropriate degree of regulation that should be applied to them were associated with support for or opposition to half of our future-oriented technologies. Organ transplants, the technology most consistently perceived, was highly supported, especially by those who disagreed that science activities should be controlled Change was registered for each of the other five technologies In three cases--

for nuclear energy development, the ABM, and the development of behavior altering drugs--support from the potential public was *less* associated with belief in unregulated scientific research in 1974 than it had been in 1972 This was especially the case for developments in "brain drugs" for which a strong reversal of association was evident The data for two of the most opposed technologies in 1972--data banks and space travel--are interesting and reflect again people's apparent propensity to discriminate between technologies. Data banks, for which support sharply decreased from 1972 to 1974, were less strongly opposed in 1974 by those who disagreed that science activities should be regulated. Speculatively, it appears that in the face of extreme opposition to technical developments a general belief in the importance of unencumbered inquiry acts as a moderating element For space travel technology another pattern developed This technology was the only one for which there was significantly increased support in 1974 compared to 1972 In this case, a belief in the importance of regulating scientific activities became insignificant as a predictor of support for the technology

Finally, there appears to be a hint of polarization in attitudes toward the ABM within the potential public This group may contain one faction that favors the ABM's development because of a general optimism about the benefits of science, technology's contributions to our living standards and its social utility But another, probably larger, faction tends on the other hand to worry about the complicating broader effects of increased technological dependency and the potential for increased materialism that might accompany that dependency

POLITICAL AND SOCIOECONOMIC INDICATORS OF SUPPORT FOR FUTURE TECHNOLOGIES

A relatively detailed picture of the cognitive associations the potential public makes with regard to our twelve technologies is, as we have just attempted to demonstrate, provided by analyzing the relationships between its support for specific technologies and its beliefs about the consequences they portend for particular social values But more familiar to political research is analysis focused on the political, socioeconomic, and demographic characteristics of a given sample of the public These characteristics are conventionally treated as "long range" surrogates predicting likely political activity. Are there informative *patterns* of relationships within our data between these more traditional indicators and support for or opposition to future-oriented technologies?

The logic and method underlying our next analytical effort is much the same as for our last. We will now identify correlations between traditional sociopolitical indicators and support for a specific technology Reasonably high correlation coefficients (r) indicate that a connection exists in people's minds between the consequences of implementing a technology and the conditions which they, as caucasians or members of a racial minority, older or younger, wealthy or poor, male or female, or liberal or conservative, associate differentially with things they value or abjure The pattern of such correlations, again drawing from data provided by the potential public samples, is summarized in Table 7-7 It shows that people holding particular political beliefs or having specific socioeconomic characteristics vary considerably in their perceptions of particular technologies as salient. Whatever the particular cognitive organization distinctively associated with differences in sex, race, and income level, they produced only a limited degree of discrimination in the support for or opposition to the twelve future-oriented technologies They correlated strongly with only four of them, and a person's sex was more consistently associated with support than either race or income was. In general, women tended to be less enthusiastic than men in 1974 about space travel and urban rail transit, while men in 1972 gave relatively strong support to the nuclear generation of power and opposed to the SST Other technologies did not evoke responses particularly related to one's gender Racial minorities were even more opposed than caucasians to genetic engineering, one of the most negatively received technologies The strength of that relationship indicates that minorities must see considerable threat from the potentials of such manipulation A person's income level tended to be less important in 1974 than in 1972 in predicting support for three technologies--nuclear and solar energy technologies and the SST--all of which are related to large industrial development Only solar energy

TABLE 7-7

POLITICAL AND SOCIOECONOMIC CHARACTERISTICS AND SUPPORT FOR FUTURE TECHNOLOGIES[a]
(Pearson's r; potential public, '72; '74)

Technologies	POLITICAL CHARACTERISTICS: Party (Democrat-Republican)		Ideology (Liberal-Conservative)		Party/Ideology Scale		SOCIOECONOMIC CHARACTERISTICS: Education		Income		Race		Sex		Age	
	'72	'74	'72	'74	'72	'74	'72	'74	'72	'74	'72	'74	'72	'74	'72	'74
Urban Rail			.22	*									*	-.25	*	-.23
Solar Energy							.22	*	.23	*	*	.22				
Organ Transpl.																
Nuclear Energy	-.21	*	*	-.25	-.25	-.24			.24	*	-.26	*	-.22	*		
Cable TV			.19	.26											*	-.34
STOL			*	-.38	*	-.23	*	-.32								
ABM	.27	*	-.47	-.41	-.43	-.38	*	-.40							.47	.38
SST									*	.30	*	.25	.30	*		
Brain Drugs	*	-.20			-.20	-.21	*	-.22								
Space Travel													*	-.32	-.22	-.33
Genetic Engin.							-.23	*			.33	.25				
Data Banks			-.31	*	-.25	*	*	.37							.24	*

[a]See Appendix C for comparative distribution of political and socioeconomic characteristics among the samples.

*$r < .15$; blank slots indicate $r < .15$ for both years.

and the SST seemed to attract disproportionate support in 1974 from those with higher incomes. Put the other way around, only those two technologies seemed to poorer citizens to be specifically disadvantageous.

Rather more interesting were the 1974 data related to age and education. There were clear indications in the 1974 data that seniority and higher levels of educational attainment became more important than they had been in discriminating supporters from opponents Both characteristics came to point toward generally more negative views on technological development In 1974 older people were much more likely than the young to be opposed to urban rail transit and cable television This negativism extended to space travel as well but was reversed strongly in the support shown by older people for the ABM These associations may be partially explained by the apparent aversion of older, more conservative citizens to technologies which threaten to raise taxes (urban rails) and by their concern for protection and maintenance of international political power (the ABM) [7]

The more highly educated differed sharply from older people in their reception of the ABM, which correlated highly with both education and age Unlike older citizens, the more highly educated opposed the development of the ABM, and they tended in 1974 to oppose the use of behavior altering drugs and STOL aircraft development.

But do those results in this emerging collage of data have much significance? If nothing else, the glimpse they provide of quite differential perceptions and evaluations of the technologies certainly has intrinsic interest the older generations in effect run counter to the general tendencies of the whole sample in their opposition to urban rail transit and, to a lesser degree, in their support of the ABM and data banks The more wealthy made a similar departure from the mainstream of opinion in their support for the SST Whether these cross-cutting trends presage political conflict is difficult to determine, for, aside from the counter-tendencies just noted, associations between support and/or opposition and the five socioeconomic characteristics were consonant with the overall trends in the overall evaluation of the twelve technologies.

More indicative of political controversy over these technologies are the several quite conclusive associations of political party identification and political ideology with support or opposition, though only about half of the technologies drew differential attitudes on the basis of political party or ideology. Solar energy, organ transplants, the SST, space travel, and genetic engineering in 1972 and again in 1974 apparently were perceived quite similarly by Democrats and Republicans, liberals and conservatives. By 1974, urban rail transport and data banks had become politically "neuter" as well, although, as our discussion has just pointed out, support for these same technologies was associated with other socioeconomic characteristics Party preference plays only a small role in predicting support for any of these technologies, on the other hand, self-identified liberal or conservative ideological orientations take on clear importance And, for those technologies about which the potential public is relatively closely divided, these loyalties seem to have become somewhat more significant in distinguishing support from opposition. The magnitude of correlation between these indicators and support/opposition increased or remained high. Increased correlation was especially apparent between ideological leanings and opposition to STOL aircraft development, to the ABM, and to brain drugs In each of these three cases, adherence to liberal political ideology was apparently a pervasive factor prompting opposition. The reverse was the case for cable TV. liberal convictions tended to encourage support for this technology

The data suggest then that political ideology and, to a lesser extent, party identification have a bearing on support for or opposition to development of *some* technologies Perhaps the most sensible interpretation here is that the social consequences of those technologies are increasingly being perceived as stimulating conditions already part of the differential preference patterns held either by political liberals or by political conservatives For example, the development of urban mass transit and the widespread diffusion of cable television have social consequences, or enable certain activities, valued more by politically liberal citizens than by political conservatives Conversely, STOL aircraft, antiballistic missiles, data banks in 1972, and nuclear power in 1974 were perceived by conservatives as enabling certain outcomes far less objectionable to them than they were to liberals.

To conclude this discussion of some of the specific attitudes and patterns of attitudes toward future-oriented technology, we turn to the most anomalous one detected--the dramatic increase in support among the potential for the technologies of interplanetary space travel.

INTERPLANETARY SPACECRAFT: A SYMBOL OF BASIC RESEARCH

One of the most evident findings from the data coming out of the surveys is the general, pervasive decline between 1972 and 1974 of overall support for most of the technologies included in the survey. Almost without exception for the cross-section samples and the potential public, both the certainty of beneficial as against harmful consequences of these technologies and of public support for them declined or remained at about the same level.[8] The single instance of significantly increased support for a technology was the enhanced attractiveness to the potential public of developments in manned interplanetary space exploration.

In the face of the general downward trend, support among the potential public as measured by mean scores for a space technology to enable travel to other planets increased from -.19, a bit below the point of exactly balancing support or opposition, to .69, up .88 points or about 15% on the six point scale.[9] This was the greatest overall change in level of support for any technology, challenged only by an overall decline of .77 for behavior altering drugs. This increase in support lifted the relative position of space travel technology from its initial low of 10th place to 7th place just below STOL aircraft development.

Paralleling this increase in general support for space travel technology, it was perceived by the potential public in 1974 to be much more certain to produce benefits than it was in 1972.[10] The *only* technology for which the ratio of Helpful to Harmful results increased (from 1.28 to 3.25), its relative standing rose from 7th to 3rd place for this measure. In similar fashion, the ratio of mean degree of certainty of beneficial to harmful consequences also increased, from 1.01, at the break even point, to 1.26 (see Table 6-3, p. 126), raising the technology's relative standing from 9th to 4th place. The magnitude of change, as measured by these indicators, is most unusual and runs counter to the tendencies for every other technology analyzed in the survey. Both in direction and in degree of movement, the change is arresting, particularly in view of the wide difference between the potential public compared to the cross-section as a whole. Space travel technology is one of three technologies for which the opinions of the potential public were significantly different from those of the rest of the sample in 1974, and the *only one* which evoked a difference in support. The rest of the sample did not support it (see Table 6-1, p 123) Do other data afford some clues to what may account for this anomaly?

First, several factors may be *discounted* as partial explanations for increased support either because they remained much the same as in 1972 or because they would lead us to expect increased opposition to space travel technologies. The negative relationships of *age* to support remained relatively constant A number of other factors were associated with decreased support These were increased fears that this technology was too *dangerous*, opposition to the technology associated with concern for effects on *employment* and on increased *taxes*, and increased disaffection with the technology from *women* respondents. But positively related factors seemed to overwhelm these which tended toward opposition

Analysis based on regression techniques of the contribution of our "primary variable" in accounting for the variations in the support for space travel technologies provides a clue to understanding the context of increased support for the technology in 1974. From comparing the regression coefficients for 1972 to those of 1974, it is evident that the power of the *perceived impact of space travel technologies upon one's own experience* and the *certainty with which a person expects harmful results* both dropped off as predictors of opposition. Each variable registered in 1972 a beta weight of - 22, the estimate for 1974 fell below the level of statistical significance. The remaining factor still related to opposition, the negative association of space travel's *impact* *upon the experiences of others*, however, rose sharply in importance from a -.16 to -.24.

In the face of these adjustments in the factors stimulating opposition, what changes were evident in those prompting support? There were important increases in both the influence of *evaluations of presently implemented technologies* (from 15 in 1972 to 24 in 1974) although the influence of a person's expectations for *certain benefits* remained about constant--a high .44 in 1972 and .45 in 1974. Everything suggests that the sharp increase in the potential public's support for space travel technologies was strongly affected by an increased sense of the positive results to be gained by such a venture, with a somewhat diminished sense of its harmful consequences. What might be the substance of these feelings?

The only beneficial consequences believed by an increased proportion of our respondents to be certainly likely was the contribution to *learning and scientific information.* This rose from about 50 to 60 percent of those certain of benefits. (Consistent with this increase was the much more positive association of support with higher levels of education (r = .06 in 1972 and 37 in 1974)) There was also a modest increase to 25% for beneficial advances in technology At the same time, there was a sharp decline, from 50 to 33 percent, in the percentage of the potential public who worried about the opportunity costs of space developments. These specific indications were paralleled by a decline in the feeling that technology complicates life, from r = .25 to r = 04.

These data evoke the following interpretation: that the potential public, a good deal more than the whole sample, had become in 1974 more certain that space travel would return beneficial scientific knowledge, and perhaps advances in technology, which would affect other people's lives more than their own. They had a growing sense that this technology would not contribute overly to life's difficulties and that it should be supported as part of the nation's basic research effort At the same time, the potential public did not believe as strongly as they had that funds spent on space projects would prevent other worthwhile programs from being taken up. Nor was their concern about the effects of these developments on tax levels or employment enough to vitiate their interests in scientific activities of this sort. It should be noted that neither of the political preference indicators was related to support for or opposition to space travel technology In this sense, perhaps, NASA has remained politically neuter in the minds of the potential public and the public-at-large

Attitudes toward space travel developments run counter to the general impression that there has been a decline in enthusiasm for space-oriented technological adventures It is possible that this decline has run its course, at least for those who are most likely to be involved in technological politics.

SUMMARY TOWARD A POLICY INTERPRETATION

The data presented in this chapter add force to a major conclusion already reached. that there is a remarkable variation in attitudes associated with the public's support for different new technologies. People's reactions differentially depend on how certain they believe a technology's benefits and harms will be, on how great they believe its effects will be upon themselves and on others, and on how they evaluate presently implemented technologies. The most telling predictor of support of a future technology is certainty of its *beneficial* consequences.

The hopes and fears people expressed about twelve future technologies covered a wide range of concerns, particularly evident in the benefits they believed certain to result Hopes for benefits were most often expressed in terms of the particular improved instrumental capacity--the technology's directly intended consequence. Fears about harms, on the other hand, were most often expressed in terms of unintended, indirect consequences for social or political values, such as for the economy, the environment, and for political rights Support for or opposition to the twelve technologies expressed in the context of those broad social attitudes is consonant with the more specific expectations about effects reported on pages 7 to 16 of this chapter. The importance of employment effects, the quality of life, the condition of the poor, the environment, the right to privacy, tax levels, and the United States' international prestige were quite differentially associated with support/opposition to the technologies.

Also variously associated with support for one technology or another were beliefs about the broad social effects of science and technology--the improvement of general living conditions by science and the adverse complications created by technology. Some technologies and not others were associated positively with beliefs that technology made life better Significantly, many of the technologies which, in 1972, were negatively associated with complicating life (i e , were opposed because of that association) were not so perceived in 1974 General anxiety toward *all* technologies appeared to decrease as a more focused concern on the negative impacts of *particular* technologies emerged. This qualified confidence was paralleled by an increase ("recovery," perhaps) of confidence in scientific activities. Together, these changes add another bit of evidence that the public distinguished scientific from technological activities.

Demographic and political correlates of support/opposition show a pattern that runs directly counter to some of the more common assertions about public attitudes toward technology that have found their way into the popular literature. There we are told, for example, that liberals, the poor, the uneducated, and the young hold antitechnological biases It should be clear by now that such generalizations ignore the complex patterns of relationships found in the groups which *do* correlate with that attitude Earlier, in Chapter IV, we presented evidence which showed that liberals evaluate presently implemented technologies differently than do conservatives and that the rich and poor do not view the fruits of technology in the same way. But we found no evidence that age or education made any difference in the way our respondents evaluated present technologies That pattern holds true for their perceptions of future technologies. When we examine the correlates to support/opposition, the fallacy of certain popular generalizations is quite apparent relationships often take other directions than those which the more stereotype-based arguments would lead us to expect Liberals, the young, and the uneducated give more approval to *some* technologies than do conservatives, older people, and the more highly educated. More interestingly perhaps, there is some evidence of increasing polarization over time for the dimensions of age, education, and political ideology. These variables were increasingly important in 1974 in explaining perceptions about future technical developments.

Important implications attach to findings demonstrating that certain of those developments are differentially perceived and that public attitudes toward them have become more coherent and polarized The cohesion of opinion around political ideology and, to a lesser extent, political party, portend growing political controversy over technology Significantly, proponents may not have to seek allies or create new coalitions. They may simply have to turn to former allies in other political battles. Needless to say, such a result can only intensify the milieu of technological politics.

These data have another message for the policy maker and for the advocates of any technical development. They echo a point made in Chapter V· that the public is concerned about the wider range of social values in its consideration of future technological developments But it seems clear, on the basis of our analysis, that these values are not equally relevant to each of the future-oriented technologies Some of them, like urban rails and cable TV, may be so familiar as to fall almost outside the bounds of perception as a debatable issue. Others, such as the STOL aircraft, nuclear generation of energy, the ABM, and the SST, are apparently the object of contradictory values concerns for employment join uneasily with concerns for the environment. Policy makers would miss the point, we think, if they discount the significance of these attitudes on the grounds that such contradiction bespeaks a confused public which neither understands nor cares much about technological development. The overall pattern of data suggests that, quite the contrary, the public is watchful and, while it may not have a very sophisticated understanding of the technicalities of technological development, it is quite concerned about the consequences of that development

For the advocate of technology, either in government or outside it, the data suggest, again, the importance of comprehensible, well balanced programs informing the public about those consequences The potential public clearly evinces differentiated judgments, and they have come to conclusions about the effects of technologies on a range of important political goals Concerns for the effects of certain technologies on privacy and on the environment were quite evident Cable TV was seen to enhance one's privacy; ABM's, STOL aircraft, nuclear generation of energy, and data banks to invade it. Other data suggest that the individual's right to privacy is a keenly important value And judgments were modified between 1972 and 1974 for example, the potential public in 1974 did not associate improved employment with genetic engineering and space travel as they had two years earlier

Whatever the premises for the public's judgments, the data indicate associations were being made Very likely these associations were not all made entirely objectively, perhaps they were even made intuitively; but even if in fact an association is not sensible, it *is* being made If the public's belief is actually unfounded that an association exists between the development of a technology and the difficulty of maintaining or achieving a valued condition, it behooves that technology's advocates to show, if they can, that such anxieties are needless. That effort must include believable descriptions of the likely effects of the new technology in terms of the second order consequences resulting from the particular way industry or government would produce and distribute it Without such a credible balance, we can expect an intensification of the mistrust and cynicism reflected in the data and discussed in Chapter V about the erosion public of confidence in decision makers charged with public policies about technological developments

NOTES

[1]These variables were discussed at length in Chapter VI: the first includes the degree of change perceived by the respondent as likely to occur in his own life and the lives of others; the second, the degree of

certainty with which the respondent perceives that the results of a technological development will be beneficial or will be harmful.

[2]In addition, path analysis can often test the correctness of some of the linkages asserted in the model. See Appendix E for further discussion of this procedure.

[3]These multiple r's were all significant beyond the .01 level of confidence; most beyond the .001 level of confidence. Confidence limits were determined by converting to z scores and then calculating the standard error in $z(\sigma_z)$ based on the equation $\sigma = \sqrt{n-m-1}$, where n is the number of cases and m the number of variables

[4]In Chapter VIII, special attention is given to the energy-specific technologies and to aspects of the energy crisis.

[5]Of the 263 individual correlations reported below in Tables 7-5, 6 and 7, only 62 or 33.6% were from the cross-section samples. This represents a ratio of one cross-section correlation for about every two from the the potential public data.

[6]This opinion marker was derived from responses to items on the survey questionnaire probing confidence in science, such as "Do you agree or disagree that if scientists are given enough money and left alone, they can be counted on to discover things that will make our lives better?"

[7]The correlation between age and self-identified political conservatism for these samples was .25 in 1972 and .32 in 1974.

[8]As indicated in Table 6-1, p 123, using an F test to determine statistical difference, only brain drugs for the total cross section and for the potential public, urban rail, nuclear power, cable TV, brain drugs, *space travel*, and genetic engineering drew significantly different responses between 1972 and 1974.

[9]Another indication of the significance of this change is that there was a statistically significant difference in 1974 between support by the potential public and the rest of the sample.

[10]This change must be interpreted cautiously because of the relatively small sample of the potential public in 1974, particularly with respect to computing the Helpful to Harmful ratio. Over 40% of the samples were uncertain about both Benefit or Harm and these are not included in this measure.

CHAPTER VIII

PUBLIC ATTITUDES AND THE ENERGY CRISIS AN UNEXPECTED DEPTH OF CONCERN

The public's attitudes toward technology form a reasonably consistent pattern characterized by enthusiasms for the benefits of past technological development. As for future-oriented technologies, there are indications of an increasing propensity on the part of the public to distinguish between them on the basis of their expected consequences Further, there is evidence that the public relates technology's consequences to the enhancement of some important social values and not to others, as well as to conditions associated with various political preferences.

Within this overall climate of opinion, attitudes toward the energy technologies, which have been and are likely to be in the future subjected to more than the usual amount of public debate, exhibit several unusual properties This chapter explores public attitudes concerning two energy technologies, along with a number of issues generated in part by the "energy crisis" of 1973-74.

The oil embargo clamped on the industrialized nations of the world in 1973 by the oil producing countries of the Middle East was, for the American people, an abrupt and rude lesson in international dependence, and it sent a shock wave of apprehension and anxiety through the country This crisis precipitated the first national experience of the widespread negative consequences of technological dependence to be felt by the whole population For the first time, people became acquainted with the problems facing a "high technology" society dependent on vast quantities of energy· primarily the difficulties of having continued access to relatively cheap oil. The issues embedded in this problem, while in the making for years, were thrust on the public with considerable force What, then, were people's concerns? What were their beliefs about the energy situation facing this nation, and about the issues which had become associated with energy technologies? Did the crisis prompt changes in the public's perceptions of energy producing technologies?

ENERGY TECHNOLOGIES AND THE CRISIS OF 1973-1974

Technologies associated with the production of energy, unlike space technologies with their boom-and-bust quality, have to varying degrees been the object of continually growing interest since World War II. The quest for unlimited atomic energy has been a public policy issue since that time, with advocates of other energy producing technologies more recently clamoring for a like share of public attention and largesse. Two energy technologies were included in the 1972 survey as representing areas which might become important focal points for public policy regarding technological development--generation of electricity by nuclear power plants and the satellite collection of solar energy to be transmitted to earth for generating electricity. The events of the so-called energy crisis of 1973 accelerated public interest in both these potentials and added an incentive for us to attempt a "follow up" survey. Fortunately, we were able to carry out the TECH II survey, analysis of which enabled us to gain some insight into the reactions of the public to the energy crisis, as well as to monitor responses to those energy technologies which had been included in the TECH I survey.

In the discussion that follows we shall emphasize any changes evident in the public's attitudes toward the two technologies which might be tied in part to the energy crisis. We will also be concerned with understanding the larger context of attitude patterns shaped by that emergency. We assume that the great outpouring of information that accompanied the events of the 1973-74 fuel shortages has had a significant impact on the public's perceptions and its information about energy producing technologies and the sociopolitical context within which they might be developed. The spotlight of concern over the nation's shrinking energy supplies and its dependence upon foreign sources for oil glared into virtually every American household. Changes in public attitudes toward the energy producing technologies included in this survey, then, signal changes in the public's perceptions and evaluations of the issues surrounding those technologies.

In terms of overall public support for the two energy technologies, the 1974 cross-section as a whole responded in much the same way as their counterparts had in 1972. There was a small, but statistically insignificant, increase in support for both technologies (see Table 6-1, p. 123). But this was not mirrored by the potential public combined with the sharp drop in its enthusiasm for urban rail transit, an increase of 45 lifted solar energy technology to the top of the list of support by the potential public in 1974. But that group evinced nearly as sharp a decline in support for the nuclear generation of energy as they did for urban rail transit--some .58 points While the potential public's support for nuclear energy was still well above their advocacy of most of the other technologies, its relative standing fell from second to fourth place.[1]

The attitude pattern for each of the two technologies differed slightly with respect to reported certainties of their beneficial and/or their harmful consequences. For attitudes toward nuclear energy, little change occurred in either the Helpful.Harmful ratio or the ratio of mean certainties as computed either for the whole cross-section or for the potential public (see Table 6-1). Thus the potential public remained consistently somewhat less certain of the benefit of nuclear power than the sample as a whole. Solar energy, however, was perceived by a modestly increased proportion of the whole sample to be certainly beneficial. Here again we see the potential public's response varying somewhat from the larger pattern a small decline from 7.25 to 7.00 is evident in the H H ratio. This decline indicates that fewer people were either "absolutely" or "quite" certain that solar energy technology would result in benefits Even so, this technology had the highest Helpful to Harmful ratio in 1974, due again to the decline in certainties about urban rail transit. The mean degree of certainty ratio, however, *increased* from 1.55 to 1 99, indicating that of those who were certain of solar energy's benefits, more were *absolutely* certain

A plausible interpretation of these data is that, for the general public, both solar and nuclear energy producing technologies maintained their intrinsic attractiveness in the face of the general decline in enthusiasm for technological development And, as can also be inferred from Table 6-1, they came to recognize by 1974 that solar energy would affect people's lives more than they had believed it would in 1972. Given the popular discussions of energy matters stimulated by the 1973-4 energy crisis, such an outcome is quite consistent. But for the potential public's attitude a somewhat different interpretation is called for. This group had always been less sure than the general public about the certainty of benefits from nuclear energy, and, *even in the face of the energy crisis*, their support for this form of energy production dropped significantly by 1974 Solar energy, on the other hand, drew from a substantial portion of the potential public much more certain estimates of benefit, although overall the intensification of this conviction for some was muted by a softening of it for others

Solar and nuclear energy technologies have been touted by their advocates as important to the solution of the nation's energy problems Were the public to become overwhelmingly convinced by these advocates, we would expect that certainties of benefits and/or harmful consequences would be less important statistically in predicting support or opposition Put in generic behavioral terms, when most people are convinced that some particular course of action is a good thing, many are certain of benefits compared to few certain of harm. That is, in a statistical sense, the distribution is so greatly skewed it is likely to lead to substantial error. However, if the consensus is not so clear cut that these technologies are solutions with unmixed blessings, then perceived certainty of their benefits or harms would remain or increase in importance in determining decisions to support or oppose them. The distributions would not be greatly skewed as in the case of a high consensus and would be more suitable for analytical purposes Keeping this reasoning in mind, consider the data in Table 8-1, A. The decline in the correlations between support for solar energy and certainty of its benefit/harm show that this technology was increasingly perceived as an important and desirable thing. Such was not the case, however, for the public's reaction to nuclear energy Cross-section respondents' certainty of benefit rose dramatically by .42 correlation points to r = .62 in importance in

TABLE 8-1

CERTAINTIES AND SUBSTANCE FOR SOLAR AND NUCLEAR ENERGY TECHNOLOGIES (cross-section sample and potential public, '72; '74)

A. CORRELATION OF CERTAINTY/SUPPORT[†] (Pearson's r)	SOLAR ENERGY		NUCLEAR ENERGY	
	'72	'74	'72	'74
Benefit	.61[a] .67	.45 .45	.20 .54	.62 .66
Harm	-.40 -.41	-.22 - 32	-.27 -.54	-.52 -.72
B. SUBSTANCE OF CERTAINTIES[†] (by percent)				
Benefits				
Conserve resources	18%[a] 22	21% 37	19% 29	26% 36
Assure supply	55 60	70 60	54 61	69 62
Reduce pollution	38 40	36 49	39 48	30 40
Harm				
Dangerous	21% *	21% 31	41% 40	68% 59
Too costly	32 60	62 69	* *	* *
Cause pollution[b]	—	—	40 50	30 25
Impractical[b]	14 34	14 21	—	—
Waste disposal[b]	—	—	14 11	28 42

[a]Numbers in top row for cross-section samples; bottom row for potential public.

[†]Correlations from Table 7-1; Substance from Table 7-4.

[b]This harmful consequence perceived for only one of the two technologies.

*Less than 20% responding.

predicting support or opposition. There was a similar though smaller increase in correlations related to the certainty of harm The increase for the potential public was only slight, for the "certainty" variable had already been highly correlated with its support for or opposition to nuclear energy in 1972 These patterns suggest that the energy crisis which stimulated increased information about solar and nuclear energy, coming from both advocates and opponents, resulted in a widening enthusiasm for solar energy and a deepening hesitancy about the use of nuclear power.[2] Do other data corroborate this inference?

The most straightforward reinforcement of this argument is found in the hopes and fears volunteered by people certain of beneficial and/or harmful consequences of these technologies Already set in their broader context in Chapter VII, these data are recapitulated in Table 8-1, B. The increased percentages of people, especially in the cross-section sample, who hoped for assurance of adequate energy supplies seems a clear indication of the influence of the energy crisis and oil embargo on responses about certainty of benefit/harm. Interestingly, the promise of reduced pollution which people associated with these technologies remained more or less constant over the two years separating the surveys

That information from the debates over the technologies was being digested by the public is also indicated by the changes in the number of people perceiving certain harms. The perceived danger of the technologies, especially of nuclear power plants, was increasingly evident and was paralleled by a greatly increased apprehension about the problems of nuclear waste disposal An increased percentage of the whole sample believed solar energy would be too costly, though that concern did not enter into their worries about the development of nuclear power. Finally, less concern was evident about the polluting effects of nuclear energy generation and about the impracticality of solar potentials.

These data suggest that learning had taken place regarding the peculiar aspects of each energy technology and that its effects were mixed, especially in terms of differing perceptions of likely harmful consequences Like variations are echoed in more generalized perceptions of the problems related to developing these technologies and in aspects of the public's responses to the energy crisis.

In the 1974 TECH II survey, a number of questions asked specifically addressed aspects of the energy crisis and some of the issues related to it These questions tapped the kinds of concerns people had about energy matters, opinions as to whether or not the shortages were genuine, whether the oil companies were responsible for them and should be regulated, whether nuclear power plants were safe enough, and finally people's preferences between adequate energy supplies, with the high level of employment it insures, and continued efforts to improve the quality of the environment. Data related to these inquiries will be discussed at some length in the following section of this chapter Suffice it now simply to report in Table 8-2 the salient relationships between them and the degree of support for the two energy producing technologies.

Notable associations between attitudes on those issues and support for the energy technologies were evident mainly in the potential public's responses, and they form an interesting pattern which suggests a distinction between perceptions of the relatively established nuclear power plants and the untried, rather esoteric process of satellite collection of solar energy. Agreement that recent energy shortages were genuine was minimally associated with support for solar energy It was as if support for the new untried solar technology increased in proportion to perception of the situation as serious enough to warrant the risk. Support for nuclear power plants, on the other hand, was much more related to judgments about the safety of the enterprise and to the importance of assured energy supplies and high employment levels even if this meant environmental degradation

Not surprisingly, agreement that nuclear power plants were "safe enough" was strongly associated with support for them Less dramatically related to support for this technology was the conviction that energy supplies and high levels of employment took priority over safeguarding environmental quality On the other hand, the potential public's modest opposition to nuclear development was apparently somewhat related to its tendency to agree that the oil companies were, in part, to blame for the "crisis" and should be more closely regulated by the government.[3] Thus,

TABLE 8-2

CORRELATES OF SUPPORT FOR SOLAR AND NUCLEAR ENERGY TECHNOLOGIES
(Pearson's r; cross-section sample and potential public, '72; '74)

ITEM	SOLAR ENERGY		NUCLEAR ENERGY	
	'72	'74	'72	'74
Energy shortage genuine.	b	*[a] .15	b	* *
Nuclear power plants safe enough.[c]		* *		.53 .55
Oil companies responsible and should be regulated.[c]		* *		* -.14
Energy, employment more important than environment.[c]		* *		.26 .32
Outcome of science.	* *	* .18	* *	* .32
Outcome of technology.	-.27 -.25	-.25 -.27	-.27 -.40	-.15 -.27
Value of scientific activities.	-.25 *	* *	* -.28	* *

[a] Top number for cross-section sample; lower, for potential public.
[b] Space blank indicates question is not asked in TECH I, 1972.
[c] Based on scale of items described below.
* r < .20.

questions related more closely to the *consequences* of the development of nuclear energy, rather than the conditions behind its initial development, were more important in differentiating support from opposition Also, indirect evidence indicates that these two technologies evoked a different perception after the energy crisis had occurred. The last three items on Table 8-2 (data already presented for the potential public in Table 7-5) remind us that support for nuclear energy technology in 1974 was related to a decline in the belief that the outcomes of technological activity complicate live or create too much dependence and to less optimism about the value of unrestrained scientific research activity. But there was some indication from the potential public that nuclear power was associated with the general opinion that the outcomes of science are positive. These changes suggest that the events of the energy crisis urged a reevaluation, at least, of the consequences of energy technologies. Perhaps, on reflection, they seemed less to complicate life; for some, given contemporary events, even capable of reducing its complications. Changes in the data from 1972 to 1974 also suggest that, at least for the potential public, the development of nuclear power might require more regulation of science activities than had seemed sensible to that politically more aware group in 1972. To the extent these inferences are valid, to that extent the energy crisis prompted quite a complex set of responses from the public.

THE CONTEXT OF PUBLIC RESPONSES TO THE ENERGY CRISIS

The rest of this chapter explores aspects of the broader attitude context of the public's reactions to the oil embargo and the energy crisis of 1973-74 The kinds of individual concerns or worry invoked by the crisis are explored first, followed by a discussion of attitudes about the genuineness of the energy crisis and the place of the oil companies in creating it, the issue of the safety of nuclear power plants, and the tension between the production of energy and maintaining high employment levels and continued improvement of the environment. Finally, since the national government has had such a visible role in attempting to cope with the energy situation, we examine the degree to which the public has confidence in its government leaders and examine the correlates to such judgments

THE SCOPE OF PUBLIC CONCERN

It is clear from Table 8-3 that in 1974 relatively few people were really concerned about the short term, "temporarily" inconveniencing consequences of fuel shortages.[4] Only about a fifth of the cross-section sample and the potential public noted the irritations of waiting in service station lines or the discomforts of reduced home heating. And

TABLE 8-3

CONCERNS ABOUT THE ENERGY CRISIS
(cross-section sample and potential public, 1974)

A CONCERN	CROSS-SECTION (n=314)	POTENTIAL PUBLIC (n=137)
1. Waiting in line for gas	20.7%	18.5%
2. Reducing heat in home	18.1	11.3
3. Being laid off from work	29.0	28.1
4. Lowering air pollution standards	41.2	53.9
5. Running out of gas before the end of the century	37.1	40.7
6. People not recognizing the problem and continuing their wasteful habits	70.1	71.8

B	NUMBER OF CONCERNS 0	1	2	3	4	5	6	$\bar{X}$	SD	n
CROSS-SECTION:	5.2%	29.2	34.1	17.8	7.7	2.0	4.1	2.16	1.34	314
POTENTIAL PUBLIC:	2.7	27.4	34.9	18.9	11.2	3.8	1.1	2.24	1.22	122

just a few more were worried about unemployment Rather, the threat of backsliding on environmental quality, the longer range worries of fuel depletion, and continued individual energy wasteful behavior were more on the public's mind This concern for the longer range outcome was especially evident in the 70% of the whole sample and the 72% of the potential public who were quite disturbed that others would not recognize the situation as serious enough to warrant changes in their energy use habits. Such large proportions of respondents voicing this concern about their fellows may in and of itself be an indication that prospects are good for conservation efforts in individual energy consumption patterns * Prospects for change in individual consumer behavior would,

*It should be remembered, of course, that these responses were made in mid-1974 and may have changed or intensified in the past year and a half as a consequence of the increased and sustained attention to energy related issues.

of course, be enhanced by a general conviction on the part of the public that the energy crisis was actually genuine and indicative of a long term problem. To what degree was the crisis believed in 1974 to be genuine?

From the data summarized in Table 8-4, there appears to have been mixed judgments on this matter. As a group, our respondents agreed *both* that "the energy shortage is genuine and will be with us for a long time" *and* that "the energy shortage has been mainly created by the oil companies in order to make greater profits." Agreement with the first assertion is consistent with the large proportions who worried about wasteful behavior and with the third of the sample worried about running out of petroleum by the end of the century * The second, more cynical, belief ran parallel to an assertion with which about two-thirds of the sample agreed, namely that "government is run by a few large interests looking out for themselves."[5]

To what degree are the two responses contradictory? If the energy shortage was genuine and a long term problem, can it also have been contrived by the oil companies? The high proportions of the sample agreeing with *both* assertions obviously suggest that many people felt that although the oil companies had to a significant degree exacerbated the problem of recent shortages, the overall energy situation was in fact a complex, longer term problem. But to some degree the two assertions in question also represented the opposed judgments of two different groups. Significant portions of our respondents held one belief, which, as is more to be expected, made another belief less credible positive responses to one of these assertions correlated negatively with positive responses to the other--r = - 27 for the potential public (see Table 8-5 on page 196).

Over 87% of the sample agreed that "we need stricter government control over the petroleum industry to prevent future shortages " The correlation between this belief and agreement that the oil companies were mainly responsible for the "crisis" was reasonably high r = .32 for the cross-section, .58 for the potential public. Increased regulation as a

*For the potential public, there was an r = 31 between belief in a genuine shortage and noting a concern about wasteful behavior.

means of assuring fuel supplies was somewhat more favorable to liberals than to conservatives; correlation between liberal ideology and favoring increased regulation was r = .22 for the public-at-large and .36 for the potential public Data related to agreement that the oil companies were mainly responsible for the fuel problem and that control over them should be increased were combined to form the "Oil Companies and Energy Crisis Scale" noted in Table 8-4 [6]

ISSUES ASSOCIATED WITH THE ENERGY CRISIS

The context of the public's response to the energy crisis includes in part its collective judgments about the promise of the energy technologies in solving overall energy problems and the priorities the public feels committed to in pursuing a solution. In addition, there is the matter of underlying public confidence in the government's veracity in informing its citizens and its dependability in representing them as the search for improved energy conditions continues.

Two questions, combined in a "Nuclear Safety Scale" probed the degree to which the public believed that nuclear power stations were safe enough to continue developing [7] As Table 8-4 suggests there was moderately widespread agreement throughout the sample that nuclear power stations were, indeed, safe enough This judgment is consistent with the relatively high level of support for the nuclear generation of power reported in the previous chapters.

Questions directly related to the difficult business of tradeoffs in finding solutions to our energy problems were combined in an "Energy/Employment Over Environment Scale " The first question concerned the priority that should be given to assuring energy supplies, even though the expansion of coal burning, steam generators, and of course nuclear power stations, might further erode the quality of the environment. The other question concerned the potential reduction of industrial jobs if environmental standards were rigorously imposed on the development of energy potentials [8] Overall, our respondents were almost evenly divided on these matters, with a significant portion of the sample agreeing that the protection of the environment should be given a higher priority than either providing dependable energy supplies or maintaining high employment levels. While the strength of agreement dropped for the item which included potential job loss, the overall resolve to continue improvement of the quality of air and water was striking. This response suggests the degree to which the public has become committed to the reduction of pollution and other environmentally damaging activities and is quite consistent with other data reported in Chapters VI and VII on the perceived importance of environmental effects.*

Finally, an attempt was made to determine the level of public trust in government leaders and elected officials Questions were put which baldly asked people if they thought their government leaders always tell them the truth and if most elected officials can be counted on to work for the things which people really believe in [9] As Table 8-4 indicates, overwhelming distrust of government leaders, elected or not, was evident, this low confidence follows the trend reported by many recent polls that have charted such disenchantment with the country's leaders.

Thus far, our analysis of the context of responses to the energy crisis can be summed up as follows both the public-at-large and the potential public for technological politics appear to be quite concerned about the longer term problems of energy resources They believed the shortages experienced in 1973-74 to have been genuine and to signal long term problems At the same time, they held the oil companies, in their pursuit of profits, responsible for making the situation worse in the short run, and they tended to opt for more strict controls on them to prevent future shortages Both nuclear and solar energy technologies continued to be seen favorably, with a good deal of confidence expressed that nuclear power plants are safe enough for continued development. Solar energy was perceived even more hopefully in 1974 after the crisis. The public was nearly equally divided in terms of priorities on the issue of whether or not environemntal quality should be placed ahead of expanded energy generating capacity and high employment levels Over 45%

*For the potential public, there was an r = .47 between asserting environmental priorities and noting a concern for "lowering air pollution standards "

TABLE 8-4

PERCENTAGE DISTRIBUTIONS FOR ENERGY RESPONSE CONTEXT FACTOR
(cross-section sample and potential public, 1974)

	STRONGLY DISAGREE 1	2	AGREE/ DISAGREE 3	4	STRONGLY AGREE 5	MEAN	STANDARD DEVIATION	N
Energy shortage genuine	15.9%[a]	17.1%	6.8%	36.5%	23.7%	3.35	1.42	298
	12.7	16.7	3.0	38.4	29.2	3.55	1.40	120
Oil firm and[b] energy crisis scale	12.2	19.0	—	33.4	35.4	2.92	1.02	310
	17.4	16.1	—	33.3	33.2	2.82	1.08	121
Nuclear safety scale	12.2	17.7	22.8	20.7	26.7	3.32	1.36	303
	15.8	16.6	17.7	21.6	28.3	3.30	1.44	118
Energy/employment: environment scale[c]	20.4	20.8	19.0	28.4	11.4	2.90	1.33	287
	27.3	22.0	16.2	17.7	16.8	2.75	1.46	115
Trust in government scale	32.4	21.4	18.3	18.5	9.4	2.51	1.36	314
	27.5	23.3	15.3	20.8	13.0	2.68	1.41	122

[a] Top figure for cross-section sample; lower for potential public.

[b] Only four point scale.

[c] Indicates agreement that energy expansion and keeping jobs should have priority over controlling pollution.

TABLE 8-5

CONTEXT OF THE ENERGY CRISIS, 1973-1974
(Pearson's r; cross-section sample and potential public 1974)

ITEM	ENERGY SHORTAGE GENUINE	OIL COMPANIES/ ENERGY CRISIS	NUCLEAR SAFETY SCALE	ENERGY/EMPLOYMENT OVER ENVIRONMENT
Energy Shortage Genuine	-- --			
Oil Firms and Energy Crisis	-.21 -.27	-- --		
Nuclear Safety Scale	* *	-.18 -.22	-- --	
Energy/Employment over Environment	* *	-.19 -.41	.28 .44	-- --
Trust Government Officials Scale	.29 .30	* -.24	* .30	* .28

[a]Top figure for cross-section; lower for potential public.

*r < .20.

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government control over them It was as if these people shied away from making too much of the oil companies as "fall guys" in the crisis--perhaps because they saw a certain amount of scape-goating in hasty attributions of cause and felt it to be counter productive to making real progress toward creative solutions to the energy problem. Also evident is a moderate correlation, for both the whole cross-section and the potential public, between the conviction that nuclear power plants are safe enough and that pollution control should take precedence over energy development. This relationship is consistent with the positive association between support for nuclear energy technology and the Energy/Employment vs. Environment Scale discussed earlier (see Table 8-2).

C.3

of the potential public hold strongly to environmental priorities even in the face of energy needs. All this is to be considered in the context of the widespread and fairly intense distrust of government just reported

Within that mass of attitudes are there points of reinforcement or contradiction? Table 8-5 presents the matrix of correlations among the five scale variables discussed thus far The pattern which emerges presents some interesting combinations and suggests, again, that attitudes of the potential public are more integrated than those of the larger group. Consistent relationships occurred between the degree to which the potential public distrusted governmental leaders and the several energy crisis response indicators. The implications of these relationships are important because of the highly visible and assertive role the government has attempted to play in dealing with the many aspects of the energy crisis The more trust there was toward government leaders, the more tendency there was to believe that the energy crisis was genuine, that nuclear power stations are safe enough, that environmental priorities should be maintained in the face of energy needs, and that the oil companies were not largely to blame for fuel shortages and should not be held in check. But recall that over half the sample was *not* disposed to trust or have confidence in governmental officials. Then, the force of these associations runs in the other direction. Those who *distrust* governmental officials tended to agree that the energy crisis was not genuine and that oil companies were to blame, that nuclear power plants are not safe enough and that energy supply and employment should take priority over protecting the quality of the environment.

The inverse relationship between believing the energy crisis genuine and attributing responsibility to the oil companies has already been noted There is a similar relationship between perceptions of the oil companies' responsibility and both belief in safe nuclear power and in the priority of environmental quality over energy development. That is, those who believed nuclear power plants were safe enough and those who deemed environmental needs equal to or ahead of energy and employment matters tended to see the oil companies in a more favorable light with respect to their part in the energy crisis and to be dubious about increasing

The data then present a pattern of moderate association between support for the development of nuclear technology and concern for environmental quality in the responses of those uneasy about overreacting to the oil companies' activities before and during the energy crisis. At the same time there is sufficient distrust of government to increase the difficulty for both advocates of nuclear power and of improved environmental standards alike in working through the established organs of government to gather public support for their programs. Do other data further enrich our understanding of the context of public response to the energy crisis?

POLITICAL CORRELATES IN THE CONTEXT OF THE ENERGY CRISIS

Associations of responses to the issues surrounding the energy crisis and development of energy technologies as potential solutions with people's political attitudes weave an increasingly intricate pattern of meaning Their understanding of those technologies is linked to the beliefs they hold and the judgments they make Table 8-6 summarizes these associations between three main issues* and the perceptions of the two energy producing technologies and of the antiballistic missile system (ABM) The ABM data is included because this technology seems to be moderately associated by the public with nuclear energy, perhaps on the grounds of their mutual radioactivity [10]

Responses to solar energy technology differed characteristically from responses to nuclear energy technology insofar as association with judgments about the oil companies' responsibility for the oil crisis is concerned those few who were certain that harmful consequences would result from solar energy development tended to agree that the oil companies had intensified the crisis But those who estimated considerable impact upon themselves or others as a consequence of solar technology were dubious about the oil companies' role in creating the shortages. These respondents in the potential public also tended to support both

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*Associations between the variables and the "energy shortage is genuine" item were limited to support of solar energy already reported.

TABLE 8-6

PERCEPTIONS OF ENERGY-RELATED TECHNOLOGIES AND THE CONTEXT OF THE ENERGY CRISIS
(Pearson's r; cross-section sample and potential public, 1974)

ATTITUDES TOWARD TECHNOLOGY	OIL COMPANIES & ENERGY CRISIS	NUCLEAR SAFETY	ENERGY/EMPLOYMENT OVER ENVIRONMENT
Solar Energy			
Impacts of Self	-.34[a] -.26	* *	* *
Impacts of Others	-.35 -.23	* *	* *
Cert. of Harm	* .29	* *	* *
Nuclear Energy			
Support	* -.21	.53 .54	.26 .29
Impact of Self	-.21 *	* *	* *
Cert. of Benefit	* *	.48 .50	* .32
Cert. of Harm	* *	-.51 -.54	-.36 -.40
ABM			
Support	* *	.29 .53	* .38
Impacts of Self	* *	* .25	* *
Impacts of Others	* *	* .22	* *
Cert. of Benefit	* *	.22 .42	* *
Cert. of Harm	.21 .32	-.29 -.45	-.30 -.44
Atomic Bomb Beneficial	* *	.31 .34	.24 .42

[a]Top figure for cross-section sample, lower for potential public.

*r < .20.

nuclear energy development and the ABM, those who opposed these developments tended to blame the oil companies for the energy crisis. Again, those certain of harm from the ABM also believed the oil companies culpable It was as if indirect hostility to industrial technology encompassed both space and weapons development More speculatively, the bits of data relating impact on self and on others with less certainty about the oil companies' adverse role may reflect a kind of feeling that "if big business is involved, we hope it won't be harmful to us "

In terms of the other issues concerning nuclear power plant safety and the tradeoff between environmental integrity and energy-and-employment, similar patterns emerged for the ABM and nuclear energy technologies Those who believed that nuclear power plant developments were safe enough also tended to strongly support nuclear energy development and the ABM In part this relationship was due apparently to consistent tendencies associating confidence in nuclear plant safety and certainty of benefits for both technologies. Of course, the obverse was also the case; those who were certain of harmful results from either the ABM or nuclear power generation did not have much confidence in plant safety And the potential public evinced moderate association between plant safety and estimates of the ABM's strong impact on themselves and others

A less extensive pattern was found in the data regarding the tradeoff between energy and employment and environmental quality. In this case those who rated energy and employment over pursuit of environmental quality were in favor of the development of nuclear energy and the ABM And, as might we expect, those certain of harm resulting from the two technologies disagreed that energy development should be placed above continued efforts to improve the environment.

A relatively close association between both aspects of nuclear development--that designed for peaceful energy production and that geared to military use--seems to exist in the public mind. The relatively high associations between judgments on nuclear power plants and the ABM and positive evaluation of the consequences of the atomic bomb[11] would appear to characterize a kind of atomic era syndrome.

Our discussion of the context of public responses to the energy crisis concludes with an examination of the associations between the attitudes toward various issues related to the crisis and more general attitudes toward technology and political values and characteristics The potential public again provides distinctive clusters of associations around the four issue areas used for analytic purposes here genuineness of the energy crisis, oil company responsibility, nuclear safety, and the energy/employment-environment trade-off. As shown in Table 8-7, the two general attitudes regarding the regulation of technology and the belief that the outcomes of technology complicate life and induce too much dependence on technology were consistently related to those issue areas Those in the potential public who felt more regulation of technology was sensible tended to question whether the energy shortages of 1973-74 were genuine and to believe that nuclear power stations were safe enough. This suggests a tendency to believe that the regulation of technology would not ultimately cripple the development of nuclear energy and therefore could improve the energy resource situation At the same time, those in the general public who felt that technology complicated life did not agree that nuclear power plants were safe enough, their counterparts in the potential public tended to believe that the oil companies exacerbated the crisis. To contrast the positive associations between the Regulation-of-Technology scale and Nuclear Safety scale and the Energy/Environment scale with the negative associations between these latter scales and the Outcomes-of-Technology scale hints at the possibility of a division within our samples We do see a politically oriented division emerging when political characteristics and social and political values are considered.

The three political orientation variables reported in Table 8-7 indicate important differences between responses to these issues by conservatives and liberals and by Republicans and Democrats. It is clear there was a consistent division of opinion in liberals and Democrats, especially those in the potential public, who tended to believe both that the energy crisis was genuine in the long run *and* that oil companies were responsible for its short term intensity They also judged that nuclear

TABLE 8-7

POLITICAL AND ATTITUDINAL CORRELATES IN THE CONTEXT OF THE ENERGY CRISIS, 1974
(Pearson's r; cross-section sample and potential public, 1974)

INDICATOR	ENERGY SHORTAGE GENUINE	OIL COMPANIES/ ENERGY CRISIS	NUCLEAR SAFETY SCALE	ENERGY/EMPLOYMENT OVER ENVIRONMENT
Regulate technology scale	*[a] -.25	* *	* .25	(.21)[b] *
Outcome of technology	* *	* .20	-.24 -.34	* *
Political party	* *	.27 .38	* *	* *
Party ideology	* *	* .36	-.30 -.34	* -.34
Party/ ideology typology	.33 .24	.37 .43	-.21 -.27	-.22 -.52

[a]Top figure for cross section; lower for potential public.
[b]r is for the Regulate *Science* Scale.
*r < .20.

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power stations were not safe enough and held that increased energy supplies and employment should not necessarily be put ahead of improving the environment More conservative (and Republican) citizens, conversely, were not sure the energy crisis was a long term problem, nor that the oil companies were to blame or should be regulated. On the other hand, they were more confident that nuclear power stations were safe enough and that energy needs should be allowed to take precedence over environmental quality

These associations were reasonably strong, especially in regard to the policy matters of the trade-offs between energy and employment and the environment. They signal a relatively high degree of partisan difference in 1974 over this issue The character of this division is shown, in part, by the strong correlations between agreement that energy should have a higher priority than environmental concerns and various social/political values already discussed in previous chapters. Table 8-8 shows the relationship between these sociopolitical values and opinions about energy and environmental priorities, political ideology, and the party/ideology typology established for previous analytic contexts. It is clear from these data that a relatively sharp division existed between those who believed effect on employment and taxes should be a major consideration in decision making about technology and those who are very concerned about the environmental problems.[12] Again, we see the quite systematic distribution within the potential public. Combined with the relatively high correlations between ranking environmental concerns highly and liberal political commitments compared to the concerns of those with conservative political persuasions, there is an obvious pattern of partial polarization To what degree this has increased, remained the same, or decreased as a consequence of recent discussions about the environment is, of course, impossible to determine, though the question is one of the most intriguing to emerge from these data.

TABLE 8-8

ENERGY VS. ENVIRONMENTAL PRIORITIES AND
SOCIOPOLITICAL VALUES AND POLITICAL IDEOLOGY
(Pearson's r; cross-section sample and potential public, 1974)

VALUES[b]	ENERGY/EMPLOYMENT OVER ENVIRONMENT	POLITICAL IDEOLOGY	PARTY/IDEOLOGY TYPOLOGY
Employment	.23	*	*
	.21[a]	*	-.24
Environment	-.37	.34	*
	-.23	*	.28
Taxes	.24	*	*
	.46	-.26	-.27

[a]Top figures for cross section; lower for potential public.
[b]See discussion in Chapter V.
*$r < .20$.

SUMMARY

The public's experience during the oil embargo and energy crisis of 1973-74 evoked a complex set of reactions to the issues surrounding the fuel shortage and apparently stimulated significant changes in the public's evaluation of two important energy producing technologies--solar energy collected by satellite and the nuclear generation of electricity. Both the public-at-large and the potential public expressed strong concerns about the long term seriousness of the energy situation and tended to believe that the energy crisis was genuine and signalled long term problems. At the same time, there was considerable feeling that the oil companies, in their pursuit of profits, acted so as to exacerbate the problems in the short term. Stricter government controls over the petroleum industry appeared to be desirable to a majority of our respondents. Both of the energy producing technologies continued to be seen favorably in 1974. Solar energy was perceived more hopefully in 1974 after the fuel shortages, nuclear energy, while still drawing strong support, was seen as more problematical than in 1972. There was a good deal of confidence, in 1974, that nuclear power plants were safe enough to be built, although there was a greatly increased concern about the problems of disposing of radioactive wastes and the overall danger posed by nuclear reactor developments

The public was nearly equally divided in its consideration of the tradeoff between assuring adequate energy supplies and maintaining employment level, on the one hand, and continuing to protect the quality of the nation's air and water on the other Other 45% of the potential public held strongly that environmental priorities should prevail over energy supply needs--even in the face of the clear demonstration that supplies might be sharply reduced

This division was reinforced by the belief, on the part of those who held priorities of energy over improvement of the environment, that nuclear power plants are safe enough and that the oil companies were not particularly culpable in circumstances attending the energy crisis This belief tended to be reversed for the environmentally minded. Underlying these attitudes, sufficient distrust of governmental officials (related to these issues) reduced the effectiveness for both the advocates of nuclear power and of environmental quality improvement, of turning to government in mobilizing support for their programs.

Finally, a degree of partisan and ideological identification is detectable in responses to some of the issues concerning the energy issue. This is mainly evident with regard to self-identified liberal or conservative pursuasions. Thus, these issues may be emerging as politicized ones; conservatives more than liberals favor high energy availability and employment levels over environmental protection, and more conservatives than liberals are reasonably sure that nuclear power developments are safe enough to continue expansion. On the other hand, conservatives were less sure than liberals that the energy crisis was genuine and that the oil companies should be blamed or subject to stricter regulation With only one slice in time represented by the data from this part of the survey, it is impossible to say with high confidence that such apparently emerging trends are evidence of an ideological polarization. But it seems a distinct possibility This question raises many other intriguing ones for further investigation.

NOTES

[1]This decline was one of four statistically significant decreases in support between 1972 and 1974.

[2]Regression analysis yields results consistent with this interpretation. See Table 7-2, page .

[3]This instance of distrust of the oil companies may be due in part to a fairly strong association with liberal political ideology, typically anti-big business. See Table 8-7, page 201 below.

[4]The particulars of people's energy concerns listed in Table 8-3 were framed as follows in the 1974 questionnaire: "During the last few months people have started to think about energy and the part it plays in their lives. Some people are not concerned about the situation; others are. Which of these things really concern you?..." Compare J.R. Murray, *et al.*, "Evolution of Public Response to the Energy Crisis," *Science* 184 (April 19, 1974), 257-263.

[5]Correlations between these items was r = .36 and .41 for the cross-section samples and the potential public respectively.

[6]Correlations of the first of these items with the scale were r = .78 for the cross section and .87 for the potential public; correlations of the second item were .87, for the cross section and potential public both.

[7]Exact wording was "Do you agree or disagree that atomic power plants are safe enough so that one need not worry about them exploding or leaking radiation?" and "Do you agree or disagree that even if atomic power plants are not 100% safe, they are safe enough for us to go ahead and build them?" Correlation of the first question with the Nuclear Safety Scale was r = .89 for the cross section and .90 for the potential public.

[8]Both questions were in a modulated forced-choice format. Respondents were asked to indicate how closely their own opinion was to one or the other of two mutually contradictory statements. Exact wording of the questions was (1) "We should not allow our growing need for energy to cause any slowdown in controlling pollution and improving the quality of the air and water" OR "If it comes to a choice, our need for energy has to come ahead of an all-out emphasis on the quality of air and water." (2) "We must produce enough energy to keep the factories going and people on the job even if it means more pollution of the air and water" OR "We should not allow any further pollution, even if some people lose their jobs as a result of the energy shortage." Correlations of the Energy/Pollution item with the Energy/Environment Scale were r = .79 for the cross section and .84 for the potential public; correlations of the Energy/Employment/Pollution item with that scale were r = -.77 for the cross section and -.86 for the potential public.

[9]Exact wording was (1)--(forced-choice format)--"Our government leaders usually tell us the truth" OR "Most of the things that our government leaders say cannot be believed"; (2)--(agree/disagree format)--"Do you agree or disagree that most elected officials can be counted on to work for things which you really believe in?" The correlations between responses to (1) and the Trust-In-Government Scale were r = .76 for the cross section and .79 for the potential public; to (2), they were r = -.65 for the cross section and -.67 for the potential public.

[10]Correlations between support for the ABM and nuclear energy in 1972 were r = .27 for the cross-section samples and .25 for the potential public; in 1974 they were r = .20 for the cross section and .35 for the potential public

[11]Item used in Present Technology Evaluation Index, discussed in Chapter III.

[12]Correlations between high rankings of tax and employment concerns were r = .22 for the cross section and .36 for the potential public;

between high rankings of environmental and employment concerns they were r = -.27 and -.42 respectively. The correlation between high ranking of environmental and tax concerns was r = -.27 for the cross section.

PART FOUR

A WARY PUBLIC AND THE POLITICAL CONTROL OF TECHNOLOGY

In the final section of this report, we will draw together the many premises, findings, and inferences from preceding chapters and from them attempt to frame a coherent statement (albeit an incomplete one) of how such evidence bears on the major issue of the political control of technology. In Chapter IX we return to a theme briefly outlined near the beginning of this book two opposed perspectives on the future control of technological development. One of these, typically American, voices an optimistic confidence in incremental decision making, the other is cast in the much more sombre tones of European pessimism. Together, these two perspectives capture the extremes of thought currently dominant in addressing the challenge with which a technological society confronts its political decision making processes. So that an empirical test of the assumptions underlying these viewpoints may be made, key elements within each of them are recapitulated and extended. Chapter X concludes the study by gathering together the major findings to emerge from the TECH I and TECH II surveys and discussing some research and policy implications which we believe derive empirically from those results

CHAPTER IX

THE POLITICS AND BEHAVIOR OF TECHNOLOGICAL DISSENT

Technological innovations have almost always been met with enthusiastic acceptance in the United States For the last century and a half, an "ideology" asserting that technological development holds the key to progress has flourished.[1] Both foreign and domestic observers have often sought out the roots of this ideology and commented upon the profound commitment of the American people to it. For example, even as early as 1830 Alexis de Tocqueville was struck by the preoccupation of the men of democracy with "practical applications of science " He noted that for those people, "every new method which leads by a shorter road to wealth, every machine which spares labor, every instrument which diminishes the cost of production, every discovery which facilitates pleasures or augments them, seems to be the grandest effort of the human intellect "[2]

Encountering virtually no resistance, new technological systems were implemented which have affected practically every portion of society Historians have documented, for example, how a system of slavery was made "economical" as a consequence of the cotton gin,[3] we have seen how the primary capacities of the railroads enabled the pioneers to push back the wilderness,[4] how automobiles have increased personal mobility and transformed cities,[5] and how large data processing systems have organized and analyzed masses of information at rates heretofore unimagined.[6]

Undesirable consequences have often accompanied such technological feats, although until recently the benefit of such developments by far seemed to outweigh the untoward results they also prompted But with growing frequency during the last ten years concerns have arisen about the increasingly evident negative impacts of technological systems on the environment, on public safety and health, and on the overall quality of life. Such consequences of technical developments were probably entirely unanticipated at the time they were innovated They are unfortunate surprises with which society must cope, long after substantial societal investments and adjustments exacted by the particular technology have been made

One reason why these unpleasant surprises come along is simply the limitation of man's vision.[7] But (as we argued in Chapter I) another, equally basic, reason for undesirable outcomes is the increase in organized social complexity which technology stimulates.[8] Previously disjunct sectors of society have merged into new networks of interaction, prompted, among other things, by the new capacities they provide and by the immense infrastructures necessary for their successful application This increased systemic complexity reduces the possibility for accurately anticipating the consequences of social action Cause and effect reasoning is often confounded even in the short term by the actualities of highly complex systems. Long term predictions are subject to even greater error One can only assume that a proliferation of unforeseen technology-induced negative consequences will follow in the wake of future efforts to prevent other such consequences.[9]

How then should we proceed? Neither resignation nor a neo-Luddite shut-down are attractive options The key may be in finding a suitable point of balance between the relatively probable and the uncertain,[10] for even small shifts in the degree to which uncertainty is discounted can have important consequences for policy outcomes. But how successful can we hope to be in preventing technology's unanticipated consequences? And what kinds of attitudes on the part of the public would be likely to foster any such success?

Among the many commentaries on the problem of the future impacts of technological development two of the most comprehensive arguments stand out as representing extremes of opposed thought on the subject. The first relies heavily on the case made by pluralist-incrementalists--that through constant monitoring and readjustment of policy, mistakes can be caught and corrected in time. The second theory, to the contrary, holds that a self-moving, automatic acceptance of the "one best way" so conditions decision makers to discount the uncertain and the unquantifiable that society is inevitably condemned to harmful technological surprises, whose amelioration must be bought at the price of successive harmful surprises. The two theories make diametrically opposite predictions about the outcomes of technological decision making. This chapter explores these predictions in detail, distilling from them a firm set of fundamental propositions which can be tested and the future implications of which assessed.

TWO PERSPECTIVES

The case for incremental policy making as determined by pluralist interactions has been argued by numerous students of American politics [11] Two interesting works have succinctly adapted these arguments to technological decision making. A report on technology assessment prepared by a panel selected by the National Academy of Science for the House of Representatives argues that all possible means of reducing the costs (negative consequences) of errors should be explored beforehand in assessing the impact of technology and making choices as to how we implement new possibilities [12] We should, for example, favor technologies which allow maximum room for future incremental maneuvering to correct any deviations from the desired course of events "The reversibility of an action should be counted as a major benefit, its irreversibility, a major cost "[13]

The most innovative proposal made by the NAS panel is its recommendation that decision making about technology be brought directly into the political process They suggest that debate range over the following issues (1) whether the costs of uncertainty prompted by the effects of a new technology--delays and loss of profit for backers of the innovation, "negative externalities" for the public--should be paid by its proponents rather than by the larger society; (2) the necessity of devising alternative modes of implementing technologies, so as to circumvent the negative effects inherent in any one. The report recommends that these and similar issues be considered in a political forum which includes strong constituencies representing varied values and that an independent study of all issues be undertaken, to make available to that forum information from which it can draw its factual premises

Paul Goodman, whose political philosophy often seems at odds with that of the NAS panel members, reaches much the same conclusions in his prescriptions for a more humane technology. In addition to endorsing the same reversibility criterion, Goodman calls for prudence and humility on the part of technologists, cautioning them not to oversell technology and to resist the temptation to apply every new technical device without a second thought. Much as the NAS panel does, he recommends as a practical matter adhering to the criterion of reversibility. Acknowledging that at its root his "bias is pluralistic," Goodman argues that increased knowledge, coupled with active participation by affected groups, offers the best hope for achieving a humane technology.[14]

A very different perspective, one rooted deeply in the European tradition, is taken by Jacques Ellul He argues that man's absorption of technique advances inexorably, moved by an internal logic not amenable to human control, a logic that pushes aside vital human values like sponaneity and freedom.[15] Ellul's theories have evoked widespread and intense interest among intellectuals. In William Kuhns' words, they are "a trenchant statement, the boldest yet to interpret the growth and significance of technology as a whole."[16] Certainly, Ellul does weave an apparently consistent logic, bolstered at virtually every turn by historical and contemporary illustrations of his point. While any summary of his argument fails to capture adequately its nuances and thematic intensity, his basic position can be reconstructed.

Two fundamental claims about the characteristics of technology lead Ellul to his pessimistic conclusions. The first is what he terms "the automatism of technical choice," the absolutism of the *one-best-way* "When everything has been measured and calculated mathematically so that the method that has been decided upon is satisfactory from the rational point of view, and when, from the practical point of view, the method is manifestly the most efficient of all those hitherto employed or those in competition with it, then the technical movement becomes self-directing "[17] No human choice can really exist when it is preceded by a fundamental belief in the desirability of the most efficient, "one best" way. "The human being is no longer in any sense the agent of choice. Let no one say that man is the agent of technical progress and thus it is he who chooses among possible techniques. In reality he neither is nor does anything of the sort. He is a device for recording effects and results obtained by various techniques. He does not make a choice of complex, and, in some ways, human motives He can decide only in favor of the technique that gives the maximum efficiency."[18]

In addition to automatism, Ellul posits a second deterministic quality of technique. its self-augmentation--by which technology is implemented without decisive intervention of man The key element in this characteristic is man's notion of a "technological fix." Technology is viewed as posing, in its development, primarily technical problems which can be resolved simply by additional doses of technology. Recall the example of the spiral of technology's self-augmentation which, in Chapter I, we used to illustrate the "technological fix" Convenient and "efficient" garbage disposal units are invented, their products pollute rivers The rivers are purified by the addition of bacteria, these bacteria kill the fish, etc., so the rivers must be reoxygenated by other technical means. .The process is a dead-end of new negative effects generated by technical attempts to quell previous ones

Ellul is not sanguine about any escape ever from this continuous spiral of technical application, the creation of problems, and further application of technique He believes that while some things may change, it is unlikely that mankind will ever be able to extricate itself from the vortex That conviction is not based upon the premise that the world is made up of naive cost benefit analysts nor even that it is impossible to satisfice or even maximize several values/conditions simultaneously. Rather, an assumption of human analytical inadequacy underlies Ellul's dire prediction. On its face, that assumption is also made by the NAS panel and Goodman, they too acknowledge the impossibility of foreseeing all the consequences of technical actions For Ellul, however, this human inadequacy forecloses the choice of "ends " A technical solution can never be devised by man, for surprises will always follow in its wake

Moreover, the possibility of reversing a technique does not mean that its problems can be avoided Of course, it is possible, Ellul allows, to abandon a technique when it proves to have deleterious effects. But he believes that "by the time a technique is modified in the light of those effects, the evil has already been done. When it is proposed to 'choose' between effects, it is always too late It is doubtless still possible to modify any given element, but only at the price of [added] secondary repercussions."[19] But more importantly, even if a technique were modified, it would be as a consequence of some new technical "advance " The sociology of technological implementation--characterized by demands for solutions to the rapidly evolving and immediate problems as well as by the urgency for industry to recoup expenses and make technology "pay off"--would seem to necessitate this process. We then come back to the cycle of implementatation and "correction" described above, which perpetually compounds the initial technology-induced problem.

In the Ellulian world, man does not choose; he calculates. Man does not weigh the benefits of technology's primary capacity; he invariably "takes advantage" of them In so doing he activates successive generations of technological problems and becomes hopelessly entrapped in the morass of technique This principle of self-augmentation leads to "the autonomy of technique the complete separation of the goals from the mechanism, the limitation of the problem to the means, and the refusal to interfere any way with efficiency."[20]

In two senses does the autonomy of technique render human autonomy and free will inoperative. First, the notion of the one-best-way implies that modern man cannot choose his means any more than, given his analytical inadequacy, he can choose his ends. Second, and even more ominous, man cannot be *responsible*. The rationality of calculation requires that all the input and output factors, including the human element, be predictable As Ellul puts it, "The combination of man and technique is a happy one only if man has no responsibility " Responsibility would oblige him to make choices, the outcomes of which are unpredictable and would subject him "to motivations which invalidate the mathematical precision of the machinery ..technique requires predictability and no less, exactness of prediction It is necessary, then, that technique prevail over the human being For technique is a matter of life and death Technique must reduce man to a technical animal, the king of the slaves of technique Human caprice crumbles before this necessity, there can be no human autonomy in the face of technical autonomy."[21] In short, the technological phenomenon requires that human behavior become standardized. Man can no longer be allowed spontaneity and diversity of behavior--these things generate noise in the system.

Ellul's theory of how the "one best way" is calculated assumes the same constraints common to any decision making. the absence of a long-term orientation, values which cannot be quantified, the immediacy of problems to be solved, and the urgency of economic considerations In the Ellulian scheme, however, the decision maker must of necessity simply discount the uncertain, the long-range, and the unquantifiable as the only rational way to proceed. Not out of malevolence, therefore, but because of "rational efficiency," Ellul's decision maker cannot include moral considerations in his decision making.

A BASIS FOR TESTING THESE OPPOSED THEORIES

The empirical content of the two theories just discussed overlaps at some points and conflicts at others Both focus on the impossibility of fully anticipating consequences of technology which can change looked-for benefits into negative surprises. Yet the two theories make dramatically different, mutually contradictory predictions. The NAS/Goodman perspective leads us to expect generally continuous progress predicated on thoughtful action, constant monitoring and, when necessary, retrenchment, mitigation and amelioration Ellul's conceptualization posits a dynamic immune to any such error-correcting mechanisms. Each school of thought proffers illustrative evidence which makes an apparently prima facia case for its validity

These theories hold implications for the behavior both of policy makers and of citizens The NAS/Goodman perspective signals that we need to increase our attention to decision making processes only enough so as to assure the representation of all those groups which might be substantially affected by the implementation of particular technologies. The Ellulian perspective, on the other hand, counsels a much more radical course of action: alteration of basic perspectives guiding institutional decision processes which determine what value preferences will be served by the results of technological development It behooves us therefore to take stock of what data can be marshalled to establish more clearly which, if either, perspective catches more of the situation actually prevailing How might we begin to disconfirm the predictions of either one?

The divergence in their predictions is linked to different views of how people relate to technology and how they reach decisions with respect to its implementation. To the extent that people behave as calculators and discount important intangible factors in their search for the one-best-way, the chance obviously increases that the "technological phenomenon" will develop. Conversely, if people include these intangible factors in their assessment about technology, they lessen that chance--even though the precise connection between these factors and outcomes is not understood.

We will derive a set of propositions from Ellul's work by which the credibility of his theory can be tested. If these propositions are disconfirmed, our confidence in the NAS/Goodman perspective, by inference, is increased The crucial propositions are listed below; the way they will be made operational is described as we proceed with the testing.

1 People's value preferences are biased toward those which are easily calculable or which are immediately associated with a technology's primary capacity.

2. People are unaware of and unconcerned with the uncertain effects of technology

3. Assessments of potential technological developments are determined by considerations associated with technology's primary capacity, factors which can be easily quantified, and by a short-term perspective.

4 Decisions on how to implement technology are heavily weighted in favor of considerations associated with technology's primary capacity, quantifiable values, and short-term perspectives.

These four human behavioral conditions must prevail in order for Ellul's theory to be viable, and, if they do prevail, so do severe constraints against any workable pluralist-incrementalist monitoring system Conversely, if these hypotheses are disconfirmed, evidence would be provided that the necessary conditions for viable pluralist-incrementalist action are at least possible in the scheme of things However, though the two theories are mutually exclusive in their predictions, they do not exhaust the set of theoretical possibilities. The disconfirmation of one does not necessarily assure the validity of the other, although it may increase our confidence in the other.

One method of testing these propositions is to look at actual policy makers and at the members of elite groups trying to influence them. Applicable values, concerns, and perspectives could then be examined and the relative importance assessed of various factors entering into the ultimate decision reached. Such an approach would be entirely appropriate since most decisions are made by elites Methodological difficulties in obtaining reliable measurements for most of those factors as they relate to our four propositions, however, force us to use another method

The approach we employ here is to examine the attitudes of the mass public. Ellul himself asserts that one possible disconfirmation of his theories would have its source in those attitudes; he allows of three conditions which would refute his thesis (1) an act of God, (2) a general nuclear war which would eliminate most modern techniques; and (3) a change in human consciousness Specifically, he holds that "if an increasing number of people become fully aware of the threat the technological world poses to man's personal and spiritual life, and if they determine to assert their freedoms by upsetting the course of the evolution, my forecast will be invalidated "[22] The data we use for testing the opposed theories on technological outcomes may well presage that awareness.

The cognitive and emotive structure of the people's attitudes is the critical element in our test. A study of those attitudes is, in part, an appropriate way to proceed. Any examination of public attitudes is, of course, subject to the criticism that public opinion bears a dubious relationship to decision maker behavior, the essential element here. A careful look at the climate of opinion evoked by California's recent Clean Environment Initiative will, at a later point, provide us a way around that difficulty

A test of the Ellulian perspective In operationalizing the behavioral premises derived from our analysis of Ellul's perspective, we must resolve the problem of identifying those values, considerations, or factors which would be highly *discounted* in decision making of the type Ellul predicts. Is it possible to partition cleanly those values which belong to the set of conditions figuring in the Ellulian "calculables" from those which do not? Ellul is not specific about the contents of those two sets, nor is it likely that he could be, given the temporal shifts which inevitably take place between the two, shifts which Ellul recognizes. Fifty years ago, for example, the environmental consequences of technology were unrecognized, and even if recognized they were heavily discounted. Today environmental values are not only recognized but are by law mandated to be weighted seriously in decision making. Even though we cannot unambiguously make the partitioning, we can array items from the TECH I and TECH II surveys along a continuous dimension marked off by the *ideal types*. There may, of course, be some disagreement over the ordering or over the proximity of the items to either end point, hence, one source of potential measurement error.

Ellul's writings do, however, offer some guidance in distinguishing between various premises behind decision making as either "calculable" or "qualitative." Here, we shall use the label "Type I" to refer to decision making criteria based on calculable values and "Type II" to refer to criteria embodying qualitative values Ellul would probably agree that those who view technology as a prerequisite for improving the standard of living give greater weight to Type I, calculable, values in issues bearing on technical development. Those who tend to be concerned with man's over-dependence on technology, who reject the idea of a "technological fix," and who tend to be alienated by technology's mechanistic influence on human life use, on the other hand, more complex unquantifiable premises in assessing technology, those incorporating qualitative, Type II, values.

As discussed in earlier chapters, various dimensions along a related scale of values were tapped by a number of "agree-disagree" items in our surveys. One asked whether the standard of living would decline if there were less technological development. Other relevant questions, discussed in Chapter III, are (1) whether people need not worry about the harmful effects of technology because new inventions will always come along to solve problems, (2) whether people are too dependent on machines, (3) whether technology has made life too complicated, and (4) whether it would be nice if we could stop building so many machines and go back to nature

Table 3-2 in Chapter III displayed the marginal distributions of agreement/disagreement with these items and showed that Californians do *not* hold a monolithic set of attitudes toward the consequences of technological development. Though a solid majority do see technology as an important factor in their economic well being and agreed that the standard of living is dependent on technological development, another overwhelming majority expressed concern in both 1972 and 1974 about the dependencies which technology may generate. Since these majorities obviously overlap, ambivalence in individual attitudes toward technology is an important fact Also, eight out of ten people in 1972 rejected the idea of a technological fix. Such responses run counter to the Ellulian thesis of a population so enamored with the primary capacity of technology that they are blind to its negative side effects.

That countering tendency was further reinforced by the value rankings (already discussed in Chapter V) derived from other questions asked in the surveys. If Ellul's behavioral premises are correct, we would expect to find a bias toward Type I values, such as employment, enjoyment of life, taxes, and the U.S image abroad. Significantly, of the four values thought to be extremely important, two--the effect on employment and taxes--were closer to Type I, and two--the effect on the environment and on the poor--closer to Type II values Nor do the mean scores show any bias toward Type I values; moreover, the large standard deviations of each ranking further emphasize the absence of any public consensus that calculable values should prevail in technological decision making.

The final set of indicators of the public's value preferences employed here to test Ellul's premises measures public confidence in the groups and institutions which hold decisive power to choose the ways technology is implemented. It will be recalled that the data presented in Chapter V clearly shows that the public is highly unsatisfied with the influence exercised by both government and business. Moreover, the data clearly indicate public disapproval over the individual citizen being accorded so little access to these decision making processes. The technologist, on the other hand, was seen as exercising a great deal of power, quite legitimately.

The importance of these findings for the present context can be appreciated if we consider what is present in the term "decision" as it is used here. Recalling the important distinction noted in Chapter V, the act so called can encompass two different facets of judgment, one based on *factual* premises, the other on *valuational* premises.[23] Because the technologist is an expert in understanding the factual premises of a decision, he is perceived as exercising legitimate power in making it. Governmental and business leaders, on the other hand, can legitimate their control of technological decision making only in valuational terms They are not perceived as doing so.

Assuming that the public's distrust does stem from disagreement over values, what is the substance of that disagreement? A number of opinion studies have documented the public's association of business and government with the calculable kind of values--efficiency, profits, cost-per-kill and so forth That public disagreement with the value premises embraced by those two institutions is so much in evidence surely tends to disconfirm Ellul's fundamental hypothesis of "the one best way." Indeed, that the public is aware of, attaches importance to, and wishes a range of values--economic, social, and psychological--to be seriously weighed when the implementation of technology hangs in the balance seriously erodes the validity of Ellul's assumptions implicit in the first two propositions listed above.

THE IMPORTANCE OF CALCULABLE VALUES IN ASSESSING TECHNOLOGIES

The critical difference between the Ellulian outlook and that held by the NAS panel and Paul Goodman lies in their opposing views of how people's responses to technology are internalized. The rational man, in Ellul's deterministic scheme, proceeds by discounting the long term or uncertain consequences of technique. In contrast, the meliorist position assumed by the NAS panel and Goodman posits not only awareness of those kinds of values but the actual *inclusion* of them in assessing technology and in reaching decisions about its implementation. If it can be demonstrated that certain variables derivable from endorsement of "Qualitative-Type II" values are causally predictive of individual assessments and are weighted in decision making, the third and fourth Ellulian propositions (see pp. 216-217) will also be disconfirmed. We will now undertake such a demonstration.

The Evaluation-of-Present-Technology Scale discussed in Chapter IV becomes the dependent variable in our test The independent variables for the test are a set of five agree/disagree questions (see Chapter III), the rankings of the value items (see Chapter V), and (also discussed in Chapter V) the difference between perceived actual influence and the degree of desired involvement of decision makers in technological decisions We also employed two other independent variables age and party/ideological identification We cannot, *a priori*, assert the value content of those variables. Some popular commentaries have suggested that the values of youth are less materialist and show more concern with the long term and with the possible psychological consequences of technological development Our data is certainly consistent with those views, but we cannot positively assert them Nor for similar reasons can we establish the value content of party/ideology Our data does accord with some impressionistic writings which allege the value content of a Democratic/liberal position to be closer to the "Qualitative-Type II" value orientation, however.

Now that the variables are defined which we will use to test the weight of "Type II" values in decision making, *how* they will be used to carry out the test appropriately comes into question. If a particular value condition carries weight in the decision making or assessment process, we would expect to find some covariation between it and the outcomes of the assessment or the decision. Put another way, if the importance an individual gives to a particular value is *unrelated* to his evaluation of technology, then it is logical to assert that that value carries no significant weight in this decision making. The stronger the covariation, the more central is the value[24] However, covariation is not always due to a causal relationship. The correlation may be due to a common antecedent; that is, it may be spurious Thus, merely examining correlation coefficients may be misleading.

The technique of causal modeling is designed to estimate the magnitude of such correlations, that is, the direct and indirect contributions of a premise to an outcome.[25] We attempted such a model, but numerous reciprocal relationships among the independent variables which could not be theoretically eliminated made for an underidentified model and prevented the estimation of weights to be accorded the various factors. While we could make some assumptions which would identify the model, too many were required to achieve enough overidentification to allow for a reasonable test of its adequacy[26] Therefore, we simply regressed all the independent variables on the dependent variable[27] Although this method gives only the direct influence and not the indirect, it seems to offer the best compromise

Table 9-1 on page 225 contains in the first column the results of that regression analysis for the entire sample. First the unstandardized coefficients (b's) and then the standardized coefficients (betas) are listed (Both are presented because both will be compared with other estimates[28]) For Ellul's thesis to be borne out by this portion of our test, significantly higher estimates must appear for Type I values We find that of the seven factors given weight in assessing technology for which an unambiguous assignment can be made either to Type I or to Type II values, only three of them are of the Type I variety. This evidence pointing toward disconfirmation is reinforced by the *size* of the estimates for the qualitative or "Type II" values: Their greater size indicates that for our sample Type II values have the most profound effect on technology assessment. Moreover, comparing beta weights, the influence of the "back to nature" variable is *more than twice* as large as that for any Type I value. Finally, the remaining four variables, whose assignment is ambiguous, are more likely to be closer to the Type II extreme than to the Type I end of the value continuum. Thus, our data for the public's assessment of presently implemented technological developments contradicts Ellul's assumption of a populace mesmerized by technique. Longer term qualitative values are given at least as much weight as the shorter term calculable types, if not more.

Throughout this present study, we have called those people most likely to become involved in activities calculated to prompt policy action on technology-related matters the "potential public" for technological politics. Does this segment of the population fit Ellul's mold any better? The estimates for the potential public appearing in column 2 on Table 9-1 parallel closely those obtained for the entire sample Looking at the b's, a somewhat stronger emphasis on calculable-Type I variables holds among this smaller group. It is interesting to note, for example, that for the potential public the impact of the economic considerations, i e , concern with the standard of living, was almost double that of the complete sample Nevertheless, qualitative-Type II value elements--rejection of a technological fix and desire to return to nature--still have the strongest influence. Thus, the temper of this politically involved segment of the population simply does *not* square with Ellul's depiction of a public which has internalized a short term quantifiable approach to assessing technology

Ellul singles out technicians as being more likely than nontechnicians to be caught up in that approach which, in turn, leads to the "technological phenomenon." As a further test of his contentions we split the sample into two groups, one of which is comprised of people holding technical jobs or engaged in a technology-intensive industry. If they could be demonstrated to weigh calculable-Type I values highly, to the exclusion of long range values, they would approximate the markedly technologically oriented group which Ellul cites as catalysts in the technological phenomenon. Regressions were run for the two subgroups within the potential public. The results are presented in columns 3 and 5 of Table 9-1.

The two patterns of estimates display some clear differences. Qualitative-Type II criteria take on considerably more importance in influencing the assessments made by the segment of the public *not* categorized as "technicians " This is particularly true for educated nontechnicians (column 6) The strength of their association with the "back to nature" variable is the strongest of any group considered. Likewise, the "technological fix" variable is highly influential for them. Finally, the effect of distrust of government and business leadership, which we link to qualitative-Type II values, is most strongly manifested by this portion of the sample It is important to remember that the 1972 data was collected before the Watergate scandals and before the publicity associated with energy shortages had done their part in eroding public confidence in government and business

The picture for the technicians is quite different, and the tendencies displayed by them are particularly pronounced among the "Ed-Tech" grouping shown in column 4 Type II values often do not appear at all. The standard of living consideration is nearly 50% stronger than in the potential public as a whole and, over twice as strong as in the entire sample. Clearly, by separating out the technicians from the nontechnicians some support is lent the Ellulian scheme while there is a mix of Type I and Type II considerations in the two groups, the emphases are quite different among "technicians" and accord with Ellul's predictions

Our findings regarding the public assessment of technology can be summarized simply We found that the entire sample applied a mixture of both calculable-Type I and qualitative-Type II criteria to their judgments, and that the latter seem to predominate! For that part of the sample most likely to be involved in any widespread political controversy

TABLE 9-1
WHAT VALUES BEST EXPLAIN ASSESSMENTS OF PRESENT TECHNOLOGY?
(Unstandardized and Standardized Regression Coefficients)

Values	Type	Sample		Potential Public		Tech		Ed Tech		Non Tech		Ed Non Tech	
	I	b	β	b	β	b	β	b	β	b	β	b	β
Standard of living	I	.37	.09	.62	.14	.69	.17	.86	.21	.33	.08	*	*
Enjoyable life	I	.24	.09	*	*	*	*	.53	.18	*	*	*	*
Employment	I	.28	.08	.49	.13	*	*	*	*	*	*	*	*
Taxes	I	*	*	*	*	*	*	*	*	*	*	*	*
U.S. image	I	*	*	*	*	.38	.13	.68	.22	*	*	*	*
Leisure time	I	*	*	*	*	*	*	*	*	*	*	*	*
Solutions via technology	II	-.60	-.14	-.53	-.27	*	*	*	*	-.64	-.15	-.89	-.18
Overdependence on machine	II	-.30	-.07	*	*	*	*	*	*	-.42	-.10	*	*
Technology complicates life	II	-.59	-.15	*	*	-.76	-.18	-.77	-.18	-.55	-.14	-.70	-.15
Back to nature	II	-.74	-.19	-1.11	-.25	-1.11	-.27	-.99	-.24	-.58	-.15	-1.30	-.28
Pollution	II	*	*	*	*	*	*	*	*	*	*	*	*
Hurt poor	II	*	*	*	*	*	*	*	*	*	*	*	*
Distrust business	II**	-.26	-.13	*	*	*	*	*	*	-.34	-.17	-.44	-.22
Distrust government	II**	-.28	-.16	-.42	-.22	*	*	*	*	-.30	-.17	-.62	-.31
Public excluded	II**	*	*	*	*	-.27	-.19	*	*	*	*	*	*
Age	†	-.27	-.15	*	*	*	*	*	*	-.28	-.16	*	*
Party/ideology	†	-.49	-.17	-.43	-.15	*	*	*	*	-.47	-.10	*	*
N		751		255		189		102		567		168	
R^2		.26		.41		.36		.47		.25		.43	

*Not significant at $p < 0.05$.
**Probably closer to Type II.
†Indeterminate type.

over technology, that is, for the "potential public," we also found a mixture of the two types, but a more balanced mixture. Neither set of findings lends any support to Ellul's conception of the way individuals internalize criteria for judging technology. *Only* if we isolate a group of "Technicians" do we find any of Ellul's premises operating In sharp contrast to the rest of the respondents, this group (about 10% of the sample) is predominantly oriented toward "one best way," calculable-Type I values.

THE IMPORTANCE OF INTANGIBLE, QUALITATIVE CRITERIA IN TECHNOLOGICAL DECISION MAKING

A study of attitudes does not provide a sufficient test of Ellul's theories, the behavioral component must also be addressed Thus it was fortunate for our purposes that the survey we have relied on was conducted three weeks after the June, 1972, primary election in California. For, with the exception of the Presidential nomination contest between George McGovern and Hubert Humphrey, the most controversial part of the ballot was the Clean Environment Initiative, or Proposition 9 This measure offered Californians a rare opportunity to make a set of critical decisions about the way technology would be implemented for years to come. The choice was clearly put to them in terms of which should carry more weight, calculable Type I values associated with technology's primary capacity or qualitative Type II values, which may be threatened by its potential negative secondary consequences The initiative contained five major sections dealing with a number of the sources of concern about the environment Among its many provisions were the following

> (1) Composition of Motor Fuels. The Act specified that five days after passage, the sulfur content in diesel fuel had to be reduced by nearly 90%, it also called for a more rapid elimination of lead from gasoline than required by Federal law and a total ban on lead by January 1, 1976.
>
> (2) Stationary Sources of Pollution The Act required industries operating under variances to

shut down during smog alerts, these industries would also have to install emission control devices within a specified time In order to discourage repeated violations, fines were authorized at the rate of 0 4% of a violator's gross income per day from the time of conviction to the time of compliance 75% of the fine would be returned upon completion of the installation program

(3) Pesticides The Act outlawed the use of chlorinated hydrocarbons such as DDT.

(4) Nuclear Power Plants. The Act prohibited the construction of nuclear reactors for five years.

(5) Developments in the Petroleum Industry. The Act banned new-offshore and coastal drilling, prohibited the renewal of old leases, and required that under hazardous conditions those sites already in production cease operating until dangers had been removed.

Newspaper and television editorials were unanimously against the measure The *Los Angeles Times*, with the largest circulation in the state, commented that "[The Initiative] is being touted as a comprehensive assault on pollution. It is in fact a slapdash and deceptive measure which, if enacted, would probably increase air pollution, disrupt control procedures, and cost the people of California untold millions in unnecessary expense and penalties."[29] The *San Francisco Chronicle*, the Bay Area's major newspaper, concurred "The Environmental Initiative.. has been judged in appraisals as a prime example of overkill. . Preservation of a clean environment is indisputably laudable but in posing as its champion, Proposition 9 is dangerously misleading "[30]

The central point of the opposition clearly was that the values of technology's primary capacity far outweigh any damage to other values brought about by its second order consequence, in this case environmental disturbances. A memorandum to the Standard Oil Company from Whitaker and Baxter, the public relations firm in charge of the campaign, set out opposition strategy a year before the election "This truly is an issue the people must decide and it must truly be a people's campaign to determine how much people are willing to endure in the loss of jobs, higher prices, and less of the niceties of life to enhance the environment. Obviously, there must be a balance between a pastoral society and an industrialized service society."

The effectiveness of the opposition's campaign was truly phenomenal As of the first of May, only 27% of those sampled by the Field Research Corporation's *California Poll* had even heard of the Proposition. At that time, nearly 60% of *those who had heard of it* expressed support for the measure, and another 10% was undecided. When informed by the Field interviewer of the contents of the Initiative, *those who had not heard of it* came out in favor of it by a margin of greater than three to one. Combined, these groups numbered 64.2% in favor, 21.5% opposed, and 14 3% undecided

Yet, four weeks later, after the campaign had been mounted, the proportion of the population familiar with the measure had risen threefold to 88% Of those who had made up their minds about it (approximately one-half of the total), feelings were running nearly two to one against the proposal. While those who had not decided or who had not heard of the Initiative tended to look on it somewhat favorably, a projection of the total vote was made as follows In favor 35%, Opposed 47%, Undecided: 18%.[31] The final vote actually turned out to be 35.2% in favor and 64 8% opposed.

It is tempting to view the two to one rejection of the Initiative as confirming the accuracy of Ellul's darkest forecasts, but we hold that it would be entirely wrong to do so. First, the conflict between the two types of values inherent in the issue was obscured by irrelevant, "contaminating" factors Legal ambiguities of the proposition itself compromised support The full consequences of many of its provisions did not appear to be well thought out Little consideration was given, for example, to how enough low sulfur diesel fuel could be obtained to operate California trucks, buses, and trains In addition, the simultaneous restriction on fossil fuel production and atomic reactors seemed contradictory at best, and perhaps potentially disastrous in the face of an ever-growing energy shortage. Even the environmentally partisan Sierra Club refused to endorse the measure, an action widely interpreted as tacit opposition. For their part, proponents of the measure were, by the end of the campaign, arguing more and more for the "symbolic necessity" of passage There is evidence that people's votes were in fact influenced not only by the primary questions involved but by peripheral issues raised differentially by both supporters and opponents When our sample was asked why they had voted as they did, 25% of those who voted against it stated that they did so because the measure was poorly written or not well thought out Over 20% of those who voted in favor of the proposition did so for "symbolic" reasons.

When we consider that Ellul's "technological phenomenon" thesis has to do with a state of mind--with people having become so seduced by the primary benefits of technique that these become the sole criterion of their choice, nothing else mattering to them--and *not* with issues of whether or not to implement particular technologies, we see again that the mere fact of this measure's defeat lends that thesis but spurious support Accordingly, the test of the validity of Ellul's thesis should be constructed to fit his fourth proposition, that decisions on implementing technology are biased by the attractiveness of "calculables"--primary capacity, the quantifiable, and the short term. We must, in other words, examine the voting in the same way we examined our survey respondents' assessments of presently implemented technology to discover the criteria for choice

We carried out a set of regressions using the vote (scored zero for "yes" and one for "no") as the dependent variable, the various values/considerations employed in the last section were again used as the independent variables. The results are presented in Table 9-2. Consider first the estimates for the regression using the complete sample.

In terms of the particular factors involved, these findings display a marked similarity to those appearing in Table 9-1. The standard-of-living variables, the sense that technology has made life too complicated, distrust of business, party/ideology, and age all are relevant criteria in the assessment of technology and in the vote on the Clean Environment Initiative. The presence of environmental considerations is to be expected given the nature of the controversy. The lack of influence of employment considerations is somewhat surprising particularly in light of the emphasis made by the opposition during the campaign. This result may suggest that a convincing case was not made that increased unemployment would result from passage of Proposition 9. Both the concern for the standard of living and concern with a technology-induced complicated life held roughly the same importance in influencing the vote as these factors did in assessing technology Distrust of government and technological fix variables were not factors in the decision, whereas the impact of age and party ideology had about the same influence as they had on evaluations of present technology The conclusions we can draw from this investigation accord overall with our survey findings As did those, voting behavior on Proposition 9 displayed a mixture of value emphases, a condition incongruent with Ellul's theory.

When the subgroups are partitioned out for reexamination, we discover few differences between the potential public and entire sample Consider however, the differences between the nontechnicians and the technicians. For the former group, the following factors retain explanatory power the extent to which it mistrusts business leaders, party/ideology, age, and the view that life is complicated by technology The strength of the first factor may be due to the "symbolic" character of the vote It is possible that age may be a surrogate for a set of value considerations explicitly measured here If we are to take seriously comments made at the time of the election, the values of the young tended more towards our qualitative-Type II variety than did the values of the older generation But in any event we cannot find any indication that the major group we have subcategorized as "nontechnicians" fits the Ellulian mold.

Turning to the "technicians," who from previous analysis seem to fit the role of Ellulian man most closely, we find something of a surprise. Of the four variables which can be relatively unambiguously identified as being of either calculable-Type I or qualitative-Type II

TABLE 9-2

FACTORS EXPLAINING THE VOTE ON PROPOSITION 9
(Unstandardized and Standardized Regression Coefficients)

Values	Type	Sample		Potential Public		Tech		Ed Tech		Non Tech		Ed Non Tech	
	I	b	β	b	β	b	β	b	β	b	β	b	β
Standard of living	I	.05	.14	.04	.12	*	*	.07	.20	*	*	*	*
Enjoyable life	I	*	*	*	*	*	*	*	*	*	*	*	*
Employment	I	*	*	*	*	*	*	*	*	*	*	*	*
Taxes	I	*	*	*	*	*	*	*	*	*	*	*	*
U.S. image	I	*	*	*	*	*	*	*	*	*	*	*	*
Leisure time	I	*	*	*	*	*	*	*	*	*	*	*	*
Solutions via technology	II	*	*	*	*	-.09	-.20	*	*	*	*	*	*
Overdependence on machine	II	*	*	-.06	-.15	*	*	-.13	-.33	*	*	*	*
Technology complicates life	II	-.06	-.17	-.05	-.15	-.09	-.24	*	*	-.05	-.13	-.06	-.15
Back to nature	II	*	*	*	*	*	*	-.08	-.24	*	*	*	*
Pollution	II	-.04	-.12	*	*	-.06	-.23	-.06	-.20	*	*	*	*
Hurt poor	II	*	*	*	*	*	*	*	*	*	*	*	*
Distrust business	II**	-.02	-.10	*	*	*	*	*	*	-.02	-.13	-.03	-.18
Distrust government	II**	*	*	*	*	*	*	*	*	*	*	*	*
Public excluded	II**	*	*	*	*	-.02	-.19	- 04	-.32	*	*	*	*
Age	†	-.03	-.17	-.05	-.26	-.03	-.16	*	*	-.03	-.18	-.06	-.35
Party/ideology	†	- 05	-.21	-.04	-.19	*	*	*	*	-.05	-.21	*	*
N		458		208		116		83		350		139	
R^2		.20		.37		.37		.41		.15		.23	

*Statistically significant at $p < 0.05$.
**Probably closer to Type II.
†Indeterminate type.

values and which appear to have carried weight in determining the vote, only *one* is of the "calculable" variety The sense of alienation as evident in feelings of overdependence on technology are more strongly evident here than in any other group. The environmental factor also emerges. That it does may be due to the greater technical knowledge held by this group, perhaps to their awareness that although atomic power plants do not pollute the air, they can thermally upset the ecosystem of the body of water used to cool the reactor Moreover, the problems of radiation leakage and disposal of nuclear waste materials which endanger the environment have never been adequately solved Thus, the only Type I criteria observed is the one dealing with the standard of living But even that estimate is only a fraction of the magnitude of the estimate used to explain assessments by technicians of present technologies. It would seem then that the technician cannot be labelled as archetypal Ellulian man any more than any other individual can.

Our interpretation of the vote on Proposition 9 is consistent with interpretations given to another example of mass decision making with respect to technology, the referenda on the introduction of fluorides into a community's drinking water The primary benefit of implementing this technology--reduction of dental cavities--appears incontestable and free of primary costs Tooth decay is a widespread, painful, and expensive affliction. Scientific studies have demonstrated rather conclusively that a significant reduction of decay comes about when one part per million of fluoride is added to water Finally, not only is that particular implementation alternative effective, it is also the least expensive method available. In short, the introduction of fluorides into community water would seem to be the ideal instance in which to observe the operation of Ellul's "technological phenomenon "

Yet in 60% of the referenda voters defeated the proposal to introduce fluorides. For the same reasons we posited in the case of Proposition 9, however, this outcome cannot in and of itself be taken as definitive We need to examine the basis of those votes Though interviews with anti-fluoridation activists reveal that the concern about "sapping vital essences" is not limited to Dr Strangelove's General, no evidence can be brought to bear which makes this attitude decisive for the general public. Just what is found is subject to some dispute. Methodological flaws have weakened the persuasiveness of some studies. Other work offers explanations which are admittedly untested and speculative. Two studies do stand out, and while they provide essentially different hypotheses, both tend to offer further disconfirmation of Ellul's theory

William Gamson suggests that a pervading sense of helplessness and alienation explains the vote. Acknowledging that "one has every reason to be skeptical at a marriage of Marx and tooth aches," he does advance some plausible arguments about why the wedding might take place. Using an index to measure the sense of helplessness, he claims that it enables him to discriminate well between pro- and anti-fluoridationists [32] While his sample and methodology leave something to be desired, Gamson's study is still the best using public opinion data

Harvey Sapolsky questions Gamson's conclusions, primarily on methodological grounds, he claims they are based on a spurious *artifact*.[33] His alternative explanation, for which only impressionistic evidence is brought to bear, holds that by active campaigning the opponents of fluoridation have managed to obscure the scientific issues and thus confuse the public In such circumstances, "the public, believing the fluoridation controversy to be a conflict among scientific experts, seeks the safest course Unable to decide between what appear to be two contending scientific positions, the voters opt to avoid voluntarily inviting any potential health risks by voting against the fluoridation proposals."[34]

Note that both Gamson's and Sapolsky's explanations have at their core considerations which the Ellulian man would find irrational For him, alienation, a psychological factor, would hardly seem to be a worthy contender against the effectiveness of the primary capacity, nor would he find it reasonable to give any weight to the long term or to the problematical. Yet it appears that it has been a combination of these qualitative factors that defeated the fluoride referenda

Evidence derived from public decision making about technology manifested in voting behavior on Proposition 9 and on the fluoridation issue reinforces our earlier assertions. We cannot establish any consistent evidence which tends to support the Ellulian hypothesis on the way people enter into making decisions about how technology should be implemented If our reconstruction of the Ellulian theory is correct, testing that theory against decision making on the technological issues is appropriate, and if our operationalization of measures is likewise adequate, we must seriously think about abandoning the Ellulian construct In the next section, we shall deal more explicitly with the support the same data provide for the NAS/Goodman scheme

SUPPORT FOR NAS/GOODMAN THEORY?

The thrust of the findings in the previous sections is to discount the gloomy argument of pessimists, exemplified by Ellul, that we have lost the possibility of choice in our continuing development of technology. To the contrary, it is apparently realistic to expect the public to make critical choices, balancing calculable-Type I and qualitative-Type II values, the core of the NAS/Goodman perspective is embedded in such an expectation. But another essential element of their theory calls for increased politicization and committed advocacy in making decisions with respect to the implementation of technology How likely is that to come about?

One major obstacle which would tend to retard the development of that debate is the dearth of information on technology possessed by the general public The issues are often complex; highly technical considerations must be brought to bear. In such a situation, the danger is that the public would either react blindly, or, as Sapolsky sees it, become confused and possibly paralyzed What people may need in order to act intelligently is a way, low in information costs, for them to locate and organize themselves on various sides of a technological controversy

Our data suggest that precisely that means is emerging in the political process, in much the same manner that any number of other issue areas are politicized. We have already seen how the party/ideology variable organized assessments of present technologies as well as the vote on Proposition 9. It is also a strong force in explaining feelings of technological alienation, distrust for business and governmental leaders, and the importance of environmental criteria in decision making. Thus, in a real sense, the dimension of that political variable is at least partially congruent with the calculable-qualitative value continuum

To the extent that that is the case, the organizational means to carry out the advocacy envisioned by the NAS panel and by Goodman may be present The problem of coalition formation to press for the consideration of values affected by technology is therefore less formidable than would be the case if those opinions were randomly distributed across the population Thus, because this issue area has engendered much the same alignments as the more traditional welfare issues have, we may find that an equitable bargaining situation can emerge--one in which no group is permanently disadvantaged.

One test of this hypothesis would be to examine the formation of cleavages as a technological controversy develops over time. We have data to do this from our study of the Clean Environment Initiative We shall first examine data from the *California Poll* taken during the first part of May, 1972. As we mentioned, that study indicated a strong margin of support for the Initiative

That early support was not a function of any particular demographic or political attributes If we were to cross-tabulate the respondent's intended vote with his geographic location, occupation, religion, race, sex, income, or education, we would not find any statistical association Political variables, too, turn out to be unsatisfactory predictors of his intended vote Neither a person's party nor his choice of candidate in the Democratic primary shows any statistical relationship. Only a person's self-proclaimed political ideology seems to differentiate--albeit weakly--those inclined to support the measure as liberals from those tending to oppose it as conservatives, but even these associations are rather weak The overall lack of association between the intended vote and this wide range of political and demographic variables was observed when the entire sample was examined, it was also observed *when only those who had heard of* the measure were included, *when only those who intended to vote in the primary* election were taken into consideration, and *when* *only those who had heard of the Proposition and intended to vote in the primary* were included. Table 9-3 illustrates the heterogeneous nature of the support given the Clean Environment Initiative by the entire sample in early May.

One month later, the electorate having been bombarded by increasing quantities of information/propaganda, the character of the cleavages had changed dramatically. In particular, whereas in May age, party identified, candidate choice in the Democratic Presidential Primary Election, and political ideology were at best only marginal predictors of an individual's intended vote on Proposition 9, by June these variables configured definite patterns of support/opposition. These are presented in Table 9-4. In short, party, ideology, and choice of political figures emerged as organizing symbols for the controversy which pitted to some degree calculable-Type I values against the qualitative-Type II variety.

Significantly, these same patterns are found in *elite* decision making with respect to technology The Congressional debate and voting on such issues as the SST, ABM, Alaska pipeline, and the recent attempts to postpone or eliminate air pollution requirements because of the energy crisis have been largely organized along a partisan-ideological dimension. In short, technology has emerged as a political issue with the lines of cleavage being similar to those of other issue areas (We make no claim as to whether the political distinctions made on the mass level proceed from those made at the elite level or vice versa, or whether the similarities are serendipitous.) Needless to say, many other factors beyond the ones the survey could examine must be operative in order for the theories behind the NAS/Goodman arguments to be accepted, factors potential in outcomes inconsistent with their predictions

Over the next decade we will have ample opportunity to test the conflicting claims of the Ellul and the NAS/Goodman theories. Two laws, the National Environmental Policy Act (NEPA) and that establishing the Congressional Office of Technology Assessment (OTA) virtually codify the perspective in the latter theory [35] NEPA has already provided environmental groups and other intervenors a legal basis for challenging the procedural integrity of many agencies' actions There have been delays in the implementation of such large scale technologies as dams, freeways, and atomic power plants. Although the law has not been interpreted as requiring substantive alternations in the weights given the relatively certain outcomes as opposed to the more problematical ones, the threat of delay has proved a resource for effecting substantial changes in the way technologies have been implemented. OTA has been caught up in a number of minor political imbroglios for the past two years and has not had much of an impact Nevertheless, in controversies involving both of these laws, the cleavages have been quite similar to the ones considered above.

These political developments may provide a means of resolving the dilemma, expressed by many writers, between technology and democracy Harvey Sapolsky poses the question well in his discussion of the fluoridation controversy: "What is the citizen's role in a society that seeks to be both scientifically [technologically] advanced and democratic? Science does not advance by a show of hands and democracy cannot exist without citizen participation "[36] Sapolsky concludes that direct involvement in policy making is inappropriate. "Administrative agencies and legislators are more able to rationally consider questions of safety and efficacy. Nor would the value aspects of fluoridation be ignored if the decision were to be restricted to administrative agencies or legislatures "[37] To the extent that our analysis of cleavage patterns is correct, it is likely that the elite debate will, in fact, be controlled by the same concepts of "rationality" that the general public holds and values In such an instance, the dangers of Jacques Ellul's "technological phenomenon" recede

The negative findings of this chapter are, in fact, heartening, little or no evidence emerged suggesting that the beliefs or behavior of the public at large presage a blind--but rational--obedience to the technological imperative. However, the absence of a consistent bias toward "the one best way" is only a necessary, not a sufficient, condition for ensuring humane and sensitive implementation of technology. It simply indicates that Ellul's technological phenomenon is not inevitable,

TABLE 9-3

HOW DOES INTENDED VOTE ON PROPOSITION NINE VARY BY SELECTED VARIABLES?
(May 1972)

	DEFINITELY YES	PROBABLY YES	PROBABLY NO	DEFINITELY NO	DK*	N
PARTY IDENTIFICATION						
Republican	34.5%	23.2%	12.9%	13.2%	16.1%	310
Democrat	38.7	26.8	10.7	10.1	12.7	466
	Gamma = 0.023					
FIRST CHOICE AS DEMOCRATIC PRESIDENTIAL NOMINEE						
McGovern	46.4%	28.2%	9.1%	7.5%	9.1%	110
Humphrey	34.6	24.0	12.5	11.5	17.5	104
Kennedy	37.0	28.7	8 3	12.0	13.9	108
Muskie	55.9	26.5	2.9	5.9	8.8	34
Wallace	50.0	10.7	14.3	14.3	10.7	28
	$X^2 = 54$ df = 44 $p < .20$					
SELF-IDENTIFIED POLITICAL IDEOLOGY						
Strong Conservative	32.3%	17.2%	14.0%	23.7%	12.9%	93
Moderately Conservative	35.7	24.5	13.9	12.3	13.6	359
Middle-of-the-road	41.0	24.5	8.7	8.7	17.0	229
Moderately Liberal	41.7	33.0	9.6	8.7	7.0	230
Strong Liberal	55.7	31.8	3.4	3.4	5.7	88
	Gamma = -.213					

*DK's were excluded when statistics were computed.

TABLE 9-4

HOW DID THE ACTUAL VOTE ON PROPOSITION NINE VARY BY SELECTED VARIABLES? (June 1972)

	VOTED FOR	VOTED AGAINST	N
PARTY IDENTIFICATION			
Republican	23.4%	76.6%	190
Democratic	46.7	53.3	291
	Gamma = -.471		
CANDIDATE VOTED FOR IN DEMOCRATIC PRIMARY			
McGovern	66.1%	33.9%	132
Wallace	48.0	52.0	20
Humphrey	35.4	64.6	74
	$X^2 = 18.5$ df = 2 $p < 0.001$		
SELF-IDENTIFIED POLITICAL IDEOLOGY			
Strong Conservative	36.8%	63.2%	52
Moderately Conservative	35.0	65.0	150
Middle-of-the-road	36.4	64.6	67
Moderately Liberal	50.7	49.3	112
Strong Liberal	85.0	15.0	49
	Gamma = -.363		

that a pluralist incremental strategy *may* work--not that it *will*. The problem of the social control of technology after all is much broader than simply the conflict between two perspectives.

Simply put, the issue is one of the extent to which it is possible to design technological systems so as to ensure that years after they are first introduced their effects remain congruent with our goals and values. As to the conditions that bear on this possibility, recall that in Chapter I we noted that one consequence of technological development is an increase in organized social complexity which in turn complicates decision making and reduces chances for making the "right" choice. Ellul correctly argues that when decision makers (and by extension the public) are confronted with these difficulties they tend to adopt rules of thumb to simplify their selection process But, fortunately, he incorrectly characterizes the nature of that simplification. In the United States of the 1970's, the easy rationale of the technological imperative does not automatically provide the mode of simplification. People are aware that other modes exist

Hopefully, data from this study will do more than cast doubts on the dire predictions of a theory Depending on the validity with which they are interpreted, they may also provide hints as to the direction actual future efforts should take to bring about for the common weal the socially responsible implementation of technology.

NOTES

[1]See Thomas P. Hughes, Ed., *Changing Attitudes Toward Technology* (New York: Harper and Row, 1975).

[2]Alexis de Tocqueville, *Democracy in America*, Ed. Richard D. Heffner (New York: New American Library, 1956), 167.

[3]See E.N. Elliott, Ed., *Cotton is King and Pro-Slavery Arguments* (Augusta: Abbott and Loomis, 1860) and James Scherer, *Cotton as a World Power* (New York: Frederick A. Stokes Co., 1916).

[4]John F. Stover, *American Railroads* (Chicago: University of Chicago Press, 1961).

[5]See Edward Ayres, *What's Good for GM...* (Nashville: Aurora Publishers, 1970) and Kenneth P. Schneider, *Autokind Vs. Mankind* (New York: Norton, 1971).

[6]Uwe Thomas, *Computerized Data Banks in Public Administration: Trends and Policies Issues* (Paris: OECD, 1971).

[7]See, for example, the ironic prediction about optimum vehicular speed in "The Ideal Automobile," *Scientific American*, 82:9 (March 3, 1900), 130. For an in-depth study of widespread unanticipated consequences following a technical innovation, see Earl W. Hayter, "Barbed Wire Fencing--A Prairie Invention; Its Rise and Influence in the Western States," *Agricultural History*, 13:4 (October, 1939), 189-207.

[8]For perhaps the most persuasive popular statement of the case, see J.K. Galbraith, *The New Industrial State* (New York: Signet, 1968), Chapter 2. For a rare attempt to qualify the technology-causes-complexity thesis, which goes "almost unchallenged in the conventional wisdom," see Serge Taylor, "Organizational Complexity in the New Industrial State The Role of Technology," in *Organized Social Complexity: Challenge to Politics and Policy*, Todd LaPorte, Ed. (Princeton, New Jersey: Princeton University Press, 1975), Chapter III.

[9]See Daniel Metlay, "On Studying the Future Behavior of Complex Systems," in *Organized Social Complexity*, LaPorte, Ed., Chapter VII.

[10]Amitai Etzioni, "Mixed Scanning: An Active Approach to Decision-Making" in *The Active Society: A Theory of Societal and Political Pressure* (New York: Free Press, 1968), Chapter XII.

[11]See, for example, David Braybrooke and Charles Lindblom, *A Strategy of Decision*, (New York: Free Press, 1963); Robert Dahl and Charles Lindblom, *Politics, Economics and Welfare* (New York: Harper and Row, 1953); Robert Dahl, *Who Governs? Democracy and Power in an American City* (New Haven, Conn.: Yale University Press, 1961); and Robert Dahl, *A Preface To Democratic Theory* (Chicago: University of Chicago Press, 1956).

[12]National Academy of Science, *Technology: Processes of Assessment and Choice*, (Washington: GPO, 1969).

[13]*Ibid.*, 32.

[14]Paul Goodman, "Can Technology Be Humane?" *New York Review of Books*, 13:9 (November 20, 1969), 17-34.

[15]Jacques Ellul, *The Technological Society* (New York: Random House, 1964).

[16]William Kuhns, *Post-Industrial Prophets: Interpretations of Technology*, (New York: Weybright and Talley, 1971), p. 111. See also Victor Ferkiss, "Man's Tools and Man's Choices," *American Political Science Review* 67:3 (September 1973), 973.

[17]Ellul, 79f.

[18]*Ibid.*, 80.

[19]*Ibid.*, 109.

[20]*Ibid.*, 133.

[21]*Ibid.*, 136, 138.

[22]*Ibid.*, xxx.

[23]See Herbert Simon, *Administrative Behavior* (New York: Macmillan, 1957) 45-60.

[24]See the related discussion in Chapter VII.

[25]H.M. Blalock, Jr., *Causal Inferences in Non Experimental Research* (Chapel Hill: University of North Carolina Press, 1964); H.M. Blalock, Jr., Ed., *Causal Models in the Social Sciences* (Chicago: Aldine-Atherton, 1971); and Arthur Goldberger and Otis Dudley Duncan, Eds., *Structural Equation Models in the Social Sciences* (New York: Seminar Press, 1973).

[26]See Jan Kmenta, *Elements of Econometrics* (New York: Macmillan, 1971), 539-550; Henri Theil, *Principles of Econometrics* (New York: Wiley, 1971), 443-450.

[27]Strictly speaking, using ordinary least squares (OLS) to estimate the impact of the independent variables on a dichotomous dependent variable may produce biased or inaccurate results. Two techniques, probit analysis and logit analysis, are more appropriate. Logit analysis was employed; it was discovered that those estimates were within 10% of the OLS estimates. Since the OLS is a more familiar technique, and since it produces both standardized and unstandardized estimates, we report the OLS findings.

[28]See H.M. Blalock, Jr., "Causal Inferences, Closed Populations and Measures of Association," *American Political Science Review*, 61:1 (March, 1967), 130-136.

[29]*Los Angeles Times* June 2, 1972 part 2, p. 6.

[30]*San Francisco Chronicle* June 2, 1972, p. 54.

[31]Originally collected by the Field Research Corporation, these data were provided by the State Data Program of the Institute of Governmental Studies, with the assistance of the Survey Research Center, University of California, Berkeley. These organizations are not responsible for the analysis and interpretation appearing here.

[32]William Gamson, "The Fluoridation Dialogue. Is It An Ideological Conflict?" *Public Opinion Quarterly* 25:1 (Winter, 1961), 527-537.

[33]Harvey Sapolsky, "Science, Voters and the Fluoridation Controversy," *Science* 162:3852 (October 25, 1968), 427-433.

[34]*Ibid.*, 431.

[35]See the laws themselves for a rather explicit adoption of the NAS/Goodman theory. NEPA Section 101 and 102, a-c and OTA Section 2a-c and Section 3c (1-5).

[36]Sapolsky, 432.

[37]*Ibid.*

CHAPTER X

PROSPECTS FOR A POLITICS OF TECHNOLOGY

Our interest in gaining a better understanding of the public's attitudes toward advanced technological development is informed by two convictions First, that technological development, particularly that prompted by public programs, plays a significant role in shaping the character of everyday experience Second, that the public's attitude toward these forces affecting our lives contributes importantly to the boundaries within which public policy is fashioned and carried out On both counts the texture and substance of attitudes toward presently implemented technologies and their apparent consequences, and toward technologies which may be implemented in the future, call for attention. Public perceptions of important aspects of contemporary life are intrinsically interesting; such perceptions take on additional significance when they become the basis for citizens' judgments about the quality and legitimacy of public policy.

Cast within an organizing perspective stressing the social character of technology, this study has focused predominantly upon a series of informal hypotheses describing the public's attitudes toward technology distinctions perceived between science and technology, technology perceived as a stimulus for social change, perceptions of technology's beneficial or detrimental consequences, and perceptions of the extent that specific technologies will impact upon individual and social experience Also addressed have been two opposed prognoses of future technological development--in simplified terms, public acquiescence to the "autonomy of technique" or public participation in processes of responsibly implementing technology In this concluding chapter we shall review these hypotheses in light of the evidence we have available, explore some of the policy implications of that evidence, and indicate the directions which future research might fruitfully take.

SURVEY FINDINGS AND EMERGENT HYPOTHESES

We shall restate here some of the informal hypotheses which initially provided our point of departure, pointing to evidence from the analysis of survey data which tends toward their confirmation, disconfirmation, or modification Necessary refinements of our original formulations are presented when indicated by the data Unless otherwise noted, all the findings reported here are consistent over time and represent a *significant finding*, that is, significant correlations appeared in both TECH I and TECH II survey data (see discussion in Chapter II). The first hypothesis states our basic initial assumption·

> (1) Technology is perceived by the public as part of social experience, instrumental in triggering changes in society and stimulating conditions that account in part for experiences which some people value and others seek to avoid

There is no doubt about the validity of this assertion. Technology, and with it science, emerged among the most frequently expressed sources of change in people's lives (IV)* Furthermore, the public clearly links both technology generally and particular technical systems with conditions they believe are beneficial and/or harmful. This association was made by all segments of the public toward presently implemented technologies (IV) as well as toward future-oriented ones (VI and VII) The public, collectively and individually, can therefore be said to regard technology and science as important factors in modern life, as making strong determinations on social and personal experience; and, as we shall see below, the public takes considerable interest in the activities of both While these reactions should not be surprising, their relative intensity is, and it suggests that we should expect evidence of a citizenry responsibly aware of the effects of technological development on their lives

If technology and science are seen as significant aspects of social experience, are they then perceived as the same activity? We postulated

*Roman numeral in parentheses indicate the preceding chapter in which the evidence is presented.

that.

(2) The public perceives a distinction between the activities of "science" and those of "technology" and infers a crucial difference in the degree of restraint that should be imposed on each activity--less for "science" than for "technology"

There is strong evidence that the public, systematically and consistently, does make a distinction between activities which can be characterized as scientific and those that are considered technological (III). There is considerable agreement about the high intrinsic value of scientific activities and the belief that the work of scientists should not be controlled Technological activities, on the other hand, are perceived warily by sizeable portions of the public; a larger proportion than not accepted as legitimate the control of technological activities, and many wished it to be increased The value placed on scientific activities is strongly a function of education. The degree to which a person has been exposed to scientific thought clearly affects his or her evaluation of the activity This contrasts with the somewhat divided sentiments toward technological development which were distributed quite broadly in the population and have not yet become associated with particular socioeconomic positions or political ideologies. The evidence, then, squarely contradicts assertions that the public views science and technology as indistinguishable activities (see Chapter III)

This finding has significant implications for representations, by scientists or by technologists, to the legislature and to the public concerning the relationship of scientific activities to technological development These advocates may come to experience less automatic support for the conduct of scientific activities While at present there appears to be a relatively firm distinction in the public's mind between science and technology, especially with regard to the greater legitimacy of unrestrained scientific inquiry, support for it could diminish if its distinction from "technology" becomes blurred

Are the consequences of technologies already implemented collectively perceived by the public to be positive or negative? The original unqualified formulation of our hypothesis proved to be too general

> The public perceives past and presently implemented technology as beneficial and useful in the solution of social problems.

The data forced the following modification of this assertion

> (3) The public perceives *most* past and presently implemented technologies as beneficial and technology as useful in the solution of *some* social problems.

Responses to eight familiar technologies made it clear that the public consistently judged their results to be quite positive overall (IV) The only technology which a majority did not see as "making life better" was the atomic bomb. Positive evaluations of presently implemented technologies were distributed across all segments of the population, with only income or political ideology and positive evaluation associated at all disproportionately Those respondents who were more affluent or who identified themselves as politically conservative were likely to be more favorably disposed to technological development than poorer or strongly liberal citizens

Responses also indicate that technology is perceived as useful for solving some but not all social problems (IV) The public saw technology as contributing positively to the solution of about half of the social problems they were asked to consider. But note that significant minorities felt that technology would very likely exacerbate several problem areas--unemployment, the cost of living, and the invasion of privacy Again in part a function of personal political ideology and income, judgments vary on the utilitarian aspects of technology

The fact that the public tempers its enthusiasm for technologies by its rather modest estimation of their utility in solving social problems tends to disconfirm predictions of public acquiescence to unbridled technical development For it certainly casts doubt on the validity of the assertion of wholesale public acceptance of a "technological fix"--blind faith that technical solutions will invariably be available to undo problems which prior technological developments have prompted (III).

Evaluations of technologies, both present and future ones, are likely to be made in terms of goals which people believe it important to achieve What is the value context the public would place as a contingency on decisions regarding technological development? Because we had only a limited sense of what to expect in this regard in 1972, we did not then advance a hypothesis Analysis of TECH I data, however, enabled us to derive a general hypothesis which we subsequently tested with TECH II data

(4) The public imposes a wide range of social values upon decisions to be made about technology.

The 1974 data clearly supported this assertion, confirming earlier analysis. Four of the seven social values which respondents were asked to rate were very strongly endorsed as decision criteria effects on employment, pollution, taxes, and enjoyment of life. Over 50% of the respondents indicated in absolute terms that a technology's effects on these conditions were "extremely important", and, in terms of mean ranking accorded these values, they clustered very closely together At least two values, control of pollution and maintenance of high employment levels, it has been argued, are incompatible; that is, protection of the environment would necessitate a decline in employment levels. Whether this is the case or not, the data suggest that the public is at least skeptical that this "trade-off" is unavoidable and that it sees enhancement of *both* employment and the environment as important criteria of technical devevelopment. Significantly, neither enhancement of U.S. international prestige nor increasing leisure time sparked much interest as values to be taken into account when decisions are made about technological development These results were highly stable over the two surveys and were distributed quite generally among the population.

To be realized, values must be pursued by decision makers and instituted in policy. What evidence is available that our public has the confidence that decision makers involved in the development of technology policy will actually represent their values? Given the prevailing climate of general distrust of all large institutions and increasing criticism that the technical informational demands of this decision area exceed the capacity of policy makers, we asserted the following hypothesis

(5) The public is suspicious of leaders involved in decisions concerning technological policies and feels illegitimately excluded from a process in which it seeks to participate.

Among the most striking and perhaps disquieting findings to come out of the TECH I and TECH II surveys was the degree to which they confirmed this hypothesis.

From our samples' responses to situations in six areas of technological decision making, a consistent pattern emerged of distrust of both governmental and business leaders (V, VII) and dissatisfaction over the perceived illegitimate exclusion of the public from decision making concerning technology-related policies (V). Top government leaders drew little support as decision makers· while they were perceived to be influential in all six of the decision areas asked about, in only two was their authority seen as warranted. These two were decisions about space travel and about the military uses of space--areas in which there is a virtual government monopoly over development and operations The results of this portion of the survey marked even more severe public criticism of the role of business leaders They were seen to be influential in four of the six areas, but they were not welcomed in *any* of them Of great significance, too, are results showing that the public saw itself as the party *most entitled* to participate in decisions on technology policy but as the *least influential* in actuality.

Attitudes toward familiar and currently operating technologies are generally positive, moderated somewhat by harsher judgments of some technologies and by apparent distrust of leaders claiming to represent the values which people feel should carry weight in decisions about technological development. Does this mixture of optimism and concern carry over to future-oriented technology as well?

Attitudes regarding technological developments not yet in operation or ones unfamiliar to most people are generated somewhat differently than are attitudes toward common or well known technologies. Attitudes about the latter can be based on actual experience with various technologies and/or on witnessing the consequences they trigger. But opinions about future technologies must be formed without experiential information on consequences, evaluations of such technologies must rely on speculation about probable future consequences. Therefore, we surmised that.

(6) The public, in considering future technological development, supports or opposes particular technologies to the degree it is certain of beneficial or harmful results from their implementation. As these certainties vary, so varies the degree to which the public is likely to support specific technologies.

This expectation of the public's position was strongly borne out. People's certainty of beneficial consequences and certainty of harmful consequences were highly associated with their support for or opposition to particular technologies (VI, VII) But it is also notable that between a quarter and a third of our samples were certain *neither* of beneficial nor of harmful effects from most of the future-oriented technologies The implications of these data for public educational strategy are obvious. Other less powerful indicators bore out our sixth hypothesis as well--the degree of impact the new technology was expected to have on personal and social experience and the degree to which present technologies were collectively judged to be beneficial Thus certainty of benefit, certainty of harm, degree of impact on individual experience, degree of impact on general experience, and strength of the judgment that current technical development is generally beneficial were the five variables providing the basis for a predictive model of support or opposition to future technologies (VII and Appendix E).

In probing for attitudes toward new technologies, we had only limited notions about what to expect. Again, suggestive patterns discerned in the TECH I survey data served as bases for assumptions to be tested by results from the TECH II survey. These follow as hypotheses 7 through 12 below

(7) Estimates by the public of the consequences of various future-oriented technologies and collective support for or opposition to them vary greatly (VI).

Collective expressions of support or opposition did indeed vary greatly, the variance is especially evident in the contrast between the great enthusiasm for urban rail transit and solar energy and the sharp opposition to centralized data banks and genetic engineering This finding tends to counter the popular stereotype, implicitly encouraged by public opinion literature, of the populace as unable or unwilling to engage with complex issues of public policy and to differentiate among those issues. Less final evidence indicates that there was a general weakening of enthusiasm for technologies between 1972 and 1974--especially, among the technologies probed, for genetic engineering and data banks (VI)

> (8) The public collectively perceives the impact of future-oriented technologies as more likely to be greater for other people than for themselves (VI)

This was the case, for both the whole sample and potential public, for every future-oriented technology asked about in both TECH I and TECH II surveys. The *degree* of difference in estimated impact upon individual experience compared to the impact upon others also varied considerably. This variation in estimating the relative effects of technologies upon one's self and upon others suggests a capacity on the part of the public not only to discriminate in their evaluation of technologies, but in their understanding of the social consequences of technical development

Those people who were certain of potential benefits and/or harmful consequences resulting from implementing various technologies expressed a wide range of hopes and fears, characterized by a particularly interesting distinguishing feature

> (9) Varying across a wide range of concerns, the hoped for benefits from implementing future-oriented technologies are mainly associated with the direct, instrumental capacities of the technologies, the feared harmful consequences, however, are associated with the *longer term, indirect* effects of these technologies (VII)

From technological development the public, in fact, hoped for the benefits of assured supplies of services and products, increased efficiency of services and production, improved knowledge and enhanced education.

Feared technological consequences included skyrocketing prices, encroachment on political freedom, violation of moral codes and technological saturation. Hopes and fears were mixed with regard to the contributions of technological development to environmental quality and safety factors, some technological consequences improving these condition, others eroding them.

Factors providing some predictive indications of whether respondents would support or oppose proposed technological innovations were more applicable to the potential public than to either the total sample or any other subdivision within it And there was a considerable variation in the degree to which the potential public perceived specific future-oriented technologies to enhance or threaten social values that they believed important Their attitudes toward the general consequences of technological development also varied, as did the relationship between self-identified ideology and their support of new technologies

> (10) Social values perceived by the potential public to be enhanced by various technologies tend to be *the same as* the specific benefits it mentioned as expected from their implementation, on the other hand, the social values it perceives to be threatened by various technologies tend to *run complementary to* specific harmful consequences foreseen from their implementation (VIII).

This finding, together with the evidence that a wide range of social values was perceived as optimal for use in technological decisions, confirms that the range of concerns about the harmful effects of technologies is quite broad--of wider scope than expectations for benefits from specific technologies

> (11) Among those in the potential public, the development of some future-oriented technologies has become politicized--associated with self-identified political ideology (VII)

That association seems to have been borne out particularly with respect to technologies about which there was closely divided support--nuclear energy, cable TV, the ABM, and behavior altering drugs Political party and ideological preference was related to support for five of the twelve technologies with all but cable TV drawing more support from conservatives than liberals

Finally, changes in the importance of some factors cannot be conclusively demonstrated because they require evidence beyond that provided by the two surveys. Therefore, the last hypothesis is more tentative than the foregoing:

(12) Within the potential public, generalized anxiety concerning technology has been declining, though concern is more sharply focused on specific technologies, and approval for unrestrained scientific research has lessened (VII)

Two instances bolster this argument--the changing attitudes of the potential public toward space travel technology and the more general public responses to the energy crisis of 1973-74 and to the two energy producing technologies which drew considerable notice during that period Contrary to numerous indications of a declining enthusiasm for technological development between 1972 and 1974, the potential public evidenced significantly increased support for space travel technology (VII) This finding marks perhaps the most anomalous change in the data related to support for future technologies and runs counter to the more or less pervasive sense that interest in space exploration has run its course This change was evident throughout the potential public, with no disproportionate associations related to educational level or political preferences Significantly, this widespread distribution of increased interest in space probes can be related to their use as tools in basic scientific research and thus suggests a continuing acceptance to the public of that activity

The complexity of public attitudes toward technology is also well illustrated in responses to the energy crisis and to the two energy producing potentials--nuclear and solar technologies (VIII) In 1974 the public perceived the energy crisis prompted by the oil embargo to signal serious, long term problems. At the same time there was considerable agreement that the oil companies had contributed to the short term problems and that they probably should be subject to more rigorous regulation by the government For their part, both solar energy collection by satellite and the nuclear generation of electricity, quite favorably viewed two years earlier, continued to receive strong support in 1974, notwithstanding the general softening of support for most of the other technologies focused on in the survey The public accepted the claim that nuclear plants were safe enough to operate, although concern about radioactive waste and the overall danger of nuclear reactors increased substantially. This dual endorsement and wariness may be interpreted as evidence that the public's recognition of the crucial need for finding new energy sources is tempered by an abiding concern for the protection of the environment

The importance to the public of environmental priorities persisted in 1974, almost equally matched by concern for maintaining employment levels Over 45% of the potential public held strongly that improvement of the quality of air and water should have priority over energy supply needs.

Detectable in public responses to issues surrounding the energy crisis was an underlying element of political and ideological identification Conservatives more than liberals favored energy and employment priorities over protection of the environment and were more likely to be sure that nuclear plants were safe enough to operate For their part, liberals were notably more prone to believe that the oil crisis was genuine and long term, that the oil companies were suspect, and that they should be regulated Ironically, such a high degree of mistrust of government officials surrounds these attitudes that it might even extend to government advocacy of the very goals the public rates as meriting the highest priority--assurance of energy supplies and environmental quality.

Out of all the fragments of public opinion just gathered we can piece together a picture of the public mind and compare it to the ones implicit in the two opposed perspectives on the future of technological development which we have discussed at key points throughout this book How does that picture bear on the viability of the proposals made by the NAS scholars and Paul Goodman? How does it jibe with the dire predictions of Jacques Ellul? The reader will recall that the pluralistic perspective of NAS/Goodman suggested a public trusting its leaders, both political and technical, to represent in technological decision making the wide range of values held by the public to be important. Well within the American political tradition, this optimistic position leads us to expect the politics of technology to take on the familiar dynamics of issue-oriented, party organized debate and conflict resolution Ellul's perspective, on the other hand, would lead us to expect a paralyzed public will, dazzled by the wonders of the "technical phenomenon," and mutely subject to a technological imperative in which the only decision criterion operating is the "one best way"--the most efficient technical way.

The findings reported here do not allow us to accept either perspective as entirely adequate, though they do offer strong evidence of the fallacy of Ellul's fear that an autonomous technical efficiency principle will dominate over other values Our society is not comprised of the kind of people whose wills can be swept away by the technical phenomenon. Yet neither can it be said that the pluralists' optimism is well founded While there is ample evidence that a sufficient basis exists for competition among those representing different interests and values to be served by technological development, the public has little confidence that the institutional leaders responsible for representing those different values will do so. In a sense, people are saying that no simplistic criterion will do--neither the "one best way" of technicians nor the simplifying techniques of politicians in reducing uncertainty And they add the disquieting assertion that the institutions of this society in the way they now function will not do either. These institutions do not win confidence because of their failure to incorporate into public policy more complex and desired combinations of social and psychological values Thus, in belying the pessimistic Ellulian description of a technological society, the American public provides a necessary condition for the development of a lively and positive politics of technology Still, it does not assure it. The leaders of our institutions have a long road to travel before they will win the confidence of the public And until they do the politics of technology will, we speculate, be hampered by public skepticism, and many of the programs put forward by political and technical leaders suspiciously rejected.

SIGNALS TO SCIENTISTS, TECHNOLOGISTS AND POLICY MAKERS

The pattern reported throughout this study of a discerning public discriminating and uneasy about technological development marks a notable change from the era immediately following World War II, when Don Price could describe the combined communities of science and technology as the "established dissenters."[1] This Scientific Estate then paralleled, in its full support from the state, without accountability to it, the position of the Church of England in its prime. The decline of uncritical support and acceptance of technological development signals the end of an era of faith and implies a number of interesting, perhaps radical, changes in the offing for scientists, technologists, policy makers, and planners.

The science statesman's dilemma. On its face, the fact that the public seems to distinguish scientific activities from technological ones, according virtually unrestrained latitude to the conduct of scientific research, should be gratifying to both scientists and to the statesmen of science. The public has in effect affirmed a version of academic freedom. Yet on second thought the statesmen of science may find such a distinction to be a mixed blessing. As the advocates of a perpetually elite status for basic research, they will realize the extent to which their past representations to legislators and executive leaders have blended scientific activities with technological ones. For scientific research has been richly supported, even within the past several years, primarily on the grounds that it clearly contributes to technological development. Now, in view of a climate of increasing public wariness about such development, a wariness fostering its greater regulation, scientists may find it necessary to argue for the dissociation of their work from applied technology in order to escape increased control over their own activities. Yet in doing so they could create another problem for themselves, for that disclaimer is contradictory to their petitioning support in the name of their contribution to technological development. The dilemma is clear: to maintain freedom from political control by pressing the distinction between science and technology, scientists risk a decline in support for the very work for which the freedom is sought. This predicament suggests that an important corner has been or about to be turned in the relationship between the public and research scientists. It forebodes an end to an unquestioning public willingness to provide very high levels of support for continued basic research. This change is already quite apparent in the halls of Congress, and it means that scientists, individually and through their associations, may be required to justify their work to a public increasingly concerned about the harmful consequences of technology and therefore likely to trace them back to the doorsteps of scientists themselves But what about the more direct agent of technological consequences? The results of this study also hold disquieting implications for the technologist

Extraordinary demands on technologists. The challenge for technologists--engineers, chemists, physicians, arthitects, and other appliers of science--stems from people's increased propensity, especially those among the potential public for technological politics, to make strong judgments conducive to support of some technologies and to opposition to others. This propensity, in conjunction with the wide range of values upon which these judgments seem to be made, could determine in part the character of technical work to be done in the future. In view of the social and economic qualities of the values the public believes to be important in evaluating the worth of a given technological development, a much clearer understanding is called for of the social and economic consequences of various technical designs and implementing organizations.

Yet some of the values expressed are--on the surface at least--incompatible, that is, one apparently cannot be achieved without sacrificing the other From our data, however, we sense that large portions of the public remain unconvinced that such tradeoffs are unavoidable and insist rather that technologists invent new technologies which satisfy all important values. Such an insistence poses a very stiff challenge to the technical designer and manager, for, in a sense, it means that the social consequences of physical technologies must be better known and taken into account in the design process itself The alternative is for technologists to convince the public that a good deal of what seems socially valuable cannot be assured or enhanced by technical inventiveness--a notion which runs counter to the ideology surrounding technological creativity in our era

Another implication for technologists, in part already visited upon them through the environmental impact review process, is a likely increase in the political intensity of many kinds of technological developments As technological projects become the object of criticism, the technologist is subject to increased involvement in political conflict. Technologies about which there is divided opinion, for example, the SST, the ABM and, with increasing likelihood, nuclear power development, have and will become the focus of intense debate Technologists will be drawn into the controversy both as advocates for their preferred technical designs and as advisers to proponents or opponents If the trend continues toward more partisan political identification with one side or the other of a conflict about the advisability of implementing a new technology, a good deal of the tension and pressure familiar in other politicized issues is likely to characterize the politics of technology as well

Technical experts--technologists and scientists--have apparently avoided the onus of distrust and skepticism which the public casts upon industrial and political leaders It is to the credit of the technical and scientific communities that they have maintained the public's trust in matters of public policy Yet a second look at the situation signals potential difficulties for them Technical experts are viewed as exercising legitimate involvement in decisions about technology probably because of their obvious contribution of factual judgments. Political and industrial leaders who historically have represented social values, the other major component of all policy decisions, on the other hand, receive little approval from the public Should the distrust of those usually expected to contribute social judgment and purpose to public programs deepen, technical experts could be pressed both to represent social values and to contribute factual information and judgment. And, if technical experts take up this duty, thev will confront the very complex and difficult matter of compromise and trade-off that inevitably accompanies decision making. There is no reason to suppose that they are any better than other leaders in dealing with such conflict-ridden situations, so they risk suffering the same decline in the regard of the public as other leaders have experienced

Policy makers and technological politics The implications of this study's findings for policy makers and planners, as for scientists and technologists, point toward more serious accounting of the social aspects of technology and toward increased political intensity surrounding technological programs. It seems apparent that the public, while probably not well informed about the technical complexities of various technological innovations, has nevertheless formed stable and definite opinions about their potential utility and benefit. These opinions form persistent patterns associated with both socioeconomic and political ideological characteristics, important traditional predictors of political behavior. Our findings suggest then that policy makers will be seriously misjudging the public's mind if they presume it to be unconcerned, transient, or irrational about technology

The public apparently responds to technological matters in terms of experience with the social consequences of implementing technology rather than simply to the improved physical capacities this implementation provides. Both the variation and stability of attitudes suggest that these perceptions are similar to generalized responses people make to other social experience. As this social, experiential context of technology becomes more ingrained in the public's perception we can expect an increasing portion of the public to associate various technologies with differential benefits to the affluent or to the poor, to those who give precedence to personal freedom and privacy or those who favor a modulated, quiescent social order, to those who have established privilege or who seek it.

Several implications for policy makers and planners stem from this situation It is likely that in the future technological issues will increasingly become identified with partisan politics The tendency already visible in the potential public for technological politics to perceive some technologies in this light is a precursor to such a development

Thus, matters of technology policy, once almost completely outside the scope of partisan debate, are likely to join with other types of issues as a major source of political threat or opportunity for contending political factions An additional element of political uncertainty is, in effect, becoming apparent in the American's political culture. This is already the case for issues surrounding the environmental consequences of technological development. It is likely to become so for the social aspects of energy production and use, of advances in biological technologies, of the capacities of high powered computer systems, and of the support of research and development in general

A second implication of perceiving technology as part of social experience is most relevant to technology assessors and policy planners. If technologies are seen as prompting differential benefits, then a very close look at the social consequences of alternative ways of implementing the same technical opportunity is in order. One design and its mode of implementation may affect the young more significantly than older citizens, another may produce more harmful effects for the poor than the relatively well-to-do, yet another mode of technological development may disproportionately increase the disruption of suburban communities as contrasted to rural populations The possibility of various design alternatives having different social effects and thus being experienced differently by consumers and citizens should be thoroughly explored

The varied pattern of public responses in evaluating the likely consequences of future-oriented technologies suggests still another important implication for policy makers. The most significant predictor of support for or opposition to a proposed technological development is the degree to which an individual is certain that benefits and/or harmful consequences will result from implementing the new technology Yet substantial portions of the public--generally over 25%--were neither certain that benefits would result nor certain that harmful consequences would result from virtually every new technology they were asked to consider Thus, in instances where opinion is divided about the desirability of governmental support for a technology, it is clear that educational or propaganda efforts directed toward such doubly uncertain citizens could sway the final outcome for it one way or the other. The apparently large number of "the undecided" surely argues for the development of public information and education programs addressed to increased understanding of science and technology Our data also convey an implicit warning to the designers of such information programs The public no longer expects only benefits to follow from new technical developments, rather, the strong sense that harmful consequences may attend them seems to outweigh optimistic expectations. Thus, any efforts by proponents of new technologies to persuade the public of the intrinsic goodness of all technical innovation are likely to be rejected, and if educational efforts do not explicitly address the question of the possible harmful consequences of a given technological development along with its touted benefits, there seems little chance that either governmental or industrial leaders will recover much legitimacy in the minds of the general public in matters of technology policy.

Finally, it is clear that the public expects a much wider range of values to be taken into account in the evaluation and regulation of technological developments than now is used In effect, the adequacy of the "one best way"--the simplistic efficiency dominated criterion traditional to engineering--does not weigh very strongly with the public The decline of confidence in this technical criterion signals a much more complex and troublesome world for the technologists, the technical managers and policy makers responsible for the implementation and regulation of technology It poses the challenge of developing a conception of technology in which the actual social effects of technical development are held accountable to a wide range of social values Public decisions about that development can then be more responsibly made This challenge is perhaps the most stringent to be faced in the next decade.

UNANSWERED QUESTIONS

This study of the public's perceptions and judgments of advanced technological development has been predominantly an exploration of new ground. Some relationships have been firmly established, others more tentatively advanced. In effect, we have engaged in two reconnoitres--

the second, TECH II, confirming and advancing the first, TECH I. Our explorations have led to some unexpected terrain where modest surprises were encountered; we have now come on somewhat higher ground, in dim view of new paths promising further insight. Thus, as in most research, the answers to many of the questions first posed have generated another round of questions, more detailed and refined.

First, there are questions whose answers would give greater precision to those already derived The experience reported in this book behind us, we know more firmly what can be done methodologically both to increase the accuracy of findings and to make refinements that would extend their narrow context and thus augment their meaning Next, further questions which could not have been confidently posed previously are required in order to probe the reasons behind the remarkable variation evident in public perceptions of technology What are the experiences and/or information people draw upon in making estimates of the impacts of technology upon their lives? How do they relate their beliefs about what changes a technology is likely to stimulate with the social values they believe to be important? (Procedures related to further investigation of variations in responses will be treated more specifically below, under "Extensions.") Finally, the implications of our findings for technologists and decision makers have stimulated an expanding, more broadly wrought set of exploratory questions. These are questions about the relationship of the design of technological systems and various modes of implementation to the variety of social and political experiences provoked by them. This set of questions, perhaps, will be the most fruitful new pathways to firmer understanding of the social character of technology

<u>Refinements</u> Because of the high costs of such work, many studies of public attitudes take place within a locale less extensive than the population which ideally would be surveyed, and most surveys are taken only once rather than being repeated over time. These practices place limits on the findings so derived In the case of TECH I and TECH II, the "public" was actually the adult population of California We have argued that the findings derived from the California sample can be safely

generalized to the United States and that the very scant findings from relevant national surveys are closely parallel to ours.[2] Yet for greater confidence in the applicability of this analysis, a more careful test of the representativeness of the data for the United States would be useful. Such a test could include a subset of our questions in national surveys to test the possibility of significant differences between our California sample and samples from the overall U.S population or particular geographic regions. It is possible, for instance, that attitudes in the northeastern states are much more in accord with those in the west than, say, are those held by midwesterners or southerners. Whether our findings in this country would be similar to attitudes in other nations is not at all clear. There is some reason to expect that they would not be. Some cross-cultural work could be done to discover, for example, the degree to which a country's level of economic development accounts for variations in public perceptions of technology's benefits and harms, of scientific as contrasted to technological activities, and of the importance of various social values that might be used in decisions about national policies bearing on technical development

Perhaps as important as increasing our confidence that findings from the largest, most "technological" state in our country are by and large representative of attitudes across the land is the task of increasing our confidence in both the firm stability of attitudes and in the nature of the changes in perceptions and judgments detected between 1972 and 1974. The remarkable degree of stability in attitudes, both within the panel sample interviewed in 1972 and 1974 and between the two analogous cross-section samples from each year suggests that members of the public have come to form apparently firm opinions about advanced technologies and their consequences Statistically significant relationships between various factors in each of two surveys greatly increases our confidence that such relationships appearing in one are not the product of random fluctuation, but rather indicative of well ingrained impressions in the public mind. Such impressions may or may not have been formed on the basis of accurate information Additional or different information may prompt changes Certainly there were enough instances of change to indicate that such opinions were not set in concrete, and the degree of change taking place within the public is as important a feature of its attitudes toward technology as is stability Here our two surveys only whet the appetite. The particular changes in perceptions and evaluations of technologies and their consequences are intriguing, some are puzzling, and all are indicated by relationships either emerging or disappearing between 1972 and 1974 But the possibility of statistically induced random error accounting for such disappearance or emergence must moderate our confidence that real changes have been discovered. Thus, a third survey is requisite to improve the precision of these findings and our confidence in them. If the attitudes which the public expressed in 1974, as contrasted to 1972, are evident again in the near future, then the change we suspected and advanced speculatively can be asserted with extreme confidence

A number of findings are of particular interest in this regard. To what degree will the following relationships change or remain stable?

1 The public's apparently increasing tendency to discriminate some technologies and their consequences from others
2 The apparent distinctions in public judgments about scientific activities
3 The apparent increasing opposition in general to various future-oriented technologies.
4 The public's perception of business leaders' influence in decision making about technological policies as illegitimate, its lack of confidence in governmental leaders' role in formulating those policies, and its apparent frustration at being excluded from them.
5. The intensity of public feeling about the importance of many social values to be applied to the evaluation of technological programs.

Several important additional questions of stability or change also arise which concern primarily the potential public This group from which it is most likely that leaders in technological politics will emerge exhibited several significant properties To what degree will these characteristics remain stable or evolve into others

6 The apparent tendency for the potential public to associate support for or opposition to technologies with various self-identified political ideological positions and to respond to these technologies in part in terms of differences in age, education and income.

7. The apparently greater degree of those in the potential public than others to evince cognitive organization of attitude toward technologies, their consequences and the more general effects of technological development upon our society.

Among other refinements that would increase the precision of this study is providing respondents the opportunity more fully to indicate the character of social values which they believe ought to be important in technological decision making This could be done by giving them a chance to nominate values which, from their own point of view, would be more than or equally important to those we included in the questionnaires. Also, refinements could be introduced with regard to the kinds of trade-offs respondents choose to make, such as between the degree of environmental clean-up and specific dollar increases in prices or taxes

The last refinement we will propose here falls between more finely tuning the existing study and extending it to specify a variety of potential consequences stemming from encouraging or inhibiting particular technological developments This refinement would provide respondents with hypothetical contingencies to which to react Analysis would then be required of particular changes in attitude of those individuals who were interviewed both in 1972 and 1974 They evinced surprisingly little change between these years, and we were able to use data attesting to this fact to argue the high degree of stability of public attitudes toward technologies. What little indication of change we detected was insufficient for us to draw any conclusions from. It is quite possible that another survey, say in 1976, would, after a four-year period, reveal the substance and drift of these changes and afford a better understanding of individual, as contrasted to group, shifts in perceptions of technologies and their consequences. The properties of slowly emerging changes could be monitored and contrasted to more abrupt shifts. As with the other refinements proposed, this one would require the collection of rather different data than were gathered in the TECH I and TECH II surveys upon which our analysis now rests. To these we now turn.

Extensions The unanswered questions noted at the outset of this final section logically extend the scope of the undertaking. They are primarily questions prompted by the wide range of variation and intensity in judgments which in the public's mind implicitly relate technology's consequences to social values and political preferences. To account for this variation more systematically than could be attempted in our two surveys, the following kinds of information are probably required at minimum

(1) Background information about respondents which would provide a basis for estimating their degree of acquaintance with various technologies and their consequences--such as, for example, the technical content of their work-related and leisure time activities, as well as their exposure to information about technology and its processes.

(2) The make-up of respondents' causality beliefs about the social and economic effects of technological development; that is, what sorts of changes they believe are likely if a particular technical process, say fluoridation of water supplies, is carried out; and, more importantly, the reason they infer as to *why* such changes are likely to occur.

(3) Conditions identified by respondents as evidence that values they hold as important would be enhanced or threatened by particular technological developments For example, when respondents say that technology will be useful in solving unemployment or conserving resources, what specific conditions do they have in mind?

(4) Beliefs of respondents about the present character of the involvement of, for example, technical experts as contrasted

to business leaders in the actual process of implementing a technology.

It is likely that such efforts as just outlined to uncover personal belief systems will be difficult and may result in the discovery of inchoate and uninformed expectations. But this was what we expected at the outset of our present work and proved not to be the case. Thus it is possible to suppose that such attempts will prove worthwhile.

Explorations It now seems clear that the public is highly aware of both the positive and harmful consequences occasioned by the improved capacities to act in the world which technology has provided and which it promises to provide. The wide range of support for and opposition to future-oriented technologies evinced by the public and its very apparent distrust of the personnel and policies behind technological implementation clearly point to that keen awareness Its signals to technologists and policy makers have already been discussed, and we conclude this briefing on unanswered questions by noting some of their research implications.

Two areas of research possibilities follow from the public's increasing tendency to make judgments about technology's "impacts" on the basis of social values which they hold to be important These areas center around the relationships between varieties of personal and/or social experience and (1) the *design* of technologies and (2) the mode of their *implementation*. In neither area does much background material exist, but each has considerable potential--not only for social science studies of technology-and-social-change, but also for directly relevant contribution to public policy issues

If, on the basis of technology's impact on social experience, we were to attempt to impose social technical and economic criteria, we would be at a loss for how to do so Yet it is clear that the design of technologies, especially those requiring large scale operations, has a decided effect on individual and group experience. The way a new building is designed affects the character of friendship patterns, the particular design of an auto assembly plant affects the feeling of participation (or alienation) experienced by its operators and workers, the placement of a new railroad almost always shapes the character of community development. While many illustrations can be provided, little if any systematic knowledge about the *social properties* of various technological designs is readily at hand The challenge is both conceptual and methodological. And much work is likely to be required before we can with confidence affirm the design of a technological system in terms of its contribution to social values held important by the public

The other area of research suggested by our work concerns the relationship between various alternative modes of implementing and regulating new or improved technologies and the character of social change and personal experience which might be affected by the different choices. The objectives of research exploring these relationships would be, first, to discover more precisely the degree to which an elected mode of implementation enables successful, socially responsible diffusion of a technological development, and second, to establish means of determining how regulation patterns imposed on a technology shape the character of successive technological designs. Such information is absolutely essential for the confident affirmation of particular technological proposals or their rejection and for modifying the implementation process of operational technologies.

It now seems clear that the rationale behind technological development can no longer be simply technical possibility and economic feasibility. The relationships of alternative technological designs and implementation modes to various social values must be established These are minimum requisites for pointing technological development in a socially responsible direction

NOTES

[1]Don K. Price, *The Scientific Estate* (Cambridge: Harvard University Press, 1965).

[2]A Harris Poll conducted in early 1975 concerning nuclear energy developments is an especially corroborative instance.

APPENDIX A

PROCEDURES FOR 1974 CALIFORNIA SURVEY OF PUBLIC ATTITUDES TOWARD TECHNOLOGY

(Provided by Field Research Corporation)
San Francisco, California

The survey consisted of two segments (1) a reinterview panel of respondents who had first been interviewed in 1972; and (2) a cross-section sample of the adult general public (18 years of age and older)

Both the original 1972 survey, and the 1974 cross-section segment were based on FRC's Master Sample of California This design defines the universe to be sampled as consisting of all adults 18 years and older who reside in residential dwelling units Not included in this universe definition are persons residing in hotels or other transient quarters, persons with no clearly defined places of residence, migrant workers, drifters, inmates of institutions, or military personnel residing in government quarters As a practical matter, urban or rural ghettos and high-rise apartment houses with limited access tend to be underrepresented in samples, although they are included in the definition of the ideal universe

SAMPLING PROCEDURES

In constructing this statewide sample, the counties of the state were arrayed in geographic order in accordance with the ten state statistical areas established by the State Office of Planning The current population of each Census County Division from the 1970 Census was listed, and random selection of CCD's was made with probability of selection in proportion to size The random choices were made by systematic sampling, with random starts, in order to insure representative geographical distribution The result is a master sample of *primary sampling units* (PSU's) consisting of distinct geographic population units (CCD's), each PSU designating the general locus of starting points for one or more interviewing clusters

Specific locations for a Cluster, or Clusters, within a given PSU are determined by random selection of residential addresses from the current telephone directory within which the PSU is contained. This selection is made from the *total* telephone directory which contains the PSU. In effect, therefore, the PSU location has been used to designate a *telephone directory* as the frame for selection of interviewing Cluster starting points

Within the designated directories, the desired number of Cluster starting points are selected A cluster starting point is a residential address drawn from the directory by use of random designation of page, column, and listing. Only residential telephone addresses are drawn

The selected "key address" designates the starting point for a cluster of dwellings which provide interviews for the survey Procedures for the formation of dwelling unit clusters are such that the inclusion of a given residence in the sample *does not* depend on whether it has a telephone The probability of a cluster's initial selection does, however, depend on the ratio of telephone homes to total homes in the area, a circumstance which is taken care of by a telephone density weighting procedure

To form a Cluster, the interviewer lists a pre-designated number of occupied residences encountered on a pre-designated route around the block from the "key address " Vacancies, transient quarters, and the institutions are excluded from the listing The interviewer calls on each of the dwellings listed in the Cluster The standard procedure for general public opinion surveys is to select respondents by a method which provides an age-sex distribution in the sample which usually closely matches the census age-sex distribution of the adult population. For certain surveys, screening questions may be asked to locate registered voters or persons with other particular characteristics of relevance for the purpose of the survey A weighting procedure is used to "fine tune" the final sample on key population parameters (e g , age, sex, political party) where these are known from independent sources

CALL-BACK AND REINTERVIEW SCREENING PROCEDURES

Call-backs to those in the independent cross-section samples are made on households where no one was found at home on the first call Up to three call-backs were made before the interviewer gave up trying to reach someone Similar call-back procedures were used with the panel sample of respondents to be reinterviewed in 1974 In the event that the respondent interviewed in 1972 was not at home, his or her name was looked up on the local telephone book If the name was listed in the same town, further calls were made there. If not, the call-back procedure was ended

Additional screening procedures are used for reinterviewed panel samples This procedure is demonstrated in the interview guide facsimile below. It is intended to assure the interviewer that the respondent is being interviewed for the second time

SCREENING PROCEDURE SHEET

Hello, my name is ________ I'm with Field Research Corporation, a national public opinion survey company We're making a survey of opinion and my instructions call for me to interview a person here by the name of · (SEE ABOVE) Is that person at home right now?

YES	NO
May I speak with ________ ?	When would be the best time to come back to interview ____________ ?
GO TO INTRODUCTION	(Day/Date) (Time of day)

NO ONE HERE BY THAT NAME

Well, a (man)(woman) by that name was interviewed here two years ago Do you happen to know where that person can be found today?

YES	NO
WRITE NEW INFO IN SPACE ABOVE THEN THANK RESPONDENT AND TERMINATE	THANK RESPONDENT AND TERMINATE

INTRODUCTION WHEN PERSON NAMED ABOVE IS REACHED·

My name is ________ I'm with Field Research Corporation, a national public opinion survey company We're making a follow-up survey to one that we made in this area about two years ago Do you happen to recall being interviewed about how people's lives are affected by new developments in science and technology?

YES, MAYBE, NOT SURE

Well, just to be sure, our records show that the (man)(woman) interviewed was between ___ and ___ years of age. Would you have fit in this category two years ago?

- YES. → Good. Now to continue--GO TO INTERVIEW.
- NO → Is there any other (man)(woman here who does fit this age category?
  - YES → LOCATE AND INTERVIEW
  - NO → Well, perhaps there is an error in our records. Let's go on with the survey and I'll report the correction to my office. GO TO INTERVIEW

NO

Well, our records show that a (man)(woman) between age ___ and ___ was interviewed here Would you have fit in this category two years ago?

- YES → Good Let's go on with the interview and you may recognize some of the questions as we come to them. GO TO INTERVIEW
- NO → Is there any other (man)(woman) here who has a similar name who fits this age category?
  - YES → LOCATE AND INTERVIEW.
  - NO → Well, perhaps there is an error in our records. Let's go on with the survey and I'll report the correction to my office GO TO INTERVIEW

The 1974 Population Sample

The survey sample for 1974 emerged as follows from attempted contacts with the gross sample

Cross-section Sample Total Interviews Attempted			802
Interview completed		316	
Interview not completed:		486	
No adult at home (after callbacks)	160		
Communication problem	43		
Illness	19		
Inaccessible (doorman, dog, etc.)	12		
Refused, too busy	246		
Terminated after starting	6		
Reinterview Panel Total Reinterviews Attempted			980
Second interview completed		472	
Second interview not completed.		508	
Moved (no forwarding address, dwelling demolished)	218		
Deceased	35		
Illness	25		
Not at home (after callbacks)	154		
Refused, too busy	76		
Total 1974 sample			788

APPENDIX B

SUMMARY OF SURVEY QUESTIONNAIRES 1972-1974
PUBLIC ATTITUDES TOWARD TECHNOLOGY

Unless otherwise noted, questions listed below were asked of respondents in both years, 1972 and 1974. Questions are listed in the original order in which they were asked

1a First of all, how long have you lived in this state, altogether?

1b How long have you lived in this city or town?

	Length of time in--	
	1a State	1b City/Town
LESS THAN ONE YEAR	. .	
1-2 9 YEARS	.	.
3-4 9 YEARS	.	.
5-9 9 YEARS	. .	.
10 YEARS OR LONGER	. .	.

2a. Now, I'd like to talk about how much things are changing in the world today. things that affect how people make their livings, how life styles are changing, and things like that I'd like you to think for a minute about changes that have taken place in the lives of the people of this country since the 1940's--say the period since the end of World War II up to the present day About how much do you think things have changed for the average person? Quite a bit or not very much? (1972 only)

QUITE A BIT . .	1
NOT VERY MUCH . .	2
DON'T KNOW . .	3

2b In your opinion, what are some of the things that you believe 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? (PROBE TRY TO GET THE RESPONDENT TO MENTION AT LEAST TWO CHANGES) (1972 only)

2b (cont'd)

CHANGE ____

____

CHANGE ____

____

3 For each of the changes listed below, the respondent is to answer how much of a change for the better or worse it has made in life in general, using the following scale

Very much worse	Quite a bit worse	Slightly worse	In between	Slightly better	Quite a bit better	Very much better

a The development of household appliances like washers, dryers, dishwashing machines

b The development of automotive vehicles like cars, buses, trucks, etc

c The development of factories that produce things by automation.

d The development of very powerful weapons like the atomic bomb.

e The growth of the civil rights movement in this country (1972 only)

f The development of high speed computers. (1974 only)

g The development of the space program, sending men to the moon, sending space probes to other planets, etc. (1972 only)

h. The ability to understand and predict human motivations and behavior

i The development of birth control pills (1974 only)

j The change in the moral attitudes of people in this country (1972 only)

k. The development of television (1974 only)

4a Here are some issues (see List No 1) which have been mentioned in press and on television recently Naturally, some people are more interested in some issues than in others Which of these issues are the ones that you often think or talk about these days? (1974 only)

4a (cont'd)

List No 1	
1	Reducing the crime rate
2.	Solving the energy crisis .
3	Providing jobs for all people who want work . .
4.	Reducing the cost of living . .
5	Protecting the environment .
6	Providing mass rapid transit .
7	Protecting individual's private records from misuse .
8	Eliminating drug addiction .
9	Improving the quality of education . . .
10	Controlling population growth . . . .

4b For each of the above issues the respondent is then asked to indicate whether he feels the increased use of technology, that is, the application of scientific ideas to designing machines in other inventions, will have any effect or not, using the following scale

Will make this easier to do	No difference	Will make this harder to do	Can't say

(INTERVIEWER REPEAT FOR ALL TEN ISSUES.)

5 For each of the technological concepts noted on List No 2, the following questions were asked (Each respondent was asked to answer 6 concepts, see Chapter II for discussion)

a Suppose that a development like the one described were to be put into operation If it were to come into being, would it change your own life; very much, quite a bit, slightly, not very much, or not at all?

5a (cont'd)

Change, very much . . .	1
quite a bit .	2
slightly	3
not very much .	4
not at all	5
don't know	0

b Regardless of the possible effects on your own life, do you think it would change life for the average person very much, quite a bit, slightly, not very much, or not all?

Change, very much	1
quite a bit . .	2
slightly .	3
not very much .	4
not at all .	5
don't know .	0

c How sure do you feel that this development would have beneficial results? Are you absolutely sure, quite sure, or not too sure?

Absolutely sure .	1
Quite sure	2
Not too sure	3
Don't know	4
None . .	5

(If Absolutely sure or Quite sure--ask Question c.1)

c 1 What do you see as the most important benefits, or good things, that might result if such a development were actually to take place? (PROBE ANY OTHERS?)

d How sure do you feel that this development would have drawbacks or bad results? Are you absolutely sure, quite sure, or not too sure?

Absolutely sure .	1
Quite sure . .	2
Not too sure	3
Don't know . .	4
None.	5

(If Absolutely sure or Quite sure--ask Question d 1)

d 1 What do you see as the most important drawbacks, or bad things, that might result if such a development were actually to take place? (PROBE ANY OTHERS?)

List No 2

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

2 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

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

4 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.

5. 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

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

7 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

8 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

9 Power plants that use atomic energy to produce electricity.

10 Altering brain responses with special drugs so that the behavior of people who have mental disorders can be improved or controlled

11. 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.

12 Missiles which can intercept and destroy enemy rockets launched against this country before they get near enough to cause serious damage

6 Now, I'd like you to take all of these cards (HAND RESPONDENT 6 CONCEPT CARDS, from List No 2) and tell me whether they are things you would like to see, or whether they are things you would be opposed to. (Each respondent was asked to consider 6 technological concepts See Chapter II)

a. FOR EACH ONE THE RESPONDENT WOULD LIKE TO SEE, ASK How strongly do you favor this one--very strongly, somewhat strongly, or just slightly?

b FOR EACH "OPPOSED TO" ASK. How strongly do you oppose this one--very strongly, somewhat strongly, or just slightly?

OPPOSED TO				LIKE TO SEE		
Very Strongly	Somewhat Strongly	Slightly	Neither like to see nor opposed to	Slightly	Somewhat Strongly	Very Strongly
1	2	3	4	5	6	7

7 For each of the statements listed below, the respondent is to answer using the following scale

Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Don't know

a The standard of living would decline if there were less technological development

b. People who try to think in a scientific manner cannot appreciate most of life's beauties (1974 only)

c The only way to make sure that what scientists learn will not cause a lot of harm is to stop them from studying things unless they are clearly important and beneficial

d. There probably aren't any real solutions to some of our serious social problems. (1974 only)

e The energy shortage has been mainly created by the oil companies in order to make greater profits (1974 only)

f Atomic power plants are safe enough so that I don't worry about them exploding or leaking radiation (1974 only)

7 (cont'd)

g Basically all scientific discoveries are good, it is just how some people use them that causes all the trouble

h. No one should attempt to regulate which inventions are produced because it interferes with the individual's right to decide what he wants to buy

i The government is run by a few big special interest groups looking out for themselves. (1974 only)

j It would be nice if we would stop building so many machines and go back to nature

k If they are given money and left alone, scientists can be counted on to discover things that will make all our lives better.

l Any attempt to control which inventions are widely produced or made available will make our lives worse.

m We need stricter government control over the petroleum industry to prevent future energy shortages. (1974 only)

n People shouldn't worry about harmful effects of technology because new inventions will always come along to solve the problems (1972 only)

8 For each of the technological concepts noted on List No 3, the following questions will be asked.

a Which *one* or *two* of the people or groups on this [decision maker] list [included below] do you think actually has the most say about how things like that are used or dealt with? (RECORD BELOW UNDER PROPER TECHNOLOGY)

b Which *one* or *two* has the least say?

c. In order to represent the public interest, which one or two of the people or groups on this list do you feel *should* have the most say about how things like that are used or dealt with?

d In order to represent the public interest, which one or two *should* have the least say?

(INTERVIEWER REPEAT FOR EACH TECHNOLOGY CARD)

8 (cont'd)

Decision Maker List

1	Technical experts	5	The courts
2	Business leaders	6	Organized consumer groups
3	Top government leaders	7	Individual people/the public
4	Congressmen	8	No one

List No 3

1 Our demands for power such as electricity are growing so fast that we may not be able to produce as much of it as we may want. In terms of deciding how this limited power is to be used .

2 Too great a use of automobiles may cause congestion in the cities and increase pollution. In terms of deciding how a public system of mass rapid transit which would reduce problems caused by cars would be put into use.

3 Medical science has given us the ability to predict the sex, some of the physical characteristics, and to alter the genes of infants before their birth In terms of deciding if such information is to be put to use

4 Space stations manned by military personnel who can aim rockets and missiles at targets on earth can be designed In deciding whether they should be built ..

5 Large amounts of information about the characteristics of the public can be collected, stored and analyzed by computers In deciding how this information should be used .

6 Rockets to take astronauts and scientists to other planets such as Mars can be designed In deciding whether we should build these space ships

9. For each of the pairs of statements listed below, the respondent is to choose the statement that comes closest to his own opinion, even though he might not completely agree with it For the statement that is chosen, he is to answer whether he agrees strongly or moderately, and is scored on the following scale _ (1974 only)

STATEMENT A-1			STATEMENT A-2	
Agree Strongly	Agree Moderately	Don't Know	Agree Moderately	Agree Strongly

9. (cont'd)

a 1 Studying most things logically and scientifically can help people understand them better, although many things may never be fully understood

or

a 2 Trying to be scientific and logical is not much help in understanding how the world really works

b 1 We ought to increase our control over how inventions and other technologies are used

or

b.2 The way we control how inventions and other technologies are used now is just about right

c 1 In times like these, we really shouldn't hold it against our public leaders if they don't have solutions to some of the serious problems in our society

or

c 2 In times like these, if our public leaders don't have solutions for almost all of society's serious problems we should get leaders who do

d.1 We should not allow our growing need for energy to cause any slowdown at all in controlling pollution and improving the quality of the air and water

or

d.2 If it comes to a choice, our need for energy has to come ahead of an all-out emphasis on the quality of the air and water

e 1 The material things that technology has provided have freed us to find more satisfying lives

or

e 2 The material things that technology has produced trap us and prevent us from finding satisfying lives

f 1 We must produce enough energy to keep the factories going and people on the job even if it means more pollution of the air and water

or

f.2 We should not allow any further air and water pollution even if some people lose their jobs as a result of an energy shortage

9 (cont'd)

g 1 Our government leaders usually tell us the truth

or

g 2 Most of the things that our government leaders say cannot be believed

10. During the last few months, people have started to think about energy and the part it plays in their lives. Some people are concerned about the situation, some others are not Which of the following things really concerns you? (1974 only)

a Having to wait in line for gas

b Having to reduce the amount of heat in your home

c Being laid off from work

d Having to lower air pollution standards

e The possibility that we may run out of oil and gas before the end of the century

f People not recognizing that this is a serious problem and continuing their wasteful habits

g None of the above

11a People have different ideas of what should or should not be important in deciding whether technologies such as the inventions which we've been talking about should or should not be developed In general, when you are deciding whether a given technology is a good thing or a bad thing, which of these phrases best describes how much importance you give to such factors as ..

11b Often it is impossible to give equal importance to all of the factors Could you please arrange these cards in order placing the most important factor first and the next most important second and so on down to the least important which would be seventh.

[See next page for choice of wording of subjective factors for 11a , and their importance rankings for 11b]

	Question 11a					Question 11b
	Extremely Important	Somewhat Important	Slightly Important	Not at all Important	Don't Know	Rank in Importance
a What it may do to make life better and more enjoyable for the average person	1	2	3	4	0	________
b What it may do to increase or decrease employment	1	2	3	4	0	________
c What it may do to increase or decrease taxes	1	2	3	4	0	________
d What it may do to help or hurt the good image the United States has in the world	1	2	3	4	0	________
e. What it may do to increase or decrease pollution.	1	2	3	4	0	________
f. What it may do to help or hurt poor people	1	2	3	4	0	________
g What it may do to increase or decrease the amount of free time people have (1972 only)	1	2	3	4	0	________
h How it affects the individual's rights to privacy (1974 only)	1	2	3	4	0	________

12 For each of the statements listed below, the respondent is to answer using the following scale

Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Don't know

a Unless scientists are allowed to study things that don't appear important or beneficial now, a lot of beneficial things probably won't ever be discovered

b Relying only on scientific and logical thinking to solve society's problems can only make things more complicated (1974 only)

c Most elected officials can be counted on to work for things I really believe in. (1974 only)

d We must make certain that scientists are not allowed to study certain things in the first place because they may cause a lot of harm

e People have become too dependent on machines.

f We could solve more of society's problems if we did not place so many controls on the way inventions are used and produced (1974 only)

g No one should attempt to regulate which inventions are produced because they do not know how to do it

h Most of the time I just don't seem to have much control over my life (1974 only)

i Technology has made life too complicated

j The energy shortage is genuine and will be with us a long time. (1974 only)

k. Even if atomic power plants are not 100% safe, they're safe enough for us to go ahead and build them (1974 only)

13 [Somewhat different wording for this question and its answers were used in 1972 and 1974 Different versions are noted below]

(1972) What actions would you be likely to take if you felt strongly about some particular technological development?

(1974) Which, if any, of the political activities on this list have you done in the past few years? (See List No 4)

List No. 4 (Combined for 1972 and 1974)		
a.	Been eligible to vote	('74 only)
b	Become active in a club or organization involved in the issue	('72 only)
c	Support your position in discussion	('72 only)
d.	Contribute to (a political candidate or to any other political causes) that support your point of view	*
e	Been a volunteer work during a political campaign	('74 only)
f.	Attended meetings (of your city or town council) or lectures	*
g.	Put a bumper sticker (supporting a political candidate or issue) on your car . ..	*
h	Attended a public hearing of some government agency, such as a school board	('74 only)
i	Written a letter to the editor of a newspaper or magazine about some public issue.	('74 only)
j	Write to congressman or legislator	('72 only)
k	Circulate petitions about it	('72 only)
l	Worked with others in your community to try to solve some community problem....	('74 only)
m	Gone to see some governmental official in person about some problem.....	('74 only)
n	Actively worked against a candidate who supported the opposite side on an issue concerning the technology	('72 only)
o	Attended a protest (rally or demonstration) meeting	*
p	Picketed or taken part in a boycott over some political issue..	('74 only)
q	Voted (in a primary election) for a candidate because of it	*
	None of these.	.

*Parentheses indicate the wording used in 1974.

Now, just a few more questions for classification purposes

14. First, in politics today, do you consider youself a Republican, a Democrat, or as a member of some other party? (If other party) What other party?

Republican	1
Democrat.	2
Other Party ______________ (specify) . . .	3
Declined to state party	0
No answer	Y

15 Do you consider yourself more as a conservative or more as a liberal? (If Conservative or Liberal, ask): Do you consider yourself to be *Strongly* (conservative) (liberal) or just *moderately* (conservative) (liberal)?

Strongly Conservative	1
Moderately Conservative . .	2
Neither, Middle of the road . .	3
Moderately Liberal . . .	4
Strongly Liberal	5
Don't know, No opinion . . .	Y

16 In the primary this past June, did you happen to vote, or did something come up which kept you from voting? (1972 only)

Voted	1
Did not vote	2
Not registered to vote . .	3
Don't know. .	Y

17 a How did you vote on Proposition 9--for it, against it, or did you not vote on it? (1972 only)

Voted for it.	1
Voted against it	2
Did not vote on it . . .	3
Don't know . .	Y

(If "voted for it" or "voted against it," ask question 17b)

b Why did you vote as you did on Proposition 9?

(INTERVIEWER GET ONE OR TWO REASONS WHY THE RESPONDENT VOTED AS HE DID ON PROPOSITION 9)

18 Ask, for the chief earner in the family

a Are you/is the chief earner employed by someone, or is he in business for himself?

b. What kind of work do you/does the chief earner do?

________________	________________
Type of work	Industry

19 How much does your (WHEN THE RESPONDENT IS NOT THE CHIEF EARNER, USE CHIEF EARNER'S) job depend on future advances in Technology?

Very much	1
Somewhat	2
Not very much . .	3
Not at all .	4
Don't know. .	Y

20 (Standard questions concerning education of respondent, age, income, sex, ethnic/racial category, etc.)

APPENDIX C

CHARACTERISTICS OF THE 1972 AND 1974 CALIFORNIA SAMPLES (compared)

TABLE C-1

RACIAL CHARACTERISTICS

		WHITE	NON-WHITE	N
1972	TECH I	82.1	17.9	966
1974	TECH II	86.1	13.9	312
1972	MICHIGAN ELECTION STUDY	88.6	11.4	2705
1970	U.S. CENSUS CALIFORNIA	90.4	9.6	-
1970	U.S. CENSUS: TOTAL U.S.	89.2	10.8	-

TABLE C-2

SEX

		MALE	FEMALE	N
1972	TECH I	47.4	52.6	976
1974	TECH II	48.5	51.5	312
1972	MICHIGAN ELECTION STUDY	43.2	56.8	2705
1970	U.S. CENSUS. CALIFORNIA	48 1	51.9	-
1970	U.S. CENSUS: TOTAL U.S.	47.3	52.7	-

TABLE C-3

AGE (IN YEARS)

		18-20	21-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+	N
1972	TECH I	5.8	12.3	15.6	8.2	6.1	8 2	10.1	7.7	6 4	19.5	976
1974	TECH II	6.0	12 2	15.1	10.9	5.8	5.8	8.9	9.1	6.7	19.3	313
1972	MICHIGAN ELECTION STUDY	5.2	9.6	12.7	8.8	8.1	8.5	9.1	7.5	7.1	23.4	2683
1970	U.S. CENSUS. CALIFORNIA[a]	-	13.6	11.5	9.7	9.2	9.6	9.9	8.6	7.4	27.9	-
1970	U.S. CENSUS: TOTAL U.S.[a]	-	12.8	10.6	9.1	8.9	9.5	9.6	8.8	7.9	22.8	-

[a]18- and 19-year-olds are not included in the census figures. 20-year-olds are counted within the 21- to 24-year-old category.

TABLE C-4

EDUCATION

		8th Grade or Less	9th-11th Grade	12th Grade	1-2 yrs. College	3 yrs. College	Completed[a] College	Advanced[b] Degree	N
1972	TECH I	9.6	13.8	29.6	22.6	6.6	10.2	7.6	974
1974	TECH II	5.4	9.7	33.0	24.9	6.2	14.5	6.3	314
1972	MICHICAN ELECTION STUDY	21.8	17.5	25.3	19.5			4.1	2228
1970	U.S. CENSUS: CALIFORNIA	17.8	17.0	33.8	15.4	3.3	6.8	5.9	-
1970	U.S. CENSUS. TOTAL U.S.	25.5	18.8	32.4	10.3	2.6	6.2	4.2	-

[a]For census figures, this category is: "4 years of college."

[b]For census figures, this category is: "5 years of college or more."

TABLE C-5

OCCUPATION[a]

		Professional and Technical	Managers	Clerical and Sales	Skilled Workers Craftsmen	Operatives	Service Workers	Farm and Unskilled Workers	N
1972	TECH I	25.4	12.2	19 1	25.6	5.7	8.6	3.3	774
1974	TECH II	32.4	10 9	14.6	18 7	11.9	6.8	4.7	248
1972	MICHIGAN ELECTION STUDY	16.1	11.8	20.9	13.8	17.3	13.5	6.6	1905
1970	U.S. CENSUS· CALIFORNIA[b]	17.4	9.3	27.7	12.9	13.7	12.6	6.4	-
1970	U.S CENSUS· TOTAL U.S [b]	14.8	8.3	25.2	13.6	17 6	12.8	7.7	-

[a]People coded as retired, unemployed, or students are not included

[b]Census figures include all individuals 16 years of age and older.

TABLE C-6

INCOME (OF CHIEF EARNER)

		Less Than $3,000	$3,000-4,999	$5,000-6,999	$7,000-9,999	$10,000-14,999	$15,000-19,999[a]	$20,000[b] and Over	N
1972	TECH I	10.9	10.4	12.4	18.8	28.2	11.5	7.7	912
1974	TECH II	7.5	8.2	6 1	12.4	35.5	14.8	15.5	291
1972	MICHIGAN ELECTION STUDY	12.3	12.3	12 1	18.4	23.4	11.1	10.2	2612
1970	U.S. CENSUS· CALIFORNIA[c]	15.2	10 3	10.9	17.5	23.9	17.0	5.2	-
1970	U.S. CENSUS. TOTAL U.S.[c]	17.3	11.1	12.0	18.9	23 0	12.7	4.0	-

[a]For census figures, this category is: "$15,000-24,999."

[b]For census figures, this category is· "$25,000 and over."

[c]Census figures are for "household income."

TABLE C-7

PARTISAN IDENTIFICATION

		Republican	Decline to State[a]	Democrat	N
1972	TECH I	33.0	10.9	56 1	929
1974	TECH II	22.0	23.4	54.6	312
1972	MICHIGAN ELECTION STUDY	23.4	36.3	40.3	2702

[a]Includes: "Independent," "No Preference" and "Other" for Michigan data.

TABLE C 8

IDEOLOGICAL IDENTIFICATION[a]

		STRONGLY LIBERAL	MODERATELY LIBERAL	NEITHER; MIDDLE OF THE ROAD	MODERATELY CONSERVATIVE	STRONGLY CONSERVATIVE	N
1972	TECH I	9.9	27.5	17.5	34.5	10.7	894
1974	TECH II	11.7	30.0	17.7	30.6	10.0	301
1972	MICHIGAN ELECTION STUDY	2.1	23.8	37.4	35.0	1.7	1548

[a]For Michigan study categories were· Extremely Liberal, Liberal = 1, Slightly Liberal = 2; Moderate = 3; Slightly Conservative = 3; Conservative, Extremely Conservative = 5.

TABLE C-9

DEMOGRAPHIC COMPARISONS BETWEEN SELECTED SUBGROUPS

GROUPS COMPARED		AGE	SEX	RACE	INCOME	EDUC.	OCCUP.	PARTY IDENT.	IDE-OLOGY
I. Technician vs. non-technician:									
	72 XS	7 94*	1.82	0.00	4.82*	1.85	57.99*	0.49	3.86*
F-test*	Panel[a]	2.31	0.00	2.20	3.33	2.31	11.65*	0.98	-.67
	74 XS	3.35	0.20	2 18	4.28	1.96	8.31*	1 48	0.86
	72 XS	-.160	-.043	.001	.141	.003	-.125	.027	.008
Tau-b	Panel	-.160	.004	-.097	.193	.010	-.132	.074	.089
	74 XS	-.125	.026	-.085	-.169	.022	-.050	.084	.045
II. Educated technicians vs. rest of sample:									
	72 XS	4.79*	7.58*	0 83	5.83*	10.18*	18.19*	0.14	1.43
F-test	Panel	2.25	0.25	0.47	1.91	4.54*	5.36*	0.17	1.33
	74 XS	3.68*	0.75	0.20	4.91*	3.85*	2.18	7.84*	0.75
	72 XS	-.073	-.088	- 029	.157	.192	-.206	-.013	030
Tau-b	Panel	- 126	.024	-.065	.175	.206	-.250	.041	.136
	74 XS	.06	-.05	-.03	.23	.18	-.08	-.18	-.05
III. Educated non-technicians vs. rest of sample:									
	72 XS	4.67*	10.71*	5.53*	4.81*	274.65*	12.22*	2.26	6.03*
F-test	Panel	0.85	5.58*	1.29	3.29	67.11*	9.09*	5.40*	1.85
	74 XS	1 42	1 80	1.80	2.63	62.18*	14.54*	1.30	3.19*
	72 XS	-.000	-.105	-.076	.143	.555	- 247	-.067	.047
Tau-b	Panel	.002	-.086	-.064	.135	.586	-.259	-.139	-.043
	74 XS	.01	-.08	-.08	.18	.58	-.39	-.08	.17
IV. Educated technicians vs. educated non-technicians.									
	72 XS	5.24*	0.00	0.76	0.58	41.80*	41.80*	0.53	1.08
F-test	Panel	1.60	2.84	0.04	0 42	9.53*	3.94*	2.43	1.09
	74 XS	1.95	0.06	0.32	2.30	14.73*	8.45*	2.06	1.95
	72 XS	-.109	-.002	.048	.041	-.576	.033	.054	-.020
Tau-b	Panel	.071	.068	.092	-.221	-.668	.378	.104	.034
	74 XS	06	-.02	-.05	-.05	.51	-.39	.12	.21
V. Potential public vs. rest of sample:									
	72 XS	6.99*	22.66*	6.89*	12.99*	246.88*	30.14*	2.11	4.45*
F-test	Panel	2.26	2.60	2.18	6.62*	67.99*	16.90*	2.87	2.46
	74 XS	3.05	3.34	2.22	7 95*	56.39*	9.48*	7.84*	1.62
	72 XS	-.053	-.152	-.084	.234	.602	-.360	-.065	.061
Tau-b	Panel	-.093	- 055	-.103	.247	.649	-.413	-.088	.065
	74 XS	-.04	-.11	-.09	.34	.63	-.38	-.21	.10

[a]Demographic characteristics of the panel are based on the responses given in 1972.

*Asterisked numbers in F-test results indicate statistical significance at $p < .05$

APPENDIX D

SUPPLEMENTARY STATISTICAL AND TECHNICAL PROCEDURES

D-1 METHOD FOR SELECTING THE POTENTIAL PUBLIC

Throughout this research report, we have provided data for two sets of people a sample representing the entire cross section of California adults and a smaller group which we termed the "potential public " That latter set was isolated in an attempt to find a group of people who would most likely hold consistent and logically connected attitudes about a subject area which, for most people, lacked salience The potential public, then, is analogous to Converse's "issue public" and Devine's "attentive public "[1] Moreover, we believed that in the event that a technological controversy bursts forth on the public agenda, the potential public would disproportionately become actively involved Thus, the attitudes of the potential public are important because they may be precursors to more widely held beliefs and values and because they will very likely determine the dialogue in any public debate

The potential public was isolated using three variables which we felt were rough indicators of previous interest and involvement in technical and political affairs The first variable was based on the degree to which the respondent was involved in a technical vocation The respondent's *job category* and *occupational environment* were both determined and coded using the standard U S Census Bureau classifications. These two factors were then trichotomized into a typology representing job types or settings as high, moderate, or low technical nature (see below) The score given each category appears in their respective boxes

Degree of Technical Content in Job Setting		Degree of Technical Content in Job Category: Low	Moderate	High
	Low	1	2	3
	Moderate	2	3	4
	High	3	4	5

[1]See note 8, p. 42.

The second variable used to select the potential public was *education*. It was calculated by means of a seven-point indicator running from "less than 6th grade" to "advanced degree" The final variable measured political participation: a respondent was categorized according to whether he had voted in a primary, was registered but did not vote, or was not registered to vote.

The three variables were combined to produce an eleven-point "scale" That index is, of course, rather *ad hoc*, but we were simply looking for a *rough* way to select out the subset of the sample we were interested in We experimented with other more elaborate methods but found none which seemed to offer better results than the "simplistic" one ultimately selected

Using the index thereby constructed we arbitrarily chose those respondents with scores of seven and above for inclusion in the potential public. Interestingly, although as we expected we observed greater *internal consistency* of belief among the potential public, we found that the *distribution* of attitudes mirrored that of the general public quite closely

D-2 ADDITIONAL PANEL DATA

TABLE D-2

STABILITY OF RESPONSES FROM *PANEL* SAMPLE
(percentage of respondents in 1974 within one category of 1972 responses)

Technology	IMPACT ON: Self	Others	CERTAINTY OF: Benefit	Harm	Support/ Opposition
Urban rail	71.2%[a]	83.3	91.6	84.8	70.2
	77.1	89.2	97.4	88.7	79.5
Solar energy	69.5	76.0	89.0	89.3	60.3
	78.0	73.8	90.5	88.4	61.2
Organ transplants	70.3	80.7	92.8	89.0	65.7
	71.9	82.1	94.5	88.7	61.0
Nuclear energy	69.1	71.7	90.3	89.0	65.4
	71.8	77.6	88.7	86.3	68.4
Cable TV	70.3	78 5	81.0	88.5	57.1
	63.6	67.1	84.7	90.3	51.9
STOL	70.0	72.3	87.0	84.2	75.9
	76.0	79.7	90.3	75.4	76.4
ABM	65.3	72.4	89.8	85.7	62.9
	56.5	73.5	94.3	83.0	61.5
SST	77.7	72.1	89.3	90.6	60.8
	81.1	74.0	87.7	89.7	63.5
Brain drugs	72.2	69.7	89.6	83.0	53.5
	70.0	73.8	95.7	81.8	62.7
Space travel	77.6	67.0	93.6	86.2	62.8
	80.3	66.2	91.7	84.5	68.9
Genetic engineering	72.3	71.9	88.2	87.3	59.3
	71.4	82.8	86.9	83.3	63.8
Data banks	68.7	81.2	91.8	82.0	51.4
	68.9	84.3	95.9	86.4	57.3

[a]Top figure for cross-section sample; lower for potential public.

D-3 ADDITIONAL STATISTICAL PROCEDURES RUN ON SUPPORT VARIABLES

TABLE D-3a

PEARSON'S R COEFFICIENTS FOR PERSONAL IMPACT VERSUS SOCIETAL IMPACT AS INDICATED BY SUPPORT FOR THE TWELVE FUTURE TECHNOLOGIES

	SAMPLE					
CONCEPT	1972 XSEC	1972 PP	1974 XSEC	1974 XPP	1974 PANEL	1974 PPP
Urban rail	.539	.541	.365	.357	.255	.280
Solar energy	.693	.601	.709	.658	.672	.737
Organ transplants	.526	.570	.575	.455	.515	.468
Nuclear energy	.773	.782	.719	.746	.719	.770
Cable TV	.524	.606	.443	.160	.593	.566
STOL	.472	.492	.418	.331	.479	.666
ABM	.828	.836	.773	.805	.810	.867
SST	.437	.494	.599	.718	.408	.428
Brain drugs	.477	.435	.408	.394	.444	.356
Space travel	.621	.558	.618	.691	.532	.545
Genetic engineering	.497	.448	.438	.291	.337	.324
Data banks	.635	.667	.568	.567	.599	.639

TABLE D-3b

SAMPLE SIZE AND PEARSON'S R FOR RELATION BETWEEN CERTAINTY OF BENEFIT AND CERTAINTY OF HARM

	CROSS SECTION 1972		POTENTIAL PUBLIC 1972		CROSS SECTION 1974		POTENTIAL PUBLIC 1974		PANEL 1974		PANEL POTENTIAL PUBLIC 1974	
CONCEPT	N	r	N	r	N	r	N	r	N	r	N	r
Urban rail	360	-.374	123	-.319	132	-.392	66	-.298	185	-.252	66	-.198
Solar energy	316	-.287	90	-.241	98	-.339	39	-.160	163	-.229	61	-.105
Organ transpl.	352	-.404	115	- 409	107	-.237	42	-.362	177	-.222	66	-.251
Nuclear power	332	-.369	107	-.463	260	-.462	115	-.446	378	-.265	134	-.241
Cable TV	372	-.402	122	-.423	121	-.283	45	-.302	187	-.455	68	- 525
STOL	788	-.352	246	-.496	122	-.476	59	-.489	181	- 415	64	-.405
ABM	361	- 465	121	-.639	118	-.567	53	-.610	172	-.336	60	-.271
SST	372	-.352	112	-.492	117	-.397	45	-.560	188	- 452	68	-.340
Brain drugs	345	-.378	114	-.422	130	-.344	69	-.414	181	- 421	64	-.462
Space travel	363	-.337	105	-.174	117	-.234	53	-.209	185	-.355	68	-.245
Genetic engin.	355	-.527	109	-.525	132	- 324	64	-.379	198	-.502	62	-.455
Data banks	351	-.399	120	-.363	128	- 520	60	-.524	188	-.448	72	- 383

D-4 FURTHER NOTES ON MEASUREMENT TECHNIQUES

Interval Techniques on Ordinal Data Three statistical methods were used to analyze the survey data in this study Pearson's correlation coefficient, multiple regression analysis, and factor analysis. Each of those techniques assumes that the data is of the interval type. We would be hard put to verify such an assumption, the best that can be said for our survey data--and for virtually everyone else's--is that it is ordinal

The significance of using interval techniques on ordinal data has been a point controversy for a long time, it seems clear that there is little chance of resolution of the issue in the near term Some scholars, like Richard Grether and Seymour Lipset, hold that using interval techniques on ordinal data is entirely inappropriate and may induce distortions not only on estimates of the size of parameters but on their direction as well Other practitioners, e g Tufte, insist that most data, even if strictly ordinal, can be used in interval level techniques because those methods are highly robust

We gave considerable and careful thought to this issue. As indicated, we opted for the use of interval level methods We did so for a number of reasons. First, we conceived of this study as an exploratory one As such, we recognized that the measurement problems of treating a virtually uncharted subject area would probably dwarf any errors induced by using inappropriate techniques. Second, the interval level techniques used are familiar to more readers than other more esoteric methods would be This factor was important because we wished to avoid overwhelming the substantive thrust of the arguments with explanations of unfamiliar techniques

In the final analysis, however, those reasons would lose all validity if the degree of error made by using interval level methods on ordinal data was large To insure that it was not, we employed other non-interval methods to check our substantive points For instance, in addition to the Pearson's product moment coefficient we also calculated gamma and tau-b In general we found that the size of the Pearson parameter was greater than tau-b and less than gamma We never found an instance where the sign of the association (if significantly different from zero) was different in any of the three cases Because of those findings, because precision of estimation was not our goal, and because we could not find a solid reason to choose between gamma and tau-b, we felt comfortable in reporting the Pearson correlation

We also employed other techniques to carry out the multivariate analysis reported in Chapter VII In addition to performing regressions to estimate the effects of the five independent variables upon the support for future technology dependent variable, two other non-interval methods were employed as a check The first was multiple classification analysis--essentially a dummy variable regression program. Here the dependent variable must be interval, but the independent variables can be ordinal or even nominal The second method was the automatic interaction detector program In this technique the quality of data required is the same as in the multiple classification analysis, but the assumption of additivity, implicit in regression, does not have to be made. In both cases the results lead to interpretations quite congruent with those inferred from the regression analysis We therefore felt comfortable in reporting the more familiar interval technique

We did not carry out alternative methods to the factor analysis, in part because of our confidence that using interval techniques data did not produce major distortions Also, we employed the factor analysis only to demonstrate the multiple dimensionality of the respondents' attitude structure, not, for instance, to provide weights for scale construction We felt it unlikely that the dimensionality would be affected by the employment of a non-interval technique

<u>The Use of Weighted Variables</u> Despite the best efforts of the Field Research Corporation to select a representative sample of the California adult population, it is often impossible to interview a cross section whose demographic characteristics mirror it precisely Males tend to be underrepresented, as do the poor and the elderly. An attempt can be made to compensate for such disparaties by assigning "weights" whereby attitudes of respondents belonging to an underrepresented group count "more" than they would otherwise But such efforts at weighting are based on some implicit assumptions which might not be valid In particular, they assume that some relationship obtains between the demographic variables weighted and the attitudes expressed by the respondents Notwithstanding such problems, weighting has become a common practice in survey research, and we have employed it here.

In this study we have weighted the respondents along three lines--age, sex, and geographic location--in order to bring our sample up to the population estimates for California Some initial work was done to determine the extent to which such weighting produced results substantively different from what would be the case were weighting not employed. Generally the differences were small, i e , well within the range of sampling error

APPENDIX E

NOTES AND TECHNICAL ADDENDA TO CAUSAL MODEL OF SUPPORT FOR TECHNOLOGY

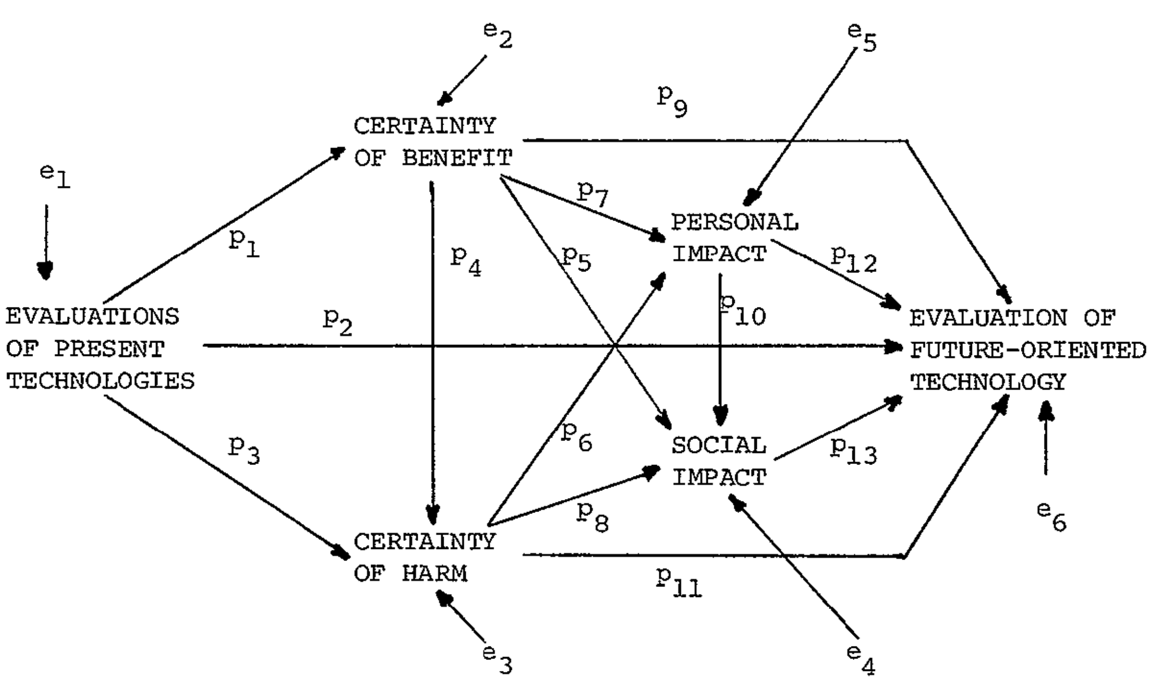
TESTS OF THE MODEL'S ADEQUACY

OVERIDENTIFICATION AS A TEST

A causal model which is recursive, i.e., does not contain any reciprocal interdependencies, can always be identified, that is, its parameters can always be estimated. Often the model contains equations which are overidentified. This means that more information is available than is needed simply to determine what the estimates of the coefficients are. That additional information can be used to test the model's adequacy.

For the model hypothesized below (from Figure 7-1), there is little additional information available to be employed in such a test, however.

A CAUSAL MODEL OF EVALUATIONS OF FUTURE-ORIENTED TECHNOLOGIES



The only predictions the additional information allows us to make is that there will be *no* path between the present technology variable and the variables measuring personal and social impact When regressions were carried out searching for such a path, none was found for any technology in either year Thus, in the limited test which could be made using the model's overidentification, the results confirmed the model's adequacy

STABILITY AS A TEST OF THE MODEL'S ADEQUACY

A second way to determine the validity of the causal model is to use stability over time to measure it If we assume that the causal relationships are stable over time, we can use the 1972 study to generate the model and the 1974 study to test it Substantial differences would suggest the model's inadequacy In the table below, the number of stable estimates (maximum of twelve) are given for each path and for both the entire cross section and the potential public Because the size of the 1974 sample was smaller than the 1972 sample, the former will be more likely to yield statistically insignificant estimates. This artifact will tend to overestimate the degree of instability. Therefore, the table also contains the number of estimates which are substantively stable even if the 1974 parameter was statistically insignificant

TABLE E-1a

STABLE PATH COEFFICIENTS
(maximum = 12)

PATH	CROSS-SECTION SAMPLE	POTENTIAL PUBLIC
p_1	10/12	9/12
p_2	4/6	3/8
p_3	6/6	5/7
p_4	11/11	9/10
p_5	9/11	4/7
p_6	11/12	8/9
p_7	9/11	4/6
p_8	7/9	8/8
p_9	12/12	9/9
p_{10}	11/12	9/9
p_{11}	9/9	11/11
p_{12}	8/11	9/9
p_{13}	10/11	10/10

As can be seen from Table E-1a, the estimates for the potential public are more unstable than those for the entire cross section This difference may very well be due to the larger sample size available in the latter instance. With the exception of paths p_2 and p_3 of the model, which are suspect, a strong case can be made for its adequacy.

THE EXTENT TO WHICH THE MODEL YIELDS STATISTICALLY SIGNIFICANT PATH COEFFICIENTS

A somewhat different question must also be addressed. how often is each path statistically significant? Each path coefficient was estimated a total of four times. for the entire sample and for the potential public in both 1972 and 1974 Those estimates could have been either statistically significant or insignificant If they were insignificant all four times, then we can infer that the particular path is non-existent If, at the other extreme, the path produced significant estimates all four times, then considerably more confidence in its existence is justifiable A given path could be significant for any one technology from zero times to four times. Table E-1b indicates how many times and for how many of the twelve technologies each path represented in the model was a viable parameter of causal influence.

TABLE E-1b

NUMBER OF TECHNOLOGIES POSSESSING VARYING NUMBERS OF STATISTICALLY SIGNIFICANT PATH ESTIMATES

	NUMBER				
PATH	0	1	2	3	4
p_1	3	2	1	1	5
p_2	2	1	7	2	0
p_3	0	3	5	1	3
p_4	0	0	0	3	9
p_5	2	0	4	5	1
p_6	3	4	1	2	2
p_7	0	1	0	4	7
p_8	5	4	3	0	0
p_9	0	0	0	3	9
p_{10}	0	0	0	2	10
p_{11}	0	0	2	1	9
p_{12}	7	2	2	1	0
p_{13}	6	2	3	1	0

As can be readily seen from Table E-1b, four paths, p_2, p_8, p_{12}, p_{13}, are statistically significant fewer than 50% of the time The remaining nine paths are significant at least 58% of the time

RESULTS OF REGRESSING SUPPORT/OPPOSITION FACTORS

The actual standardized regression coefficients for the model are presented in Table E-2 Figures indicate the influence of the upper variable on those variables beneath it

TABLE E-2

RELATIVE INFLUENCE OF FACTORS RELATED TO DECISION
TO SUPPORT OR OPPOSE SELECTED FUTURE-ORIENTED TECHNOLOGIES
(standardized regression coefficients for cross sections and potential publics)

Tech-	Present Technology				Certainty of						Certainty of Harm				Self	
	Certainty of				Harm		Benefit				Self		Others		Others	
	Benefit		Harm				Self		Others							
nologies	'72	'74	'72	'74	'72	'74	'72	'74	'72	'74	'72	'74	'72	'74	'72	'74
Urban	.05*	-.06*[a]	04*	17	-.38	-.38	42	.34	.32	.40	.06*	.06*	-.05*	-.01*	.41	23
rails	.19	00*	.12*	-.31	-.34	-.35	.45	.44	40	.26	.04*	.04*	.08*	-.14*	.37	28
Solar	-.07	-.16*	15	.02*	- 28	-.34	.32	.43	.20	.15*	-.05*	- 01	-.03*	- 06*	.62	.64
energy	-.14*	-.12*	.16*	-.31*	-.26	-.22*	.41	.52	.38	.18*	.04*	.10*	-.16	.06*	.44	.68
Organ	- 02*	-.05*	.18	.06*	-.40	-.23	.34	.37	.23	.08*	- 02*	.02*	04*	.04*	.45	.55
transpl.	-.11*	-.13*	13*	-.36	- 39	-.09*	.37	.30	37	.17*	- 04*	.28*	.04*	.13*	.44	.40
Nuclear	-.21	-.27	18	.21	- 33	-.41	.38	.29	.09	.11	.27	.26	.14	01*	73	.70
energy	-.44	- 36	.35	.30	-.31	- 49	.32	20*	.00*	.16	.19*	.22	.06*	.06*	.78	.77
Cable TV	-.01*	.08*	.04*	.10*	- 40	-.29	.53	.60	.28	.28	.02*	-.11*	.16	.13*	.40	.30*
	-.12*	21*	.03*	.40	-.42	- 43	.66	.50	.23	.16*	.09	-.18*	.21	.12*	.50	.00
STOL	-.14	-.30	20	.16	-.32	-.43	.30	.20	.16	.24	.07*	-.04*	-.02*	06*	.43	.37
	-.29	-.38	.20	.21	-.44	-.47	.46	17*	.22	22*	27	-.24*	-.09*	.11*	.43	.32
ABM	-.25	-.23	13	.26	-.43	- 51	.36	.18	.05*	.02*	.05*	.08*	.03*	-.02*	81	.77
	-.41	-.36	17	.35	-.57	-.60	.35	.02*	.00*	.09*	16*	.04*	00*	02*	.84	77
SST	-.19	-.29	.12	.00*	-.33	-.48	.39	.48	.21	.34	.15	.16	.00*	.18	.38	.47
	- 23	-.41	.37	-.07*	- 48	-.61	.42	.41	.12*	.14*	.17*	- 04*	.09*	-.03*	.45	.71
Brain	-.22	-.19	.09*	.10*	-.36	-.40	.22	07*	.20	.24	.18	.24	.08*	.15*	.44	.38
drugs	-.22	-.33	.10	.12*	- 40	-.29	.17*	-.16	.27	.22*	.21	.26	.03*	.19*	41	.42
Space	- 25	-.24	.25	.14*	- 28	-.33	39	.46	.17	.23	.12	-.10*	.07	.06*	.56	52
travel	-.16*	-.29	39	.10*	-.11*	-.37	.43	.40	.07*	.16	.08*	-.17*	15*	.29	.53	63
Genetic	-.10*	-.11*	.10	.01*	-.52	-.20	.32	.30	.17	.11*	17	.30	.10*	.30	.46	37
engin.	-.17*	-.19*	.11*	-.13*	-.51	-.40	.45	.16	.03*	.34	.27	.19	.00*	.47	.44	.18*
Data	-.14	-.07*	.14	.19	-.38	-.32	.19	.00*	.09*	.01*	.38	.28	.09*	29	.61	.48
banks	-.34	-.24*	.19	19*	-.31	-.46	.11*	-.21*	-.03*	-.22*	.42	.09*	.13*	17*	61	.48

[a]Top figure for cross section, lower for potential public

*Indicates regression coefficient not significant at $p < .05$; i.e., sigma beta > 5 of beta weight.

APPENDIX F

BRIEF REVIEW OF THE PRIOR LITERATURE ON PUBLIC ATTITUDES TOWARD TECHNOLOGY

Over the past twenty years, questions similar to the ones asked in our study were included in a number of public opinion polls Sometimes the wording of these questions was remarkably like that used in our own surveys, other times the wording was different, but the underlying concept being measured was the same. We have gathered together nine other studies and selected from them a set of questions which deal with the issues examined in this report In general, we have found an impressive degree of congruity between the work of others and our own To be sure, we found some differences in the precise distributions. But the extent of those differences, which in any case usually appear minor, is even further diminished when one considers that deviations are induced simply when questions are worded in slightly different ways. Thus, while we cannot make any claims about the stability over time of the results of these additional studies, they do seem to affirm that the California population's attitudes do not depart markedly from those of people in the rest of the country Moreover, differences in verbal presentation between our study and the others are not particularly crucial, efforts to measure the same underlying concept or issue generally yield much the same results

The nine studies to be reviewed here are

(1) Science Writers' study, done by the University of Michigan Survey Research Center, published as *The Public Impact of Science in the Mass Media*, 1958 1919 persons were chosen using a national sample.

(2) Irene Taviss study, done by Harvard Program on Technology and Science, published in *Technology and Culture*, 1972 201 persons from three communities near Boston

(3) American Federation of Information Processing Societies (AFIPS) study, done by Lieberman Research, Inc , New York, published as *A National Survey of the Public's Attitudes Toward Computers*, 1971 1001 telephone interviews with a national sample

(4) National Science Board study, done by Opinion Research Corporation, published as *Attitudes of the U.S. Public Toward Science and Technology*, 1972 2,209-person national sample

(5) A Etzioni and Clyde Nunn's study, based on Michigan SRC data and Harris Polls, published as "The Public Appreciation of Science in Contemporary America" in *Daedalus* (Summer, 1974): national samples

(6) Ebasco Services study, done by the Louis Harris Corporation, published as *A Survey of Public and Leadership Attitudes Toward Nuclear Power Development in the United States*, 1975 1,537-person national sample

(7) Gallup Poll, Oct 9-13, 1970. national sample.

(8) Opinion Research Corporation study, September, 1965 national sample

(9) A French study, done by the Center for the Study of French Contemporary Political Life, published as "Research on the Attitudes of Public Opinion Concerning Scientific Research," (Mimeo, 1973). 1200-person national sample.

Items selected from the above are grouped here so as to parallel the order in which similar items were discussed in the present report.

I GENERALIZED ATTITUDES TOWARD SCIENCE AND TECHNOLOGY (We had consulted the Taviss work in writing our questionnaire. Four items in particular were used by both of us, and the distributions are quite similar to the ones we report in Chapters III and V. The Michigan SRC study employed a set of questions, responses to which demonstrate the same rather strong commitment to the value of scientific activity as our data reveal While the Etzioni and Nunn data would seem to suggest a greater degree of disenchantment with scientific work in 1964 than in 1957, the National Science Board study clearly indicates that the disenchantment has receded--perhaps to below the 1957 level The French study provides evidence of somewhat more negative attitudes toward scientific research)

1. Taviss study

Item	% Responding Agree	Not Sure	Disagree	(N)
People today have become too dependent upon machines	78.1	5.5	16.4	(201)
It would be nice if we would stop building so many factories and go back to nature	35 8	10 0	54 2	(201)
Technology has made life too complicated	32 3	10.4	57 2	(201)
If there were less technological development, do you think that the standard of living would decline?	60 2	8 5	31 3	(201)

2 Michigan SRC study.

	Agree	Disagree	Don't know	NA	Total	Number of Cases
Science is making our lives healthier, easier and more comfortable	94	3	2	1	100%	(1919)
One of the best things about science is that it is the main reason for our rapid progress	89	6	4	1	100%	(1919)
One trouble with science is that it makes our way of life change too fast.	43	51	5	1	100%	(1919)
The growth of science means that a few people could control our lives	32	60	7	1	100%	(1919)
One of the bad effects of science is that it breaks down people's ideas of right and wrong	23	67	8	2	100%	(1919)
Science will solve our social problems like crime and mental illness	47	45	6	2	100%	(1919)

3 Etzioni and Nunn study

Item	Percent Agreeing 1957	1958	1964
Science makes our way of life change too fast	43%	47%	57%
Science breaks down people's ideas of right and wrong	23	25	42
The growth of science means a few people could control us	32	40	--
Number of respondents	1919	1547	923

4. National Science Board study

Do you feel that science and technology change things too fast, too slowly, or just about right?

	NUMBER OF INTERVIEWS UNWTD	WTD	TOO FAST	TOO SLOWLY	JUST ABOUT RIGHT	NO OPINION
Total U S Public	2209	8221	22	16	51	11
Men	1053	3969	23	19	49	9
Women	1156	4252	22	12	53	13
18 - 29 years of age	592	2130	26	15	51	8
30 - 39	410	1315	17	19	55	9
40 - 49	396	1579	20	18	51	11
50 - 59	318	1290	24	11	55	10
60 years or over	493	1908	23	14	45	18
Less than high school complete	738	3532	22	14	48	16
High school complete	757	2888	23	14	56	7
Some college	704	1775	23	19	50	8
Professional	341	969	21	18	54	7
Managerial	247	805	23	17	56	4
Clerical, Sales	210	707	21	20	50	9
Craftsman, Foreman	388	1408	19	16	56	9
Other manual, Service	486	2087	25	14	50	11
Farmer, Farm laborer	88	326	35	12	39	14
Non-Metro--Rural	257	987	34	11	44	11
Urban	397	1801	20	11	56	13
Metro--50,000 - 999,999	736	2504	23	15	54	8
1,000,000 or over	819	2930	19	19	48	14
Northeast	548	1962	19	21	49	11
North Central	653	2294	24	15	53	8
South	643	2578	23	12	50	15
West	365	1388	24	14	53	9
Under $5,000 family income	378	2347	22	13	48	17
$5,000 - $6,999	276	963	27	11	48	14
$7,000 - $9,999	498	1523	24	19	47	10
$10,000 - $14,999	494	1788	23	13	58	6
$15,000 or over	506	1398	16	21	56	7
White	2009	7261	22	15	53	10
Nonwhite	191	933	21	15	40	24

5. French study

The development of scientific knowledge makes men better.

Completely Agree	Mainly Agree	Mainly Disagree	Completely Disagree	Don't know
10	28	30	18	14

Technological progress increases unemployment.

Completely Agree	Mainly Agree	Mainly Disagree	Completely Disagree	Don't know
32	37	17	10	4

Even if certain scientific studies risk compromising moral principles (for example, test-tube babies, brain operations), one must nevertheless continue this kind of research.

Completely Agree	Mainly Agree	Mainly Disagree	Completely Disagree	Don't know
27	29	15	21	8

Technological progress creates such an artificial life style that it endangers the life of the next generation.

Completely Agree	Mainly Agree	Mainly Disagree	Completely Disagree	Don't know
33	34	19	9	5

II· CONTROL OF SCIENCE AND TECHNOLOGY. (The National Science Board survey reinforces our argument that the public does not want to see any decrease in the amount of control exercised over technological innovations More people would rather it be increased rather than diminished.)

National Science Board survey

Do you feel that the degree of *control* that society has over science and technology should be increased, decreased, or remain as it is now?

	NUMBER OF INTERVIEWS UNWTD	WTD	INCREASED	DECREASED	REMAIN AS IT IS	NO OPINION
Total U S Public	2209	8221	28	7	48	17
Men	1053	3969	29	9	49	13
Women	1156	4252	27	5	47	21
18 - 29 years of age	592	2130	29	8	48	15
30 - 39	410	1315	27	8	52	13
40 - 49	396	1579	25	10	45	20
50 - 59	318	1290	31	7	45	17
60 years or over	493	1908	28	4	47	21
Less than high school complete	738	3532	25	6	45	24
High school complete	757	2888	30	7	51	12
Some college	704	1775	31	10	46	13
Professional	341	969	26	11	51	12
Managerial	247	805	27	9	52	12
Clerical, Sales	210	707	29	7	50	14
Craftsman, Foreman	388	1408	30	8	47	15
Other manual, Service	486	2087	28	8	46	18
Farmer, Farm Laborer	88	326	32	3	48	17
Non-Metro--Rural	257	987	32	8	42	18
Urban	397	1801	22	5	52	21
Metro--50,000 - 999,999	736	2504	29	8	52	11
1,000,000 or over	819	2930	29	7	44	20
Northeast	548	1962	29	6	48	17
North Central	653	2294	27	7	51	15
South	643	2578	27	8	42	23
West	365	1388	28	10	51	10
Under $5,000 family income	378	2347	27	6	43	24
$5,000 - $6,999	276	963	31	7	43	19
$7,000 - $9,999	498	1523	29	7	46	18
$10,000 - $14,999	494	1788	31	7	51	11
$15,000 or over	506	1398	23	10	57	10
White	2009	7261	28	7	50	15
Nonwhite	191	933	27	7	31	35

III EVALUATIONS OF SCIENCE AND TECHNOLOGY. (Four American studies reinforce our point that evaluations of science and of technology are highly skewed in the positive direction. The somewhat more positive finding of those works compared to our own is due to differences in question format They asked about technology and science as global entities while we asked about particular presently implemented technological systems. The French study is interesting as well It repeats our finding that science is distinguished from technology and that the former is more highly valued than the latter.)

1. Michigan SRC study

The Net Impact of Science on Society

The world is better off due to science	83%
The world is better off, qualified	5
Both better off and worse off, about fifty-fifty	3
The world is worse off, qualified	1
The world is worse off due to science	2
Don't know	5
Not ascertained	1
	100%
	N = (1919)

2. Taviss study

Item	% Responding Agree[a]	Not Sure	Disagree[b]	(N)
Technology does more good than harm.	76 1	12.4	11 5	(201)

3 AFIPS study.

Attitude Towards Effect of Inventions and Technology on Life in the Past 25 Years

	Total (1,001)
Life is better	85%
Life is much better	56
Life is somewhat better	29
Life is the same	2
Life is worse	8
Life is much worse	3
Life is somewhat worse	5
Don't know, no answer	5
Total	100%

Based on the questions "All in all, what effect do you think inventions and technology have had on life in the past 25 years--have they made life better, worse or haven't they affected us one way or the other? Would you say much or somewhat (better/worse)?"

4 National Science Board study

Do you feel that science and technology have changed life for the better or for the worse?

	NUMBER OF INTERVIEWS UNWTD	WTD	BETTER	WORSE	BOTH	NEITHER/ NO EFFECT	NO OPINION
Total U.S. Public	2209	8221	70	8	11	2	9
Men	1053	3969	73	8	11	2	6
Women	1156	4252	68	8	12	2	10
18 - 29 years of age	592	2130	70	11	12	1	6
30 - 39	410	1315	74	6	11	3	6
40 - 49	396	1579	73	8	11	1	7
50 - 59	318	1290	74	6	8	3	9
60 years or over	493	1908	63	7	14	2	14
Less than high school complete	738	3532	64	10	10	2	14
High school complete	757	2888	73	7	13	2	5
Some college	704	1775	78	8	11	1	2
Professional	341	969	78	6	11	1	4
Managerial	247	805	74	6	5	2	3
Clerical, Sales	210	707	72	6	13	3	6
Craftsman, Foreman	388	1408	74	9	11	1	5
Other manual, Service	486	2087	66	10	13	2	9
Farmer, Farm Laborer	88	326	65	13	9	5	8
Non-Metro--Rural	257	987	66	12	12	2	8
Urban	397	1801	70	7	10	1	12
Metro--50,000 - 999,999	736	2504	72	9	13	2	4
1,000,000 or over	819	2930	70	7	11	2	10
Northeast	548	1962	72	6	12	2	8
North Central	653	2294	71	7	13	3	6
South	643	2578	65	9	10	2	14
West	365	1388	76	11	9	1	3
Under $5,000 family income	378	2347	63	10	11	2	14
$5,000 - $6,999	276	963	60	8	17	2	13
$7,000 - $9,999	498	1523	70	7	12	4	7
$10,000 - $14,999	494	1788	76	8	13	*	3
$15,000 or over	506	1398	83	5	6	3	3
White	2009	7261	72	8	12	2	6
Nonwhite	191	933	55	10	10	*	25

5 <u>French study</u>·

In a general way do you think that *science* brings to man more of good than bad, or more bad than good, or about the same of good and bad?

-More good than bad	56
-More bad than good	5
-About the same of each	38
-Don't know	2

In a general way do you think that *technical progress* brings to man more good than bad or more bad than good or about as much good as bad?

-More good than bad	43
-More bad than good	10
-About the same	45
-Don't know	2

IV SOCIAL UTILITY OF TECHNOLOGY (The National Science Board's study recapitulates our finding that the public sees the possibility of widespread but nearly universal use of technology in solving social problems.)

National Science Board study:

For the most part, do you feel that science and technology will eventually solve *most* problems such as pollution, disease, drug abuse and crime, *some* of these problems, or *few if any* of these problems?

	NUMBER OF INTERVIEWS UNWTD	WTD	MOST	SOME	FEW IF ANY	NO OPINION
Total U S. Public	2209	8221	30	47	16	7
Men	1053	3969	34	45	16	5
Women	1156	4252	26	49	16	9
18 - 29 years of age	592	2130	27	52	16	5
30 - 39	410	1315	32	52	13	3
40 - 49	396	1579	30	51	15	4
50 - 59	318	1290	34	40	19	7
60 years or over	493	1908	29	40	18	13
Less than high school complete	738	3532	29	41	18	12
High school complete	757	2888	28	53	15	4
Some college	704	1775	34	49	14	3
Professional	341	969	31	48	19	2
Managerial	247	805	39	46	14	1
Clerical, Sales	210	707	27	57	12	4
Craftsman, Foreman	388	1408	31	50	14	5
Other manual, Service	486	2087	30	46	17	7
Farmer, Farm Laborer	88	326	20	44	28	8
Non-Metro--Rural	257	987	27	42	24	7
Urban	397	1801	30	42	19	9
Metro--50,000 - 999,999	736	2504	29	51	15	5
1,000,000 or over	819	2930	32	48	13	7
Northeast	548	1962	30	56	9	5
North Central	653	2294	29	50	17	4
South	643	2578	27	41	20	12
West	365	1388	37	40	19	4
Under $5,000 family income	378	2347	30	40	16	14
$5,000 - $6,999	276	963	22	53	19	6
$7,000 - $9,999	498	1523	31	46	17	6
$10,000 - $14,999	494	1788	32	50	15	3
$15,000 or over	506	1398	33	50	16	1
White	2009	7261	31	48	16	5
Nonwhite	191	933	25	39	14	22

V CONCERN ABOUT THE ENVIRONMENT. (The Gallup and Harris questions confirm the importance of the environment as a value for the America public--a finding which supports our own work Interestingly, the ORC data do indicate that a substantial number of individuals express a willingness to "put their money where their mouth is.")

1 Gallup survey.

When people around here go to vote on November 3rd for a candidate for Congress, how important will pollution be in their thinking? Do you think it is extremely important, fairly important, or not so important?

1970 October 9-13	*Extremely Important*	*Fairly Important*	*Not So Important*	*Don't Know*
National total	58%	30%	9%	3%
By size of community:				
1,000,000 and over	72	24	4	-
500,000-999,999	54	40	4	2
50,000-499,999	62	27	20	1
2,500-49,999	60	27	10	3
Under 2,500, rural	47	34	13	6
By geographic region				
East	61	31	6	2
Midwest	59	29	10	2
South	51	30	12	7
West	64	30	5	1

2 Harris survey

What are the two or three top problems facing people such as yourself that you would like to see the new Congress do something about? Anything else?

1971 January 4

State of the economy	63%
Control of air and water pollution	41
War in Vietnam	31
Taxes and spending	31
Crime	28
Drugs	18
Student unrest	15
Education	11
Increase Social Security	9
Racial problems	8
National health insurance	7
Housing	6
Farm problems	5
Labor problems	4
Cut foreign aid	4
Abolish the draft	4

3 ORC survey

If it would cost each family an extra $100 a year in taxes to have water/air pollution greatly reduced, would you be willing to accept this expense? IF NO *How much would you be willing to pay?*

1965 September

	Willing to Pay: $100	*Less than* $100	*Not Willing*
Water pollution:			
National total	29%	8%	63%
By size of community			
1,000,000 and over	30	10	60
100,000-999,999	27	9	64
2,500-99,999	31	6	63
Small towns, rural	29	19	61
By geographic region:			
Northeast	29	9	62
Midwest	29	9	62
South	32	8	60
West	21	9	70
Air pollution			
National total	21	9	70
By size of community			
1,000,000 and over	19	14	67
100,000-999,999	27	3	70
2,500-99,999	23	8	69
Small towns, rural	16	9	75
By geographic region			
Northeast	23	11	66
Midwest	17	6	77
South	21	8	71
West	21	15	64

VI DECISION MAKING WITH RESPECT TO TECHNOLOGY (The Taviss study of decision making with respect to technology supports several of our findings

(1) The Congress, President are seen to be exercising decision making power illegitimately, although not nearly to as great a degree as in our study.
(2) Technical experts are seen as exercising considerable power legitimately.
(3) The public feels that it is being excluded from power unfairly--although, again, the feeling is less intense than in California.

Business leaders do not appear to have come out as poorly in the Taviss study as they did in our own. The Etzioni and Nunn data reinforce the finding that the public places a great deal of confidence in technical experts and scientists The French study offers a sharp contrast to the American findings The government is much more highly regarded while the public's actual role seems more acceptable.)

1. <u>Taviss study</u>

Technology and Decision-Making

Decision	Percent Responding: Indi-vidual	Public Opinion Poll	Direct Vote	Presi-dent	Congress	Elected State Reps	Elected Local Reps	Experts	Military	Industry	(N)
Stop Pollution											
Who Does	9 5	4 2	5 8	8 4	26 8	9 0	3 7	20 5	--	12.1	(190)
Who Should	7 6	4 1	9 1	11 2	18 8	6 6	3 1	20 3	--	19 3	(197)
Trips to Mars											
Who Does	5	2 0	2 0	30 5	18 8	--	--	36 6	8 6	1 0	(197)
Who Should	2 1	7 2	19 2	21 8	19 7	5	--	24 9	4 7	--	(193)
Nuclear Power Plants											
Who Does	5	3 6	6 2	10 8	16.5	8.2	7.7	18 0	12 9	15 5	(194)
Who Should	1 5	7 7	27 7	5 6	10.3	4.6	10 3	18 5	7 7	6 2	(195)
Creating Data Bank											
Who Does	3 8	4 3	7 0	18.4	49 7	2 7	.5	7.6	2.2	3 8	(185)
Who Should	5.7	10 3	37 6	13 9	21 6	1 6	--	6 7	5	2 1	(194)

2 Etzioni and Nunn study

*Percentage of the Public Indicating "A Great Deal" of Confidence in 16 Institutional Areas. 1966 vs. 1971-1973**

Institution	Year of Poll 1966	1971	1972	1973	Change 1966-1973
Medicine	72%	61%	48%	54%	-18%
Science	56	32	37	37	-19
Education	61	37	33	37	-24
Finance	67	36	39	—	—
Religion	41	27	30	35	-6
Psychiatry	51	35	31	—	—
U S Supreme Court	51	23	28	32	-19
Military	62	27	35	32	-30
Retail businesses	48	24	28	—	—
Federal executive branch	41	23	27	29	-12
Major U S companies	55	27	27	29	-26
Congress	42	19	21	23	-19
The press	29	18	18	23	-5
Television	25	22	17	19	-6
Labor	22	14	15	15	-7
Advertising	21	13	12	—	—

*Louis Harris and Associates for polls in 1966, 1971, 1972. National Opinion Research Center, General Survey of the National Data Program for the Social Sciences, 1973.

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*Public's Confidence in Those Who Run Science. 1966 vs. 1971-1973**

Confidence in Science	Year of Poll 1966	1971	1972	1973	Change 1966-1973
Great deal	56%	32%	37%	37%	-19%
Only some	25	47	39	47	+22
Hardly any or none	4	10	8	6	+2
Not sure	15	11	16	10	-5

*Louis Harris and Associates for polls in 1966, 1971, and 1972. National Opinion Research Center, General Survey of the National Data Program for the Social Sciences, 1973.

3 French study

In your opinion in the following list who, in France, has the most influence on the orientation of scientific research and technology?

	1st	2nd
-the government	37	22
-scientific researchers	33	22
-the military	6	10
-the whole of the population	9	9
-private enterprise	11	24
-don't know	10	13

And 2nd?

And, in your opinion, who should have the most influence on the orientation of scientific and technological research?

	1st	2nd
-the government	34	22
-the military	1	2
-the whole of the population	19	23
-private enterprise	4	15
-don't know	7	3

And 2nd?

VII ATTITUDES TOWARD NUCLEAR POWER. (The Ebasco study demonstrates that the favorable opinion towards nuclear power found in California is also present nationally. Moreover, the national sample offers a quite similar set of advantages and disadvantages as did our California population Finally, there seems to exist nationally a strong consensus that nuclear power plants are safe--such a finding is in complete accord with our data)

EBASCO study·

FAVOR/OPPOSE THE BUILDING OF MORE NUCLEAR POWER PLANTS IN THE UNITED STATES

	Favor %	Oppose %	Not Sure %
Total Public	63	19	18
East	58	23	19
Midwest	65	18	17
South	64	15	21
West	68	18	14
Cities	64	21	15
Suburbs	65	18	17
Towns	63	19	18
Rural	62	16	22
18-29 years	64	22	14
30-49 years	64	20	16
50 years and over	63	15	22
Some H.S. or less	57	15	28
H S. grad/some college	66	20	14
College grad	68	23	9
Under $5,000	52	20	28
$5,000-$9,999	61	17	22
$10,000-$14,999	64	20	16
$15,000 and over	71	19	10
White	65	19	16
Black	55	17	28
Men	73	16	11
Women	54	21	25
Total Nucplant Neighbors	63	23	14
Indian Point, N Y.	56	28	16
Morris, Ill	58	25	17
San Onofre, Calif	75	17	8
Nucpower in Own Community			
Main energy source	64	25	11
Not main energy source	69	20	11

TWO OR THREE MAIN ADVANTAGES
OF NUCLEAR POWFR PLANTS

	Total Public %
Cheap, produced more cheaply, less expensive to use	31
Clean energy, less pollution than gas, oil, coal	25
Unlimited supply, abundant source, reusable	21
More powerful, efficient, high output of energy	12
Make U S independent of foreign oil	11
Alternative to gas, oil, coal	8
We need energy, good source of energy	7
Cheaper in the long run	7
Helps save natural resources	5
Would create jobs	4
More reliable, dependable	2
Favor, if safe, properly controlled	2
Compact, self-contained, less storage space necessary	2
It's available immediately	2
Progress, modern, advanced technology	2
It's safer, not dangerous	1
Could be built anywhere	*
They'll solve waste disposal problems	*
Favor, if built away from populated areas	*
Easy transportation of fuel	-
All other answers	4
None, no advantages	5
No answer	1
Don't know	20

TWO OR THREE MAIN DISADVANTAGES
OF NUCLEAR POWER PLANTS

	Total Public %
Unsafe, dangerous	23
Danger of radiation contamination, leaks, cracks in reactor	20
Danger of accidents, explosions, earthquakes	14
Thermal pollution, kills marine life	12
Problems with radioactive waste disposal	10
Pollution, damage to environment	9
Expensive, high cost	7
Initial expense is high, financing problems	7
Lack of technical knowledge, uncertainty of consequences	6
Need stringent controls, safeguards	5
Public anxiety over safety, objections of environmental groups	4
Danger of sabotage	2
Sites not available	2
Danger to workers in nuclear plants	1
Puts people out of work	1
Inefficient, breaks down	1
Shortage, lack of plutonium	1
Length of construction time	-
Fuel getting into wrong hands, theft of plutonium	-
Exempted by government from liability claims, insurance coverage	-
Human carelessness, error	-
All other answers	5
None, no disadvantages	9
No answer	1
Don't know	27

HOW SAFE ARE NUCLEAR POWER PLANTS

	Very Safe %	Some-what Safe %	Not so Safe %	Dangerous (Volunteered) %	Not Sure %
Total Public	26	38	13	5	18
East	26	36	16	6	16
Midwest	22	45	12	6	15
South	25	36	12	3	24
West	32	38	9	6	15
Some H S or less	19	34	14	4	29
H S grad/some college	28	41	12	6	13
College grad	35	41	10	8	6
Men	38	35	10	5	12
Women	15	42	15	5	23
Favor more nucplants in U S	39	45	5	1	10
Oppose more nucplants in U.S	4	31	34	22	9
Total Nucplant Neighbors	35	38	12	7	8
Indian Point, N Y	25	44	16	9	6
Morris, Ill	33	38	14	5	10
San Onofre, Calif	48	32	5	7	8

VIII ATTITUDES TOWARD COMPUTERS (In the AFIPS study, we discover that most people have positive evaluations toward computers, that there is concern about the use of computers to abridge individual liberties, and the government ought to be concerned about such problems All of those attitudes are completely consistent with findings made in our study)

AFIPS study

Attitude Toward
Effect of Computers on Life

	Total (1,001)
Life is better	71%
Life is much better	40
Life is somewhat better	31
Life is the same	5
Life is worse	15
Life is much worse	5
Life is somewhat worse	10
Don't know, no answer	9
Total	100%

Based on the questions "Overall, what effect do you think the use of computers has had on life--has it made life better, worse, or hasn't it affected us one way or the other? Would you say much or somewhat (better/ worse)?"

Beliefs about Computers

	Total (1,001)		
	Agree	Don't know No answer	Disagree
The development of large computerized information files will help make our government more effective	63%	8%	29%
Safeguards are used by government to make sure that personal information stored in computers is accurate	53	19	28
Because of computerized information files, too many people have information about other people	58	9	33
Computerized information files may be used to destroy individual freedom	53	7	40
There is no way to find out if information about you that is stored in a computer is accurate	42	14	44

Based on the question: "Now, I'm going to mention a few more things people have said about the use of computers As before, tell me whether you agree, disagree, or have no opinion about each statement "

Concern about Information Being Kept about People

	Total (1,001)
Concerned about information being kept	62%
Very concerned about information being kept	27
Fairly concerned about information being kept	35
Not concerned about information being kept	36
Not too concerned about information being kept	26
Not concerned at all about information being kept	10
Don't know, no answer	2
Total	100%

Based on the question "Nowadays, some organizations keep information about millions of people How do you feel about this--are you very concerned, fairly concerned, not too concerned or not concerned at all?"

Beliefs about What Types of Information Should Be Kept in a Computer File

	Total (1,001)		
	Should Be Kept	Don't know No Answer	Should Not Be Kept
Police records	83%	3%	14%
Medical records	81	2	17
School records	77	3	20
Tax records	76	2	22
Credit ratings	75	3	22
Employment records	74	2	24
Salary records	54	3	43
Political activity records	50	5	45
The brands of products people buy	46	7	47

Based on the question· "For each type of information about people that I mention, please tell me whether you believe this information should or should not be kept in a central computerized information file "

How Concerned Government *Should Be* about Regulating the Use of Computers

	Total (1,001)
Government should be concerned	84%
Government should be very concerned	60
Government should be fairly concerned	24
Government should not be concerned	12
Government should not too concerned	7
Government should be not concerned at all	5
Don't know, no answer	4
Total	100%

Based on the question "How concerned do you think the government *should be* about regulating the use of computers--very concerned, fairly concerned, not too concerned or not concerned at all?"

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