THE HISTORICAL EMERGENCE OF STS AS AN ACADEMIC FIELD IN THE UNITED STATES

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Science, technology, and Society (STS) as an explicit academic field of teaching and research first emerged in the United States in the 1960s. The emergence has both a deep historical background in the modern attempt to transform society through the pursuit of science and technology (the Enlightenment) and the critical reaction to this project (Romanticism). Previous moments in this cultural conflict included the emergence of sociology (the scientific study of society) and the history of philosophy of science (society attempting to comprehend its own creation).

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During the mid-1960s, however, tensions regarding the science-technology-society relationship took on a new form, in large part reflecting a perceived need for a more complete understanding of the societal context of science and technology. STS emerged in a period of widespread social upheaval, itself reacting in part to the social-cultural quiescence of the 1950s. Scholars and more activist critics alike began to raise doubts about the theretofore largely unquestioned beneficence of science and technology that had become the post-World War II consensus.

Activist groups claiming to speak on behalf of the public interest in such areas as consumerism, civil rights and the environment, together with protest demonstrations against the Vietnam War, multinational corporations, nuclear power, etc., set the tone for much of the general context of the period. Within this context there emerged a critique of

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the idea of progress that by United States standards was quite radical. Fo, llowing a collapse in the mid-1960s of a twenty-year-long, direct translation of science and technology into prosperity for the American working class, there emerged the recognition that it was also becoming necessary to cope in practical terms with assessing the value of societal expenditures on science and technology, especially in the face of an accumulated burden of negative impacts. Voices began to question whether science and technology were the unalloyed blessings that society had generally come to believe they were. Both intellectuals and more widely read authors from a variety of perspectives suggested there were negative externalities associated with those blessings long assumed to be the primary legacy of science and technology.

Among more popular writers, Rachel Carson's 1962 Silent Spring raised serious questions about the hazards associated with chemical insecticides such as DDT and in many ways helped to crystalize the contemporary environmental movement. At roughly the same time, consumer activist Ralph Nader's 1965 expos6, Unsafe at any Speed, claimed to document the dangers of the Corvair, and by extension more broadly criticized the cavalier attitude of the automobile industry toward consumers. Like Carson with the environment! Nader played a key role in galvanizing the consumer movement[1]. Included among the varied political responses to this new public perception regarding science and technology were the passage by the U.S. Congress of the establishment of the Environmental Protection Agency (1969), the Occupational Safety and Health Administration (1970), the Clean Air and Clean Water Acts (1970, 1972), and the creation of the now defunct Congressional office of Technology Assessment (1972).» The EPA was created with the re-

[1] Rachel Carson, *Silent Spring* (Boston: Houghton Mifflin, 1962); Ralph Nader, *Unsafe at Any Speed: The Designed in Dangers of American Automobile* (New York: Grossman, 1965). Carson and Nader were by no means the only or even the first critics to question science and technology, for John Kenneth Galbraith in *The Afiluent Society* (Boston: Houghton Mifflin, 1958, 2 nd rev. ed., 1969) and *The New Industrial State* (Boston: Houghton Mifflin, 1967, rev. ed., 197 1) had suggested that in the industrial state power had shifted from consumers and the marketplace to a «technostructure» within the corporation that controlled technology for the sake of the growth of the organization. He warned of the instability of an economy keyed to production for its own sake. Preceding Galbraith's work was Vance Packard's *The Hidden Persuaders* (New York: D. McKay, 1957; rev. ed., New York- Washington Square Press, 1980) which painted a picture of the advertising industry as a creator of wants, artificially generating consumer demands while glossing over the absence of real choice. Both authors viewed production as driven by production goals, not consumer needs.

lated requirement that Environmental Impact Assessments be conducted on all projects involving the federal government or federal monies, and subsequently many individual states enacted similar legislation. OSHA was a response to the impact of technological development in the workplace. The creation of OTA-to say nothing of the emergence of a whole new field of endeavor with its own methodologies, specialist practitioners, and professional societies and journals-was a direct response by Congress in terms of the desire both for technical advice independent of the executive branch and to anticipate more fully the societal impacts of technology[2].

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European responses, while not directly parallel to the American experience, nonetheless, reflected similar concerns. In Britain, Derek de Sola Price's 1963 study, Little Science, Big Science, prompted debates over what seemed to be a potentially disastrous exponential growth in government funding of science and led to calls for a «science of science.» Among the responses was the 1965 formation in London of the Science of Science Foundation. Societies for «Social Responsibility in Science» also appeared in England and elsewhere at roughly this same time period[3].

Although not institutionalized until later, Denmark also began to pursue technology assessment studies at the level of political culture. This occurred first within the context of labor unions in the late 1970s, then with the Danish Social Science Research Council's establishment

[2] See Gregory Kunkle, «Early Warning? The United States Congress and Technology Assessment,» (Ph.D. dissertation, Lehigh University, 1995) for an extended analysis of the debates surrounding the creation of the OTA and for an insightful discussion of public perceptions regarding science and technology more generally during this period, and a related article, «New Challenge or the Past Revisited?: The Office of Technology Assessment in Historical Context,» *Technology in Society* 17 (Spring 1995): 175-96. Also useful for the period of the 1970s and 1980s is Bruce Bimber's *The Politics of Expertise in Congress: I he Rise and Fall of the Office of Technology Assessment* (Albany: SUNY Press, 1996).

[3] Derek de Solla Price, *Little Science, Big Science* (New York- Columbia Univ. Press, 196')). David Edge's overview essay, «Reinventing the Wheel,» in the Society for the Social Studies of Science's *Handbook of Science and Technology Studies*, ed., Sheila Jasanoff, et al. (Thousand Oaks, Calif.: Sage, 1995), 2-23, contains a good discussion of early British developments in STS.

of a subcommittee in technology and society in 1982, and three years later with the creation of a Board of Technology under theauspices of the Danish Parliament.

In contrast to what Lars Fuglsang calls Denmark's bottom up it outside» response to technology, Sweden developed a more top down «corporatist» model, in which debates about technology and working life» have been frames. Thus, in the mid-1970s the Swedish Parliament widely debated and eventually passed a law on «Co-Determination in Working Life» and established a Center for Working Life located in Stockholm in 1976. The goal was to allow Swedish workers to participate more extensively in the planning and organization of the work process, especially as if~ is affected by scientific and technological change. The Swedes also established a Secretariat for Future Studies, with a charge «to conduct critical projects with technology assessments[4].

A final example of the range of political responses to the societal implications of science and technology was the establishment in the Netherlands of their so-called «science shops» in which gove rnment-supported scientists and engineers provided information and «expert opinion» free of charge to any community group, trade union, or public-interest organization willing to use the information in their work. Collectively these European developments reflected a similar set of concerns regarding science and technology as had motivated the U.S. response[5].

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All such developments reflected an increased interest in the complexities of modern science and technology in contemporary society and attempts to bring to bear a more interdisciplinary approach for understanding not only the obvious benefits of scientific technology but also the often previously ignored negative externalities. In addition to more popular critics, intellectuals from a variety of perspectives extended to the public and the academic world the argument that science and tech-

[4] Lars Fuglsang, *Technology and New Institutions: A Comparison of Strategic Choices and Technology Studies in the UnitedStates,* Denmark and Sweden (Copenhagen: Academic Press, 1993), see esp. chs. 10-11; quotation, p. 155.

[5] For a discussion of Dutch science shops, see Richard Sclove, «STS on Other Planets,» *EASST Review* 15 (June 1996): 3-7.

nology were inherently value-laden and often, if not always, problematic in terms of societal impact. Among the most widely read such works were the Frenchman Jacques Ellulls La Technique llenjeu du siecle (1954), translated in English as The Technological Society (1964),and the American Lewis Mumford's two-volume The Myth of the Machine (1967 and 1970). Ellul presented a critique of «technique,» while Mumford assessed what he called the «megamachine,» terms denoting the all -encompassing power of modern science-based technology.

Perhaps the most influential intellectual precursor of the STS movement was C.P. Snow. Trained as a scientist, Snow first began to describe the gap between the scientific and literary cultures in a series of novels. Then in his now famous, 1959 Cambridge University Rede Lecture he posited the existence of a widening split between «two [non-communicating] cultures» in society--one composed of scientists, the other of humanists. His «two cultures» metaphor did much to shape (and in many ways still serves as a reference point for) discourse within the STS field[6].

Coterminous with the political and interdisciplinary intellectual responses were cognate changes within a number of traditional disciplinary academic fields as well. Evolving in large part out of the work of such scholars as Thomas Kuhn, John Ziman, and J.D. Bernal, historians, sociologists, and philosophers of both science and technology increasingly moved away from internalist-oriented subdisciplines to progressively more externalist or «contextual» interpretations. This shift was expressive of the same intellectual and social forces that precipitated

6 Jacques Ellul, *The Technological Society*, 1954, translated by John Wilkinson (New York: Alfred A. Knopf, 1964); Lewis Mumford, *The Myth of the Machine* (New York: Harcourt Brace Jovanovich, 1967-70); C.P. Snow, *The Two Cultures and the Scientific Revolution* (Cambridge: Cambridge Univ. Press, 195 9) and rev. ed. *The Two Cultures: And a Second Look* (Cambridge: Cambridge Univ. Press, 1964). Indicative of the ongoing interest in the issues raised by Snow's metaphorical image is Jonathan Cole's recent essay, «The Two Cultures Revisited,» in the National Academy of Engineering's journal *The Bridge*, 26 (Fall/Winter 1996): 16-2 1, in which he argues that «the gulf in understanding between scientists and nonscientists may be traceable to an educational system that neglects the historical importance of scientific and technological developments.» Among other quasi-intellectual popularizers who had an important influence on public perceptions regarding the societal implications of science and technology were Theodore Rosak, *The Making of a Counter Culture: Reflections on the Technocratic Society and Its Youthful Opposition* (Garden City, N.Y.: Doubleday, 1969) and *Where the Wasteland Ends: Politics and Transcendence in Postindustrial Society* (Garden City, N.Y.: Doubleday, 1972) and Alvin Toffler, *Future Shock* (New York: Random House, 1970).

the more avowedly interdisciplinary approach of STS. Independent of approach, however, all such developments reflected an increased interest in the complexities of modern science and technology in contemporary society.

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Something of a pendulum-like swing of attitudes regarding science and technology has occurred during the course of development of the STS field. Responding to the largely uncritical stance of the 1950s and 1960s, the tenor of much of the early STS literature was anti-establishment and highly critical in tone, and this was reflected in much of the first generation of STS course work being taught in numerous programs, during this period. The initial focus, often coming from engineers and scientists themselves, was frequently directed toward educating science and engineering students about the «true» societal impact of their work. Many of the earliest STS courses and curriculum programs emerged at institutions with engineering colleges and sometimes within those colleges themselves. It was as though STS courses were for adding a cultural veneer to the «coarse» surf ace of a technical education.

Not unexpectedly, liberal arts students were just as interested in such questions, and very quickly a second generation of STS course work emerged, aimed more generally at all students. This second generation took as its approach a social process interpretation of science and technology. Both were seen as shaped and influenced by societal values, which were, in turn, affected by scientific knowledge and technological values. These developments, taking place in the mid- to late 1970s, corresponded closely with the emergence of a science and technology studies approach to STS, and reflected in part an attempt to rise above the fray of a simplistic pro-con debate regarding the merits and demerits of science and technology.

Then during the 1980s, the STS community moved beyond this social content analysis of science and technology, to the design of courses and programs aimed at developing «literacy» on the part of liberal arts students in technology, rather than about, technology. The aim here regarding technology was somewhat parallel to what liberal arts students are expected to learn visa-vis science and mathematics. Typi-

cal of «literacy» developments during the 1980s were the formation of the Council for the Understanding of Technology in Human Affairs; the emergence of the Alfred P. Sloan Foundation's New Liberal Arts Program, which has produced an extensive series of books, monographs, and extended syllabi; and the holding of a series of annual Technology Literacy Conferences now coordinated under the auspices of the National Association of Science, Technology and Society[7].

During the latter part of the 1980s and through the mid1990s a subsequent interpretative swing toward a «contextual ist» or «social constructivist» interpretation has, among many STS scholars at least, led to something of a relativist view of science and technology. Science and technology are seen as the products not so much of an objective «out thereness,» but rather. depend upon socially determined causal factors. One of the more influential scholars and works in this regard has been Bruno Latour's Science in Action (1987). He argues that to properly understand what he calls «technoscience» one must examine scientists «in action,» that is before the inventions and discoveries become widely accepted or «black boxed»[8].

At its most pronounced, this is an extreme view, and one not shared uniformly within the STS community. Nonetheless, it has occasioned a counter response especially among scientists and engineers who want to maintain the objective reality of science and technology. Perhaps most illustrative of this side of the recent debate was the 1994 publication of a book by Paul Gross and Norman Levitt entitled Higher Superstition: The Academic Left and Its Quarrels with Science, in which the

[7] The relationship of «technology literacy to» to STS and liberal arts education is elaborated upon in Steven L. Goldman and Stephen H. Cutcliffe, «STS, Technology Literacy, and the Arts Curriculum,» *Bulletin of Science, Technology, and Society* 2, nº 4 (1982); 291-3 07; Cutcliffe and Goldman, «Science, Technology, and the Liberal Arts,» *Science, Technology, and Human Values* 10, nº I (Winter 1985): 80-87; Cutcliffe, «Understanding Science, Technology, and Engineering An Essential Element of Cultural Literacy,» *Federation Review. The Journal of the States Humanities* Councils 8, no. 4 (July/ August 1985); and Goldman, «The Warp and the Woof,» *The Weaver* (1985). See also Barrett Hazeltine, «Past Efforts in Technological Literacy-CUTHA,» in *Technology Literacy Workshop Proceedings*, ed. Russel C. Jones. Accreditation Board for Engineering and Technology, The Association of American Colleges, National Science Foundation (Newark: Univ. of Delaware, 199 1), James D. Koerner, ed. *The New Liberal Arts* (New York: Alfred P. Sloan Foundation, 198 1),- and Samuel Goldberg, *The New Liberal Arts Program: A 1990 Report* (New York: Alfred P. Sloan Foundation, 1990).

[8] Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge: Harvard University Press, 1987).

authors argued vehemently against the perceived anti-realist stance of at least some constructivist STS scholars[9].

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The pendulum-like swing of attitudes regarding science and technology that has occurred during the course of the development of the STS field's would seem to have damped. In general, the notion of being «pro» or «anti» science and technology is not particularly helpful. Very few people today when expressing criticism of science and technology mean to suggest doing away with them completely, which would presumably be the logical outcome of an «anti -techno 1 ogy» position. Nonetheless, strong supporters of traditional science and technology are often described as «pro-,» while critics are pejoratively criticized as it anti-» science and technology. The latter especially makes little sense and would be somewhat akin to calling art critics «anti-art»[10]. At the same time, just because we better understand science and technology in their societal context, does not mean we should not be careful of lapsing into uncritical acceptance. There is still an enthusiastic element within the science and technology literacy perspective of «if you only understood us better, you would love us more.» We must be very careful, in the words of Langdon Winner, to avoid HSTS--Hooray for Science, Technology and Society[11].

Certainly it can be said thatf on balance, the STS field has moved far beyond its early and simplistic black and white image of science and technology in society to a much more sophisticated understanding of the STS relationship. Today STS views science and technology as complex enterprises taking place in specific historical and cultural contexts. What has emerged is a consensus that while science and technology do bring us numerous Dositive benefits, they also carry with them certain negative impacts, some of which are perhaps unforeseeable, but all of which reflect the values, views, and visions of those in a position to

[9] Paul Gross and Norman Levitt, *Higher Superstition: The Academic Left and Its Quarrels with Science* (Baltimore: Johns Hopkins Univ. Press, 1994).

[10] David Dickson, *The New Politics of Science* (Chicago: Univ. Of Chicago Press, 1980), 6; Langdon Winner, *The Whale and the Reactor* (Chicago: Univ, Of Chicago Press, 1986), xi.

[11] Langdon Winner, «Conflicting Interests in Science and Technology Studies: Some Personal Reflections,» *Technology in Society* I I (1989): 436.

make decisions regarding the scientific and technical expertise within their domain. The central mission of the STS field to date, then, has been to convey just such a social process interpretation of science and technology that views them as complex enterprises in which cultural, political, and economic values help to shape the process, which in turn affects those same values and the society that holds them.

To assist in carrying out that mission numerous STS programs have come into being during the past three decades. While the specific number is not clearly known, and some have dropped along the wayside, the number of full-fledged programs in the U.S. numbers nearly one hundred, with perhaps half that number in Europe. At least equally important are the hundreds of individual courses and groups of courses, which, while they cannot be considered programs in the fullest sense, certainly complement the more formally established programs. Similar program and course development has also taken place in Japan, China, Australia, and several Latin American nations as well.

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What were some of the earliest landmarks, at least in the U.S., in this approximately three-decades long development? The first major effort was the Harvard University Program on Technology and Society funded in 1964 by a five million dollar grant f rom IBM. Its primary purpose was to «undertake an inquiry in depth into the effects of technological change on the economy, on public policies, and on the character of society, as well as into the reciprocal effects of social progress on the nature, dimension, and directions of scientific and technological developments[12]. Although prematurely disbanded, primarily as a developments result of bureaucratic infighting, the program did produce a number of studiest books, articles, and bibliographical works culminating in director Emanuel Mesthene's final report in 1972[13].

Subsequently other programs began to emerge with a curriculum orientation. one of the first was the Science, Technology and Society program at Cornell University, which appeared in 1969 at least in part

[12] Quoted in Albert H. Teich, ed., *Technology and Man's Future*, 4th ed. (New York: St. Martin's Press, 1986), 3.

[13] Emmanuel Mesthene, *Harvard University Program on Technology and Society*, 1964-19 72: A Final Review (Cambridge: Harvard University, 1972).

as a response to campus unrest and the need to develop «interdisciplinary courses at the undergraduate level on topics relevant to the world's problems»[14]. That program has since evolved in terms of focusing more extensively on the intellectual study of science and technology, especially at the graduate level, as reflected in its current status as a Department of Science & Technology Studies. Today it is one of the leading STS Ph.D. granting programs in the U.S. Another important early program-the Science, Technology and Society Program at Pennsylvania State University-emerged out of a «Two Cultures Dialog» begun in 1968-1969; under the influence of the Cornell program, it solidified about 1971. For many years it served as the host institution for the National Association for Science, Technology and Society.

Evolving in a different pattern, but with similar motives, was the 1972 Humanities Perspectives on Technology effort at Lehigh University under a curriculum development grant from the National Endowment for the Humanities. In 1979 it was renamed the Science, technology and Society Program to bring its title into alignment with the more generic name then coming into vogue across the field. The aim of the original Lehigh program was to «create educational experiences which bring humanistic perspective to the application an evaluation of technology»[15]. While Lehigh's program has also grown to include both a modest level of graduate education, as well as a somewhat broader contextual focus, it has largely remained true to its original undergraduate, issue-oriented educational mission.

Somewhat later, in 1977, a number of science and technology studies-oriented activities at MIT coalesced with the formal establishment of the Program in Science, Technology and Society. Its aims were «to explore the influence of social, political and cultural forces on science and technology, and to examine the impact of technologies and scientific ideas on people's lives[16].

These goals, then, as well as those of a host of additional programs too extensive to list individually[17] reflected a desire to expand and

[14] Franklin A. Long, *First General Report, Cornell University Program on Science, Technology and Society* (Ithaca, N.Y.: Cornell University, 1971), 2.

[15] Edward J. Gallagher, *Humanities Perspectives on Technology, Annual Report Year Five*, 1976-1977 (Bethlehem, Pa.: Lehigh University, 1977), iii.

[16] *Program in Science, Technology and Society* (Cambridge, Mass.: MIT, 198), 3.

[17] Unfortunately no current comprehensive guide to STS programs exists. However, several surveys of ST S programs conducted in the mid- I 970s are helpful for

deepen our conceptualization of the workings of science and technology, so as to both understand their societal impacts and to offer insights into better ways of controlling and directing them as societal forces. The rise of undergraduate major programs, for example, Lehigh's STS Program and Wesleyan University's Science in Society Program, and more recently the emergence of graduate degree programs, such as those at Cornell and MIT, as well as a special focus on graduate work in the public policy area, typified by Washington University's Department of Engineering and Policy and a second MIT Technology and Policy Program, to name but two, reflects a sophistication and maturation only initially dreamed of in the late 1960s and early 1970s. The development of such policy-oriented programs further reflects a practical application of STS and reinforces the notion of public involvement in an age in which we are trying to exert stronger and more deliberate social and political control of science and technology.

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Taken together these developments suggest the seriousness of purpose with which STS has evolved and an appreciation of the complexities of modern science and technology in contemporary society. At

understanding the formative period: Ezra D. Heitowit, Janet Epstein, and Gerald Steinberg, *Science, Technology and Society. A Guide to the Field* (Ithaca, N.Y.: Cornell University Program on Science, Technology and Society, 1977), and *EVIST Resource Directory: A Directory of Programs and Courses in the Field of Ethical Values in Science and Technology*, Document 78-6 (Washington, D.C.: American Association for the Advancement of Science, 1978).

A brief follow-up to the Heitowit surveys was conducted by Rusturn Roy and Joshua Lerner in 1982-1983: Roy and Lerner, "The Status of STS Activities at U.S. Universities," *Bulletin of Science, Technology and Society* 3, no. 5 (1983): 417-32, and, much more recently, the Directorate for Science and Policy Programs of the American Association for the Advancement of Science has published the third edition of Albert H. Teich, ed., *Guide to Graduate Education in Science, Engineering and Public Policy* (Washington, D.C.: AAAS, 1995), which includes material on twenty-eight U.S. graduate degree-granting programs and another fourteen programs outside the U.S. in this particular facet of STS. Most recently the National Association of Science, Technology and Society has issued under the editorship of Carl Mitcham and Stephen H. Cutcliffe a second edition of its *STS Directory* (University Park, Pa.: NASTS, 1996), an admittedly incomplete survey of some sixty U.S. and international STS programs. Although useful entrees to many of the major STS Programs in the United States, Britain, Europe, and some other parts of the world, these surveys do not track the many hundreds of individual courses or clusters of courses that also contribute to the academic vitality of the STS field.

least three different interdisciplinary research and educational approaches to STS can thus be identified: a) Science, Technology, and Public Policy, b) Science and Technology Studies, and c) Science, Technology, and Society programs to distinguish among them. While much more could be said to delineate the current state of affairs within the field[18], suffice it to say for the moment that by roughly the mid-1980s STS had formalized as a sophisticated interdisciplinary field of study with the usual accouterments of academic pursuit-formalized departments and programs, professional societies, and scholarly journals. Today it serves as one of the most exciting,interdisciplinary nexuses for the essential study of the relationships among science, technology, and society.

[18] For a more extended discussion of some of these themes, see Stephen H. Cutcliffe, "The Warp and the Woof of Science and Technology Studies in the United States," Education 113 (Spring 1993): 381-91, 352.