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ABSTRACT

This quarterly review presents two main entries. The first one is a selected bibliography of twentieth-century poems relevant to science and social aspects of science. The other is concerning institutional review boards and the need for assessment of research involving human subjects. In addition, news items reporting on conferences, publications, workshops, and programs are presented. Finally, a meetings calendar and a general bibliography are presented. (BB)

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SCIENCE, TECHNOLOGY, & HUMAN VALUES

AN INTERDISCIPLINARY QUARTERLY REVIEW

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News Items

A. Public Broadcasting's "NOVA" Series Begins Sixth Season

[EDITOR'S NOTE: "The scientific community is not alone in its concern for the public's understanding of science. We in public television agree that science and technology have become too important to the conduct of the nation's business to be left to the academic journals or the occasional news story in the press."* This quote from our first news item on what was then called "The Science Program Group of Public Television" attests to the attitudes that motivated development of the PBS "NOVA" series. It is unfortunate that twenty-one issues (and five television seasons) later we cannot yet describe development of a national commercial television series that regularly examines "basic science, science's impact on society, and science's involvement in public policy."*

Perhaps the time has come for the scientific community and its compatriots to assert that science and technology have become too important to the conduct of the nation's business to be left to the academic journals, the occasional news story in the press, or a single public television series. - MCL]

The PBS NOVA series on science and technology begins its sixth broadcasting season with these programs:

- January 4 - Black Tide (WGBH Production; Graham Chedd).

  On the morning of 16 March 1978, the U.S.-owned, Liberian-registered supertanker, the *Amoco Cadiz*, went aground off the coast of Brittany. Over the following days and weeks its entire 68 million gallons of oil drained into the sea. A NOVA production team began filming at the scene shortly after the disaster. The film describes the cleanup efforts, the effects of the biggest oil spill in history on local tourism and fishing industries, and the attempts of U.S. and French marine biologists to trace the passage of the oil through the environment. Tanker safety, crew training, navigation systems and the chances of further disasters are examined.

- January 11 - Patterns From the Past (Cohen/WGBH Production; Sari Sapir)
  The Q'eros Indians of the Peruvian Andes are an isolated mountain group who have retained almost intact the life-style of the days

*Michael J. Ambrosino, quoted on pp.24-25 of the "Science and the Media" section, Newsletter #4 of the Program on Public Conceptions of Science (June 1973).

before the Spanish conquest. Contemporary scenes frequently mirror the description of life in the Incan empire found in various Spanish chronicles. Via an examination of Q'eros agriculture, crafts, music, and social attitudes, this film contrasts the isolated mountain society with the lives of Andean Indians in the towns and cities of modern Peru.

•January 18 - A World of Difference (WGBH Production; Veronica Young)

A film biography of behavioral psychologist B.F. Skinner. The famous scientist describes his childhood and early work, and visits (at NOVA's invitation) a commune based on the ideas set out in his fictional utopia, Walden Two. The ten-year-old commune is firmly established and Skinner's behaviorist framework still forms the basis of the organization; but, as the members explain, Walden Two had some important omissions.

•January 25 - The Mind Machines [REPEAT] (WGBH Production; Paula Apsell)

A repeat performance of a film on the researchers and critics in the field of artificial intelligence.

•February 1 - Cashing In On the Ocean (BBC/WGBH; BBC Producer: Stuart Harris)

One of the more controversial issues debated in the current United Nations Law of the Sea Conference concerns the exploitation of a particular ocean resource - manganese nodules. Mile upon mile of these nodules - which are rich in minerals and hence valuable commodities - may be found deep on the ocean floor. In a world of diminishing resources, they are the subject of considerable attention from the five international mining consortia which are now developing methods of raising the nodules to the surface and from a group of Third World nations which objects strongly to the possibility of this international resource being exploited only for the benefit of Western countries. The film examines the complex science, technology and politics behind these innocent-looking minerals.

The dates given are those supplied by the WGBH-TV NOVA office and represent the earliest date on which a program may be broadcast. Individual local stations may delay, repeat, or reschedule programs throughout the season. For information on particular programs or on the availability of teacher's guides, address inquiries to the NOVA Office, WGBH-TV, 125 Western Avenue, Boston, MA 02134.

B. STHV Publishes Law and Science Bibliography

Particularly in the last few decades, both the multiplicity and the types of advances made by science and technology have increased the interaction between science and the law. Each new development has brought its own potential for new effects on society and frequently has created new benefits or hazards to be managed. At the same time, the law has

increasingly relied on science and technology; scientists and engineers serve as expert witnesses and judicial advisors; scientific methods are used to obtain evidence; and computers manage complex legal data systems. The scientific community is also now confronted with legal intrusions into the previously sacrosanct domain of research--expressed via legislation, the implementation of monitoring bodies or administrative structures, and threatened restrictions on topics or methods. Each of these areas of interaction results in its own literature "explosion".

One method of coping with a rapidly expanding literature is to devise a topical organization scheme into which new publications may be classified; another is to build a selected, basic bibliography of "foundation" works in the field. A new book published by the Science, Technology & Human Values Program aims to fill these needs by bringing together 1) a topical organization scheme based on existing library classifications yet cognizant of subtle aspects of the various topics, and 2) a listing of representative publications on these topics. The compilers of Law and Science: A Selected Bibliography - Morris L. Cohen, Jan Stepan, and Naomi Ronen - have combined their knowledge of library resources with an acute sense of the important arenas of legal and scientific activity and interaction. For each topic, a "Current Sources" section lists references such as periodicals, serial bibliographies, or loose-leaf services that can provide additional future references to the reader. Within the 1655-entry bibloigraphy, emphasis is placed on not only seminal works on the topic but also on review articles and bibliographies that can act as pointers to other works. In addition, an introductory essay by Morris L. Cohen sets the law-science interaction in an historical framework, from Archimedes, through Lysenko, to current bio-medical issues in the courts.

Major topics in the bibliography include:

*Law and Social Science, including Empirical Research on the Law
*Law as Science: Scientific Methods, Logic, and Legal Reasoning
*Expert Witnesses and Scientific Evidence
*The Law of Computers and Legal Uses of Computers
*Hazards to Public Health and Safety: Addiction, Automobiles, Nuclear Hazards, and Food Purity
*Legal Problems of Privacy
*National and International Controls on Natural Resources and the Environment
*Aviation Law and Outer Space
*The Law of the Sea
*Arms Control and Disarmament
*Taxation of Scientific and Technical Research Operations
*The Role of Law and Government in the Protection and Distribution of Scientific and Technical Knowledge and Developments

Law and Science: A Selected Bibliography (soft cover; 143 pages + author index; ISBN 0-932564-00-3; October 1978) is published by Science, Technology and Human Values. Single copies are $7.50 each; ten or more copies mailed to the same address are $6.50 each. For further information or orders, write: Science, Technology & Human Values, Aiken Computation Laboratory 234, Harvard University, Cambridge, MA 02138.

C. Einstein Centenary in Jerusalem

An international symposium to mark the 100th anniversary of the birth of Albert Einstein will be held in Jerusalem, 14-23 March 1979, under the sponsorship of The Israel Academy of Sciences and Humanities, Hebrew University of Jerusalem, Van Leer Jerusalem Foundation, Jerusalem Foundation, and Aspen Institute for Humanistic Studies.

The first part of the ten-day conference will be devoted to broad scientific, historical, cultural and social perspectives of Einstein's work and influence; the second part, to developments in gauge and unification theories. Some of the participants in the lecture sessions include (in alphabetical order as announced in the Preliminary Program): *"Einstein's Scientific Contributions: Perspectives of the History of Science" - Peter G. Bergmann; Max J. Jammer; Martin J. Klein; Arthur I. Miller. * "Reception of Einstein's Ideas by Scientists: Then and Now" - Paul Forman; Loren R. Graham; Banesh Hoffmann. * "The Impact of Einstein's Work on Scholarship and Science" - Erik Erikson; Roman Jakobson; Eugene P. Wigner. * "The Impact of Einstein's Work on Modern Thought" - Daniel Bell; Yehuda Elkana; Nathan Rotenstreich. * "Einstein and the Culture of Our Time" - Kenneth J. Arrow; Alan Bullock; Meyer Shapiro. * "Coherency in Einstein's Work and Life" - Gerald Holton. * "Einstein and the Nuclear Age" - Bernard Feld; Yehoshafat Harkabi; Paul Doty. * "Unification: Aims and Principles"- Valentine Bargmann; Chen N. Yang. * "General Relativity and Cosmology" - Jacob D. Bekenstein; Nathan Rosen; Dennis Sciama. * "Gauge Theories of Gravity and Its Enlargements" - Daniel Z. Freedman; Yuval Ne'eman. * "Working with Einstein" - Reminiscences by Associates and Assistants: Valentine Bargmann, Peter Bargmann, Helen Dukas, Banesh Hoffmann, Bruria Kaufman, Nathan Rosen, and G.E. Straus. * "Quantum Chromodynamics" - Roger Dashen; Yoichiro Nambu; Gerald 't Hooft. * "Gauge Theories of Weak and Electromagnetic Interactions and Flavour Dynamics" - Sheldon L. Glashow; Haim Harari. * "Grand Unification Theories" - Feza Gursey; Steven Weinberg. Others listed in the program include Sir Isaiah Berlin and Murray Gell-Mann.

Further program information available from: Israel Academy of Sciences and Humanities, P.O. Box 4040, Jerusalem, Israel.

D. NAS Statements and Documents Discuss Scientific Repression and Human Rights

Since 1959, the U.S. National Academy of Sciences and the U.S.S.R. Academy of Sciences have participated in a scientific exchange program. Recent events and rising public awareness of Soviet treatment of dissident scientists prompted review of the NAS program; and, as part of that review, the NAS-NRC Commission on International Relations, Board on International Scientific Exchange included discussion of scientific repression and political dissidence in its report Review of U.S.-U.S.S.R. Interacademy Exchanges and Relations (available from National Technical Information Service, Springfield, VA 22161). This report affirms the reasons scientists are rightfully concerned with what may seem partisan or political activities, and asserts that Soviet repression of dissidents may, indeed, become a "serious obstacle" to continued scientific exchanges. An NAS

description of the report points out:

> "Although scientists quite understandably do not normally consider questions of politics or ethics to be central to their professional concerns, there is one area where the link between science and ethics is inevitable and proper. That area pertains to the ethics of scientific research itself. The one set of ethical rules which a scientist must defend qua scientist is the set of principles necessary to gain knowledge, such as free access to information, the right to communicate with other scientists freely, and the right to question reigning scientific assumptions. When a scientist participates in scientific exchanges he has every right to anticipate that these principles will be observed, for he knows that his scholarly work will be hampered if they are not."

In August 1978, in response to Soviet actions against particular Russian scientists, the NAS Committee on Human Rights (with the approval of the NAS Council) issued a statement protesting the arrest and prosecution of these scientists (NAS-NAE News Report, Vol. 28, No. 10, October 1978, p. 5). The NAS statement concluded:

> "The Committee on Human Rights of the National Academy of Sciences has been witness to much of the personal decision-making that took place in the aftermath of the trials and has been impressed that the decisions were the product of painful soul-searching. Those who decided to cancel or postpone their trips or to confront their Soviet hosts have done so with great reluctance. They include scientists who pioneered in the earliest Soviet/U.S. exchanges, seeking to build bridges of common scientific endeavor across the chasm of the cold war. They also include others who have seen themselves as steadfast in resisting the politicization of science. People have reached their decisions in varied ways; sadness, rather than anger, has been the most common emotion.
>
> "Academy programs of individual exchanges with the Soviet Academy of Sciences are continuing. At the same time, the Committee on Human Rights seeks in every way possible to convince Soviet authorities that these three scientists [Orlov, Shcharanskiy, and Kovalev] should be released and to offer what solace is possible to them and to their families. Within this framework, each American scientist contemplating a visit to the USSR (or asked to host a Soviet scientist in the U.S.) must determine his or her own course of action.
>
> "It is precisely because the response of U.S. scientists is so individualistic that continued Soviet-American scientific relations are in peril. Scientific exchange programs can be negotiated and organized, but individual participation cannot be

commanded. There has been no institutional instruction or decision making, no rush to judgement, and no stampede to boycott. Rather there is a tide of spontaneous response, running deep, and it will not be easily reversed in the absence of some judicious and humanitarian actions by Soviet authorities."

E. Conference on the Social Assessment of Science

[EDITORS' NOTE: In May 1978, the International Council on Science Policy Studies sponsored a conference on the "Social Assessment of Science". It was organized for the Council by Everett Mendelsohn (Harvard University), Dorothy Nelkin (Cornell University), and Peter Weingart (University of Bielefeld, West Germany). The brief account of the meeting which appears below was prepared by Dorothy Nelkin.]

The social assessment of science is a concept that has emerged from recent controversies over scientific and technological issues, especially about aspects of biomedical research. One key element of the concept is that research be evaluated in terms of social and ethical criteria external to the process of research and to its immediate objectives. It assumes that decisions about science, long considered to be the province of expertise, are appropriate questions for public debate. Indeed, the very idea of social assessment indicates the emergence of a new relationship between science and society involving far greater public evaluation of the consequences of research. This trend has been developing for some years in the United States, where struggles over the boundaries of science have led to legislation, regulation, and new institutions for monitoring research practices. Similar concerns are appearing in other countries.

Even at this early stage, it is apparent that there are significantly different ways of assessing and controlling research. Perceptions and expectations about science, the traditional relationships between government and scientific activity, the organization of the scientific community, and ideological factors, all influence the institutions that are developed to deal with controversial scientific and technical issues. Subjects that provoke profound political debate in one country (e.g., recombinant DNA in the United States) fail to raise a public eyebrow in others. Discussion about DNA guidelines in Germany, for example, caused little or no public debate. Fetal research is more controversial in America than in England. The definition of a "carcinogen" varies from country to country. Furthermore, the adversary and open nature of decision-making that is characteristic of some countries is absent from more centralized political systems, and this will bear on the external relationships of science.

The March 1978 issue of Daedalus on the "Limits of Scientific Inquiry" focused on the social assessment of science in the American context. To explore similar questions in a comparative context, the International Council on Science Policy Studies convened a conference in May 1978 at the Center for Interdisciplinary Research at the University of Bielefeld, West Germany. It was supported by the National Science

Foundation's EVIST Program and the Deutsche Forschungs Gemeinschaft. Fifty-five people from Western Europe, North America, England, the Middle East, and Japan attended. The 16 speakers represented such diverse disciplines as biochemistry, physics, sociology, political science, and history. Some papers analyzed formal modes of science assessment in different countries: for example, the guidelines for genetic research in Germany, the Institutional Review Boards for human experimentation in the United States, and the development of various radiation protection standards. Other papers analyzed the value issues underlying such controversies as those over recombinant DNA research, fetal research, genetic manipulation, and various social science projects. Several interpretive papers raised general issues about the impact of science, the autonomy of the scientific community, the relationship of the control of research to political power and to special interests, and, finally, about the impact of public assessment on the development of science itself.

I had hoped that the papers would deal with diverse approaches to parallel problems, and thus yield some initial comparative data as a basis for further research. However, as international complexity compounded disciplinary diversity, it became clear that an initial conference could not be expected to yield a data bank. The differences are too profound and the very concept of social assessment is still too poorly defined. Is the central problem methodological or political? Who should be responsible for assessing science, the scientist or the public? What should be the role of political institutions in controlling scientific research? What kinds of research are problematic? If research poses definite and clearly identifiable risks, there is little ambiguity--but this is rarely the case. Many aspects of scientific research become controversial because they threaten cherished beliefs or traditional values. Although the conference could not provide comparative research data, it did help to sort out such questions.

On balance, the meeting was productive. Provocative discussions resulted from the intense efforts to communicate and to understand the highly complex issues involved. Whether comparative research on the social assessment of science is possible remains an open question. It may be that the issues are so tied to national values that comparisons can be made only at the most philosophical level.

F. NSF and NAS Reports Examine Graduate Education in Science

Several recent reports published by the National Science Foundation and the National Academy of Sciences emphasize conflicting currents in American graduate education in science and engineering.

1) Results of NSF surveys taken in Fall 1976 and 1977 provide evidence that enrollment in graduate science and engineering programs may be declining. The 228,600 science and engineering students enrolled in full-time studies in 1977 represented an estimated decline of 2% from 1976, and, although enrollment has increased by 12% since 1970, the last few years

have seen shifts and regressions that have, in essence, produced a "no growth" state. Enrollment in part-time graduate studies continues to rise--up 2% from 1976--but showed a slower gain than in previous years.

Preliminary 1977 estimates indicate that the number of women enrolled full-time at all levels of higher education and in all areas of study rose nearly 5% over 1976. In 1976, the number of women enrolled in full-time graduate studies in science and engineering was up 11.1%, accounting for 27% of all S/E graduate students. The NSF report asserts that this rise is "a response to growing job opportunities and rising salary levels."

The NSF report "Graduate Science Enrollment Stabilized in 1977" (Science Resource Studies Highlights, No. NSF 78-307, 30 May 1978) may be obtained gratis by writing the Division of Science Resources Studies, National Science Foundation, 1800 G Street, N.W., Washington, DC 20550. Other analytical reports on this survey project will be issued biennially in the future.

2) Extensive analyses of data on Ph.D.'s granted in the last hundred years are included in a recent report from the Board on Human-Resource Data and Analyses, Commission on Human Resources, National Research Council. The report, A Century of Doctorates: Data Analyses of Growth and Change. U.S. Ph.D's--Their Numbers, Origins, Characteristics, and the Institutions from Which They Come, Lindsey R. Harmon (180 pages; ISBN 0-309-02738-1), may be purchased for $10.50 from the Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue, N.W., Washington, DC 20418.

3) The career patterns and chances for employment of science and engineering Ph.D.'s depend largely on their field, according to a National Research Council Comprehensive Survey of Doctorate Recipients. The picture painted by this report is not nearly as gray as anecdotal evidence would indicate. The results, based on a February 1977 survey of Americans who have earned research doctorates since 1934, show that the unemployment rate among the 280,200 science and engineering (S/E) Ph.D.'s was approximately 1.2%, as compared to 2.9% for the 73,100 humanities Ph.D.'s, 2.3% for all Americans with 5 or more years of college training, and 8.5% for the entire U.S. labor force in that same month. In some S/E fields, such as computer science, agricultural science, and medical science, the rate of unemployment was negligible; among the sciences, biology had the highest rate.

The NAS summary of the report (in the NAS News Report, July 1978) noted that "women reported higher unemployment and lower median salaries than men in all fields of science and engineering and the humanities." In February 1977, 3.6% of the women in the S/E doctoral labor force were "unemployed and seeking work." Median salaries for women S/E Ph.D.'s were 20% less than those for men. Science, Engineering, and Humanities Doctorates in the United States: 1977 Profile, issued by the Commission on Human Resources, National Resources, National Research Council, is available from the Commission (c/o NRC, 2101 Constitution Avenue, N.W., Washington, DC 20418).

G. Inventory of Programs in Science and Mathematics for Women

The AAAS Office of Opportunities in Science is conducting a comprehensive national inventory of efforts made since 1966 to improve the natural science and mathematics education of girls and women in the United States and to increase their participation in mathematics and science-related careers. The AAAS asks that persons who know of such projects contact the AAAS Office.

The kinds of efforts to be incorporated will include provision of career information, improvement of mathematics or science counseling, innovations in science and mathematics curricula directed toward women, new methods of teaching science and mathematics to women, recruitment of women into science education programs, assistance to women with degrees who wish to reenter the workforce, major institutional changes involving some combination of all these approaches, and research studies related to the participation of women in science. Features of special interest to minority and handicapped women will be highlighted.

The inventory, which will be completed in late spring 1979, should provide useful data to funding agencies and other organizations for planning and policy purposes. Please forward names and addresses of persons and institutions to: Dr. Michele L. Aldrich, Inventory of Women's Programs, OOS-AAAS, 1776 Massachusetts Avenue, N.W., Washington, DC 20036; (202)-467-5431.

H. NSF Career Workshops to Increase Participation of Women in Science

The National Science Foundation Women in Science program has funded 25 additional multidisciplinary workshops designed to provide motivation for careers in science and engineering, advice on preparation for scientific careers, and information about job opportunities. Most of these workshops specifically address the problems of women who hold science degrees but who are neither in graduate school nor in scientific jobs commensurate with their training. For information on particular workshops, write directly to the sponsoring institution.

Recent grants for college level workshops were awarded to these institutions and project directors: California State University--Bonita J. Campbell (Engineering); University of Colorado--Jana G. Everette (Political Science); University of Hartford--Stephanie F. Troyer (Math and Physics); Morris Brown College (Atlanta)--Henri M. Turner (Biology); Sangamon State University (Springfield, IL)--W. Williams Stevens, Jr. (Public Affairs); Clarke College (Dubuque, IA)--Mary L. Caffery (Chemistry); Tulane University--Jean Cohen DiLeo (Counseling); Mesabi State Jr. College (Virginia, MN)--Glenn Mauston (Biology); Jackson State University (Jackson, MS)--Lou A. Gray (Mathematics); University of Nebraska--Sylvia Wiegand (Mathematics); Bergan Community College (Paramus, NJ)--Estelle K. Meislich (Physics and Math); University of New Mexico--Nancy Martin (Computer

Science); Dutchess Community College (Poughkeepsie)--Mary Jean McGivern (Biology); SUNY-Buffalo--Rosalyn Lindner (Sociology); Notre Dame College (Cleveland)--Sister Jeanmarie DeChant (Chemistry); Christian Brothers College (Memphis)--Nancy W. Hinds (Chemistry); East Tennessee State University--Cynthia S. Burnley (Sociology); George Peabody College (Nashville)--Jeanne M. Plas (Human Development); Texas Southern University--D. Gaye Perry (Speech Communication); James Madison University--Margaret A. Gordon (Biology).

A grant for a graduate student workshop was awarded to: University of California-Los Angeles--Jane Szutu Permaul (Education).

Grants for post-education workshops were made to: University of California-Berkeley--Marvalee H. Wake (Zoology); University of New Mexico--Peggy J. Blackwell (Behavioral Research); University of Dayton--Carol M. Shaw (Engineering).

I. Advance Program for AAAS National Meeting: Houston, Texas, 3-8 January 1979

Under the general theme "Science and Technology: Resources for Our Future," the American Association for the Advancement of Science will hold its National Meeting in Houston, Texas, on 3-8 January 1979. Morning and afternoon sessions will meet in the Shamrock Hilton (SH) and the Houston Marriott at Astrodome (HM). Selections from the 140 symposia sessions (and session arrangers) include:

General Interest

"Getting into Orbit: Historical Perspectives on the American Space Program," January 3 (pm), SH, Roger E. Bilstein (University of Houston);

"The Frontiers of the Social Sciences," January 5 (pm), SH, Meredith Crawford (GWU) and Priscilla Reining (AAAS);

"Science in Society: Are There Limits to Usable Knowledge?" January 7 (am/pm), SH, Gregg Edwards (NSF) and William A. Gale (Bell Labs).

Biological Sciences

"Handicapped Scientists: Some of Their Current Contributions to Biological and Medical Research," January 7 (am), SH, Nansie S. Sharpless (Albert Einstein College of Medicine).

Health Care

"Technology and Health Care: Prospects and Pitfalls," January 3 (pm), HM, Stanley Joel Reiser (Harvard);

"Politics, Science and Cancer: The Laetrile Phenomenon," January 6 (am), HM, Gerald E. Markle and James C. Peterson (Western Michigan University);

"Medical Innovation and Public Policy: The Case of DES," January 6 (pm), HM, Diana B. Dutton, John P. Bunker, and Halstead Holman (Stanford).

Agricultural Sciences

"Environmental, Socioeconomic, and Political Aspects of Pest Management," January 7 (am/pm), HM, David Pimentel (Cornell) and John H. Perkins (Western College of Miami University).

Ecology and Environment

"The *Amoco Cadiz* Oil Spill," January 5 (am), SH, Wilmot N. Hess (NOAA).

Mathematics in Biological and Social Sciences

"The Uses and Misuses of Survey Data," January 3 (pm), HM, Barbara A. Bailar (U.S. Bureau of Census).

Social and Behavioral Sciences

"Immigrants: New and Old," January 4 (pm), SH, Charles Hirschman (Duke);

"Feminism and the Philosophy of Science" (morning session) and "Women and Scientific Research" (afternoon session), January 6, SH, S. Leigh Star (University of California-San Francisco) and Sandra Harding (Delaware).

Personal and Family Development

"Paradigms and Prejudices in Research on Homosexuality," January 5 (am), HM, Noretta Koertge (Indiana);

"Violence in the Family: Psychiatric, Sociologic and Historical Perspectives," January 6 (am/pm), HM, Maurice R. Green (American Academy of Psychoanalysis).

History and Philosophy of Science

"China's Science in World Persepctive," January 4 (am/pm), SH, Leo A. Orleans and Patricia J. Tsuchitani (NAS);

"Science and Society--A Comparative History of Eugenics in Four Countries: USSR, Weimar Germany, United States, England," January 5 (am), SH, Garland E. Allen (Washington University)

"Thomas A. Edison: A Critical Examination on the Occasion of the Centennial of Electrical Lighting," January 5 (pm), SH, David A. Hounshell (Harvey Mudd College);

"One Hundred Years of Scientific Psychology: 1879-1979," January 6 (am/pm), SH, Gregory A. Kimble (Duke) and Barbara C. Ross (University of Massachusetts-Harbor Campus);

"The Einstein Centenary," January 7 (am/pm), SH, John J. Stachel (IAS, Princeton).

Education

"Minority Access and Representation in Higher Education: An Empirical Assessment," January 4 (am), SH, Gail E. Thomas (Johns Hopkins);

"How Academies of Science Can Communicate Science to the General Public," January 4 (am), SH, Richard J. Raridon (Oak Ridge);

"The Public Understanding of Organized Science," January 6 (am), SH, Keith M. Wulff (Concordia) and Jon D. Miller (Northern Illinois);

"The Anatomy of Controversy: Scientific Freedom and Responsibility In Teaching," January 6 (pm), HM, H. Bentley Glass (SUNY-Stony Brook).

Information and Communication

"Individual and Social Electronics: Coping, Communicating, Understanding," January 5 (pm), HM, Joseph M. Dasbach (AAAS) and Joseph I. Lipson (NSF);
"Evolving Economics and Technology of Science Publishing," January 7 (pm), HM, Seldon W. Terrant (ACS), Michael Bowen (ACS), and James Barsky (Academic Press).

Energy

"The Nuclear Waste Management Controversy: Can Conflicting Values be Reconciled?" January 5 (am), SH, Dorothy S. Zinberg (Harvard).

Technology and Engineering

"Technological and Legal Aspects of Noise Control," January 5 (am) SH, William A. Thomas (ABA), and Richard A. Scribner (AAAS).

Science and Technology Policy

"Science as Evidence in Judicial and Administrative Proceedings," January 4 (pm), HM, Arthur F. Konopka (NSF) and J.V. Martinez, (DOE);
"Scientific Freedom and Responsibility in the International Arena," January 5 (am), SH, Joel Primack (UCLA-Santa Cruz) and Jessica Tuchman Mathews (NSC).

J. National Series of Conferences on "Toxic Substances: Decisions and Values"

The Washington-based Technical Information Project will hold four national conferences in 1979 to analyze the ethical aspects of crucial issues, decision factors and criteria in the handling of toxic substances. The conferences will examine closely the rights and responsibilities of citizens, chemical producers, government agencies, and scientist/engineers.

Before each two-day conference, in-depth papers and drafts of interdisciplinary reactions will be distributed and will serve as starting points for participant analysis and action papers. Proceedings of each conference will be published and distributed to key state and federal agencies and representatives, industries, academic institutions, unions, libraries and individuals. The four conferences will be held as follows:

*Conference 1 Topic: "Decisionmaking" (Title 1, "Assessing Risks"; Title 2, "The Consumer and Public Decisions"); deadline for participants 15 November 1978; conference dates are 19-20 February 1979.

*Conference 2 Topic: "Information Flow" (Title 1, "Testing Information"; Title 2, "Availability and Accessibility of Information"); deadline, 15 December 1978; conference dates, 16-17 April 1979.

*Conference 3 Topic: "Distribution of Burdens" (Title 1, "Worker and Victim Compensation"; Title 2, "Environmental Compensation"); conference dates, 18-19 June 1979.

*Conference 4 Topic: "Worldwide Environmental Problems" (Title 1, "International Problems"; Title 2, "Global Problems"); conference dates, 10-11 September 1979.

Deadline for all abstracts and outlines for all conferences is 1 November 1979. For specific topics, deadlines, conference locations, and dates, contact Thomas Conry, Project Manager, Technical Information Project, 1346 Connecticut Avenue, Suite 207, Washington, DC 20036; (202) 466-4512. Honoraria and travel supplements are available.

K. Spring Conference to Examine "The Humanities in a Computerized World"

The Institute for Humanistic Studies, SUNY-Albany, is sponsoring an international symposium on the relationship between the humanities and mechanical or electronic information flow, to be held at the Alumni House-Conference Center (SUNY-Albany), 19-21 April 1979. The Institute has issued a call for papers, to include such topics as:

1) Contrasting models of men and women as statistical units or as autonomous individuals; the tension between concepts of thought as mechanistic and as uniquely human.
2) The portrayal of computers or similar mechanisms in world literature, art, music, or history (for example, by Leibniz, Jonathan Swift, Jules Verne, or H.G. Wells).
3) The uses of the computer in the humanities today (for example, in bibliography, audience analysis, electronic art and music, stylistics, or cliometrics).
4) Problems of policy involving the humanistic implications, both positive and negative, of computers in areas such as data banks, education, industry, medicine, law, crime and criminal justice, economics and banking, social services, or political analysis.

"Apollo Agonistes: The Humanities in a Computerized World" is co-sponsored by the SUNY-Albany College of Humanities and Fine Arts and the Computing Center. One-page proposals or abstracts, comprehensible to a lay audience, should be submitted by November 15 to: Professor M.E. Grenander, Director, The Institute for Humanistic Studies, State University of New York at Albany, Albany, NY 12222.

L. Education Workshops on Ethical Issues in Engineering

From 16-27 July 1979, the Center for the Study of Ethics in the Professions, Illinois Institute of Technology, will present an institute for philosophy and engineering educators who are developing courses on ethics and professional responsibility of engineers. Subject matter and cases will confront 1) the professional and ethical problems encountered by engineers, 2) strategies for resolution of problems, and 3) the roles and responsibilities of engineering societies, government, and the individual. Staff for the NSF-NEH supported workshops includes both philosophy and engineering faculty of Illinois Institute of Technology and distinguished visiting lecturers. Participants will receive travel funds and a stipend. For further details and application forms write: Dr. Vivian Weil, Center for the Study of Ethics in the Professions, Illinois Institute of Technology, Chicago, IL 60616.

M. NSF Chautauqua-Type Short Courses on Topics in Ethics and Values

Every year, the American Association for the Advancement of Science and the University of Missouri-Kansas City jointly administer a series of courses designed to brief college science and engineering teachers on recent scientific and technical advances and issues. The courses are both discipline-oriented and interdisciplinary and meet for a total of four days (two full days in the fall and two in the spring). During the three-month interim between sessions, participants are expected to work on "projects" related to the course.

Participation is limited to teachers of undergraduate students in degree-granting institutions of higher learning; in the interdisciplinary courses, every effort is made to select persons from a wide range of fields. There is no charge to participants and lodging is provided. The first meetings of most of the 1978-79 courses are scheduled for October or early November 1978. A few of the courses on ethics and values that begin in November are:

Western Circuit: "The Historical Foundations of Modern Science," Duane H.D. Roller (Texas, 9-10 November); "Ethical Issues in Engineering," Robert J. Baum (Oregon, 2-3 November); "Emergence of the Global Society and Education for the Future," Mihajlo D. Mesarovic (Oregon, 6-7 November).

Central Circuit: "Risk/Benefit Analysis," Chris Whipple (Kansas City, 13-14 November; Ohio, 16-17 November); "Social Indicators," Denis F. Johnston (Ohio, 2-3 November).

Eastern Circuit: "Recombinant DNA: Social and Scientific Perspectives," Elizabeth Kutter and LeRoy Walters (Massachusetts, 13-14 November; Maryland, 16-17 November; Georgia, 20-21 November); "Ethical Issues in Engineering," Robert J. Baum (Connecticut, 16-17 November).

Persons interested in attending a Chautauqua course next year should request a copy of the announcement booklet from the Office of Science Education, AAAS, 1776 Massachusetts Avenue, N.W., Washington, DC 20036.

N. Hastings Center Announces Availability of 1979-80 Post-Doctoral Fellowships

Under a grant from the National Endowment for the Humanities, The Hastings Center (Institute for Society, Ethics and the Life Sciences) will provide four one-year post-doctoral fellowships for the study of ethics and the life sciences during the academic year 1979-80. The objective of the fellowship program is to permit researchers to prepare themselves systematically for future productive research on ethical problems arising from advances in medicine, biology, and the behavioral sciences.

Applicants from all disciplines are welcome; however, a minimal requirement is an advanced doctoral or professional degree (or its equivalent). In addition to a form, applicants must submit a detailed statement of past work, future aspirations in the field, and a proposal for research or study. Application deadline is 1 January 1979. Awards will be announced on or before 15 March 1979. Forms and additional information may be obtained from: Post-Doctoral Fellowship Program, The Hastings Center, 360 Broadway, Hastings-on-Hudson, NY 10706.

O. Awards for Public Service Science Residencies and Internships

NSF's Science for Citizens Program has announced the award of twenty-five Public Service Science Residencies and nine Public Service Science Internships. The awards are designed to enable experienced scientists and engineers, and science and engineering students to provide community groups such as citizens' organizations, trade unions, and state and local government offices, with scientific and technical information. The range of projects included in the awards is illustrated by the following examples:

1) A resident will work with the Department of Health Improvement Services of the Navajo Tribe and the Department of Food Service and Nutrition at Colorado State University to analyze the nutritional status of Native Americans and its relation to relevant public policies. He will conduct training sessions on health and nutrition policy for Native American decision-makers.

2) Working with the Minnesota State Legislature and the Center for Local Self Reliance, an intern will prepare and disseminate information on energy conservation for a low- and middle-income Minneapolis community.

3) A resident will produce and moderate bilingual programs for California Public Radio, focused on scientific issues in proposed state legislation.

4) A resident working with the Natural Resources Council of Maine will hold meetings to help citizens understand the effects of modern farming and forestry practices on the state's natural resources.

5) An intern will work with one of 59 New York City Community Planning Boards in analyzing patterns of community participation and in the preparation of community planning handbooks.

For additional information about Public Service Science Residencies and Internships, write to: Science for Citizens Program, Office of Science and Society, National Science Foundation, Washington, DC 20550.

P. CIA Information Declassified and Available

This publication has received a news release from UPDATA Publications, Inc., entitled "Central Intelligence Agency's Reference Series on Microfiche". Excerpts from that announcement follow:

"UPDATA Publications Inc. of Los Angeles, California, has announced the forthcoming [microfiche] publication of the Central Intelligence Agency's Reference Aid Series. . . .

"The Collection consists of close to twelve thousand pages of information compiled by the CIA for release to U.S. Government Officials. All of this information has now been declassified.

"The vast research capabilities of the CIA have compiled political, economic and statistical information in such important areas as oil, gas, minerals, metals, agriculture; political, economic and military structures of Communist-

affiliated countries. There are directories of the officials of many Government structures such as the USSR, German Democratic Republic, Polish People's Republic, People's Republic of China, Democratic People's Republic of Korea, Socialist Federal Republic of Yugoslavia, Socialist Republic of Vietnam, Lao People's Democratic Republic, People's Socialist Republic of Albania, the Cuban Government, and others.

"Included are dollar cost comparisons of Soviet-USA Defense activities, China and Russia oil production prospects, grain outlooks, [and] the International Energy outlook to 1985. The current and past National Basic Intelligence fact books are included.

"This hard-to-find information will be updated on a periodic basis. . . .Inquiries may be addressed to UPDATA, 1756 Westwood Boulevard, Los Angeles, CA 90024."

Q. Monthly List of New Publications in Bioethics

Since 1975, the Kennedy Institute Center for Bioethics (Georgetown University) has published a monthly categorized list of recent books, pamphlets, serial titles, audio-visual aids, and other non-serial literature on bioethics acquired by its library. In its continuing effort to secure a copy of every new document published in the field of bioethics, the Center's Library monitors a wide variety of indexes, bibliographical services, and automated data bases. New Titles in Bioethics lists over 800 titles annually and is available, by subscription, from the Center for Bioethics Library, Kennedy Institute of Ethics, Georgetown University, Washington, DC 20057.

R. Smithsonian Packages Info on Science Policy Research

The Smithsonian Science Information Exchange, Inc. (SSIE) is now marketing a series of "information packages" covering research in progress in science policy, technology transfer, and ethics and science. Each package consists of brief descriptions of ongoing and recently completed research projects in the given subject area. Titles available include: Ethical Issues in Modern Science; History and Philosophy of Science; Overviews of the Social Impact of Technological Development; Technology Assessment; and Effects of Technological Change.

Individual "packages" contain from 25 to 300 project descriptions (title; supporting organization; names of investigators; performing organization; period of performance; level of funding; and a 200-word technical summary of the project). Prices are based on the number of project descriptions provided and range from $45 to $65. For more detailed information, write to: Ann Riordan, SSIE, Room 300, 1730 M Street, N.W., Washington, DC 20036.

News from the Societies

A. Society for Social Studies of Science

4S to Hold Annual Meeting in Indiana: 3-5 November 1978

An invited speech by John Ziman (University of Bristol, England) will highlight the 3rd Annual Meeting of the Society for Social Studies of Science to be held in Bloomington, Indiana; 3-5 November. Taking office at that time will be Dorothy Nelkin (President), Lowell Hargens (Secretary-Treasurer) and three new council members, Jerry Gaston, Ian Mitroff and Arnold Thackray. The 4S business meeting, presently scheduled for Sunday afternoon, November 5, will be preceded by a full program of papers and panels.

Invited speakers include: John Ziman, "Epistemological Consequences of a Social Model of Science"; Donald T. Campbell (Northwestern University), "Comments on the Fragmented History of the Psychology of Science"; John Law (University of Keele); Trevor Pinch (University of Bath); Spencer Weart (American Institute of Physics); and Steve Woolgar (Brunel University).

Panel sessions will be chaired by: Thomas G. Gieryn (Department of Sociology, Indiana University, Bloomington, IN 47401), "Varieties of Theoretical Orientations in the Social Studies of Science", and Belver C. Griffith (School of Library Science, Drexel University, Philadelphia, PA 19104), "Methodological Problems and Potentials in the Social Studies of Science". Persons interested in contributing to these sessions should contact the coordinators.

The Program Committee had announced three contributed paper sessions as of press time:

1. The Social Assessment of Scientific Risk, chaired by William A. Blanpied (NSF EVIST Program): "Regulation and Risk Management in Federal Science-Related Agencies," Michael S. Baram (Franklin Pierce Law Center); "The New Zealand Accident Compensation Act: An Innovative Response to Technology-Related Risk," Jane C. Kronick (Bryn Mawr College); "Equity Issues in Radioactive Waste Management," Roger Kasperson (Clark University); and "Case Studies of Scientific Research on Aggression", Ronald Bayer (Hastings Institute of Society, Ethics, and Life Sciences).

2. Public Participation in Science: Research Approaches, chaired by Alexander J. Morin (NSF Office of Science and Society): "Citizen Participation in State Weather Modification Policy," W. Henry Lambright (Syracuse University); "Public Involvement in the DNA Controversy," Rae Goodell (MIT); "Can the Science Court Work? The Minnesota Experience", Barry M. Casper (Carleton College); "Institutional Review Boards and Medical Research", Bradford Gray (Institute of

Medicine, National Academy of Sciences); and "The European Experience: Comparative Studies," Dorothy Nelkin (Cornell University).

3. Public Understanding of Science, chaired by Robert Wright (NSF Science Indicators Unit): "Selective Attentiveness: A Conceptual Framework for Understanding Public Attitudes Toward Organized Science," Jon D. Miller (Northern Illinois University); "The Development of Attentiveness to Organized Science Among Young Adults," Robert Suchner and Allan Voelker (Northern Illinois University); and "The Mobilized Public for Science Politics," Kenneth Prewitt and Robert Pearson (National Opinion Research Center, University of Chicago).

A session on Social Psychology of Science is being organized by John Wilkes (Social Science Department, Worcester Polytechnic Institute, Worcester, MA 06109) on behalf of the Study Group for the Social Psychological and Subjective Aspects of Science (this group was formed at last year's meeting).

Although pre-registration and local (campus) room reservations must be made by October 20, persons may also register at the meeting. Local Arrangements Committee is chaired by Nicholas C. Mullins (Department of Sociology, Ballantine Hall, Indiana University, Bloomington, IN 47401).

B. Society for the History of Technology

Publishing Project and Conference on the Works of Thomas A. Edison

In one of the largest documentary projects ever undertaken in the history of American technology and science, Rutgers University, the National Park Service, the New Jersey Historical Commission and the Smithsonian Institution have begun a major project to edit and publish the papers of Thomas A. Edison. More than two million pages of manuscripts will be published in a comprehensive microfilm edition and a 15 to 20-volume letterpress edition. Documents located at the Edison National Historic Site (West Orange, NJ) include over 2700 laboratory notebooks, patent and legal files, and substantial correspondence. In addition, thousands of Edison artifacts and photographs at the Edison laboratories in West Orange will be employed in the scholarly documentary publications and in a series of more popular associated works. For more information, write Reese V. Jenkins, Editor and Director, Thomas A. Edison Papers, 1 Richardson Street, Rutgers University, New Brunswick, NJ 08903.

The Edison Papers Project is also conducting a search for an Assistant Professor of American Science and Technology to be associate editor of the Edison papers. The appointee will be responsible for some teaching in the Department of History in addition to assisting in the editorial work. Potential candidates should write Reese V. Jenkins, Project Director, at the above address.

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In October 1979, the New Jersey Historical Commission will sponsor a conference on Thomas A. Edison and the recent history of science and technology. The general themes of the meeting will be "the nature of discovery or invention" and "inventors' responsibility to society". Specific topics include: Edison's impact on the growth of American business; development of the "systems approach" to technology; and Edison as a folk hero. Persons interested in presenting papers should submit proposals, no later than 1 January 1979, to: Richard Waldron, Associate Director of the Historical Commission, 113 W. State Street, Trenton, NJ 08625.

Electrical Engineering History Fellowship Offered by IEEE

In Spring 1979, the History Committee of the Institute of Electrical and Electronics Engineers (IEEE) will award a fellowship to a student in the field of electrical engineering history. This fellowship provides a basic stipend of $6500 and up to $2000 for tuition and fees. Deadline for applications is 1 February 1979. Write: Reed Crone, Secretary of the IEEE History Committee, IEEE Headquarters, 345 East 47th Street, New York, NY 10017.

C. History of Science Society

Symposium on History of Science in the Science Curriculum

The History of Science Society Committee on Undergraduate Education will sponsor a symposium on "History of Science in the Science Curriculum" at the society's annual meeting in Madison, WI. The symposium, scheduled for Friday evening, 27 October 1978, and chaired by Maurice Finocchiaro (University of Nevada), will include the following: Elizabeth Patterson (Albertus Magnus College), "History as an Introduction to Science", Robert Dott (Wisconsin), "The Pros and Cons of the Historical Introduction to Science"; and Walter Gross (American Association of Physics Teachers), "The History of the Physical Sciences in the Two-Year College Curriculum". For further information, contact Stephen G. Brush, Institute for Physical Science and Technology, University of Maryland, College Park, MD 20742; (301)454-2724.

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The April 1978 issue of SCAN (a journal of scientific research for science teachers) contained a report on the December 1977 Symposium sponsored by the History of Science Society Committee on Undergraduate Education. Topics included discussions of courses on the history of genetic recombination and the history of medicine. To obtain a reprint of the SCAN report, send a stamped, self-addressed envelope to Stephen G. Brush, (University of Maryland).

European History of Chemistry Tour in 1979

For the fifth year, Southern Illinois University-Carbondale will offer a European travel and study course in "The Evolution of Modern Chemistry" during June and July 1979. The eight-week program is open to chemistry and science teachers, professors and graduate students for credit or audit. The first such tour offered by this organization is described in 49 Journal of Chemical Education 593 (1972). Inquiries should be directed to Professor John H. Wotiz, Department of Chemistry and Biochemistry, Southern Illinois University, Carbondale, IL 62901; (618)-453-5721.

D. Society for Philosophy & Technology

Symposium on Recent Developments in the Philosophy of Technology

On 28 December 1978, in conjunction with the American Philosophical Association's Eastern Division meeting at the Washington (D.C.) Hilton, the Society for Philosophy and Technology will sponsor a discussion of recent developments in the philosophy of technology. The morning symposium, chaired by Stanley R. Carpenter (Georgia Tech), will feature talks by David F. Noble, M.I.T. ("Technology as a Reflection of Social Relations") and Don Ihde, SUNY-Stony Brook ("Technics as Telos").

The session is one of a series of on-going symposia usually held in conjunction with regional APA meetings and the annual PSA meeting. Future symposia are scheduled for meetings of the APA Pacific Division (March 1979) and Western Division (April 1979). All sessions are open to APA conferees. For further information: Stanley R. Carpenter, Department of Social Sciences, Georgia Tech, Atlanta, GA 30332; (404)-894-3195.

E. Philosophy of Science Association

Forthcoming Publications on the Philosophy of Science

The Philosophy of Science Association has announced a late October 1978 publication date for Current Research in Philosophy of Science, edited by Peter D. Asquith and Henry E. Kyburg, Jr. Contents of the volume include:

Metascience Topics: Robert L. Causey, "Theory and Observation"; Ernest W. Adams, "Measurement Theory"; Noretta Koertge, "The Problems of Appraising Scientific Theories"; Myles Brand, "Causality"; Bas C. van Fraassen, "Modality"; Joseph F. Hanna, "An Interpretive Survey of Recent Research on Scientific Explanation"; Frederick Suppe, "Theory Structure"; Isaac Levi, "Inductive Appraisal"; and William Wimsatt, "Reduction and Reductionism".

Different Methodological Approaches to Philosophy of Science: Larry Laudan, "Historical Methodologies: An Overview and Manifesto"; Gary Gutting, "Continental Philosophy of Science"; Henry E. Kyburg, Jr., "The Application of Formal Methods in the Philosophy of Science"; and Wesley C. Salmon, "Informal Analytic Approaches to the Philosophy of Science".

Philosophy of Science and Other Disciplines: Thomas S. Kuhn, "History of Science"; Bernard Barber, "On the Relations Between Philosphy of Science and Sociology of Science"; Marx Wartofsky, "Philosophy of Technology"; and Robert H. Ennis, "Research in Philosophy of Science Bearing on Science Education".

Philosophical Foundations of Various Scientific Disciplines: Nancy Cartwright, "Philosophy of Physics"; Hilary Putnam, "Philosophy of Mathematics: A Report"; Arthur W. Burks, "Computer Science and Philosophy"; David L. Hull, "Philosophy of Biology"; H. Tristram Engelhardt, Jr., "Philosophical Problems in Biomedicine: Towards a Philosophy of Medicine"; Ned Block, "Philosophy of Psychology"; Alex C. Michalos, "Philosophy of Social Science"; and Ronald N. Giere, "Foundations of Probability and Statistical Inference".

General Discussion of Methodological Issues: Ernan McMullin, "The Ambiguity of 'Historicism'"; Patrick A. Heelan, "Continental Philosophy and Philosophy of Science"; Patrick Suppes, "The Role of Formal Methods in the Philosophy of Science".

Pre-publication prices (effective until 31 October 1978) for the 50-page volume are $7.00 (paper) and $8.50 (cloth). Orders should be addressed to PSA, 18 Morrill Hall, Michigan State University, East Lansing, MI 48824.

The proceedings of the 1978 Biennial Meeting of the Philosophy of Science Association (San Francisco, 26-29 October) will be published in August 1979 in two volumes edited by Peter Asquith and Ian Hacking. The contents - which will also encompass the proceedings of symposia, special sessions, and invited lectures - are expected to include papers on such topics as "The Development of Kant's Conception of Scientific Explanation", "The Role of Psychology in Functional Localization Research", "Reasons, Causes, and Empathetic Understanding", "Four Contributions Values Can Make to the Objectivity of Social Science", "Four Basic Concepts of Medical Science", "Why Astrology Is a Pseudoscience", and "Rhetoric and Scientific Rationality".

Special pre-publication prices are also available for this volume. For further information, write: PSA, 18 Morrill Hall, Michigan State University, East Lansing, Michigan 48824.

Meetings Calendar

3-5 November 1978	Society for Social Studies of Science, Indiana University, Bloomington, Indiana.
7-9 December 1978	Davy Bicentenary Symposium, Royal Institute of Great Britain, London.
26-29 December 1978	American Philosophical Association (Eastern Division), Washington Hilton, Washington, DC.
3-8 January 1979	AAAS Annual Meeting, Houston, Texas.
11-15 January 1979	Annual Meeting of the American Mathematical Society, Milwaukee, Wisconsin.
2-3 March 1979	Society for the Advancement of American Philosophy, 6th Annual Meeting, John Carroll University, Cleveland, Ohio. Contact: John Howie, SIU, Carbondale, Illinois 62901
8-10 March 1979	The 22nd Annual Missouri Valley History Conference, Omaha, Nebraska. Program Chairperson: Jacqueline D. St. John, M.V.H.C., Department of History, University of Nebraska at Omaha, Box 688, Omaha, Nebraska 68101.
6-7 April 1979	6th Annual Meeting of the Joint Atlantic Seminar in the History of the Physical Sciences, University of Pennsylvania. Contact: Profs. Robert E. Kohler or Jeffrey L. Sturchio, Department of History and Sociology of Science, E.F. Smith Hall - D6, University of Pennsylvania, 215 South 34th St., Philadelphia, Pennsylvania 19104.
20-21 April 1979	Thirteenth Conference on Value Inquiry Topic: "The Life Sciences and Human Values." Papers due: 1 December 1978. Contact: Directors, 13th Conference on Value Inquiry, Department of Philosophy, SUNY-Geneseo, Geneseo, New York 14454.
14-17 September 1979	Royal Institute of Philosophy Conference on Law and Philosophy, University of Lancaster, Lancaster, ENGLAND. Contact: M.A. Stewart, Department of Philosophy, The University of Lancaster LA1 4YT, ENGLAND.
September 1979	American Sociological Association 1979 Annual Meeting, Boston, Massachusetts.

A SELECTED BIBLIOGRAPHY OF TWENTIETH-CENTURY POEMS RELEVANT TO SCIENCE AND SOCIAL ASPECTS OF SCIENCE

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The scientific world-view and its philosophical implications have had a pervasive influence on twentieth-century poetry. Although relatively few poems contain direct comments on the social and philosophical implications of science, a study of the ways in which scientific concepts and vocabulary are used in serious artistic works can shed light on aspects of the "two cultures" debate. In addition, significant topics in social studies of science courses -- e.g., epistemological questions about the nature of scientific knowledge, and questions about the ethical, social and political implications of science -- can be productively studied through relevant literary works.* The following bibliography has been designed as an aid for research into the relation between literature and science, and for courses which focus on the relation between science and culture. It has been constructed with a special view to the requirements of science students taking such courses.

All of the poems listed in this bibliography were written in the twentieth century. Each was chosen because, in one way or another, it exhibits a direct relationship to science. Selection was based on the following criteria:

1) use of concepts of the natural sciences directly or in an imaginative manner (e.g., as metaphor);

2) use of the vocabulary of the natural sciences directly or in an imaginative manner;

3) relevance to questions about the nature and/or reliability of scientific knowledge, to the image of the scientist, or to the ethical, social or philosophical implications of scientific knowledge.

Works focusing exclusively on medicine or the social sciences have not been especially selected for inclusion; however, comments on these subjects are often incorporated in works pertaining to science as a whole. "Nature" poetry is traditionally considered to be related to science, but this bibliography includes only those "nature" poems with explicit emphasis on scientific concepts, philosophy, or vocabulary. It should be pointed out that the list also does not include poems about technological or engineering achievements. "Science fiction" poetry, as a genre, has also been omitted, unless a particular poem

* In Issue Number 10 (January 1975) of the Newsletter of the Program on Public Conceptions of Science, Richard Freedman presented a "checklist" of imaginative literature -- fiction and drama -- concerning the relationship between science, technology, and human values.

fulfilled other criteria listed.

Although, for convenience, the entries are organized by author, it must be emphasized that the criteria used were applied to poems rather than poets. This accounts for the absence of some modern poets of major literary stature (e.g., T.S. Eliot and Ezra Pound) and the inclusion of other less famous ones. Wherever possible, both the American and British editions have been noted. If a poem was first published in a language other than English, only the English translation edition is cited.

1. DANNIE ABSE A British poet with a medical education.

From Walking Under Water (London: Hutchinson, 1952):

"Letter to Alex Comfort" - a poem about discovery, which mentions Ehrlich, Koch, Archimedes, and Newton and favors accidental discovery.

2. A.R. AMMONS The contemporary American poet A.R. Ammons frequently employs the vocabulary of biology and geology. Often, modern ecology and ecological theory play an important role in the conceptual aspects of Ammons' poems.

From Collected Poems 1951-1971 (New York: W.W. Norton, 1972):

"Interval" - relevant to the philosophy of biological taxonomy and cycles in ecosystems.

"Hymn" uses biological vocabulary; also, there is an interesting juxtaposition of metaphysical terms with the entities of reductionist physiology.

"Mechanism" - direct use of thermodynamics, molecular biology, biochemical physiology, ethology, chemical kinetics and bioenergetics.

"Terrain" incorporates metaphorical use of geomorphology and geology (plate tectonics).

"Identity" is a poem about entropy, arachnid behaviour, adaptation, instinct, variation, freedom vs. necessity; in some lines, it verges on biological theorising.

"The Misfit" is a poem with epistemological concerns, relevant to Kuhn's view of paradigms, normal science and scientific revolutions.

"Zone" concerns the limitations of reductionist method, and possible dangers of holism; it employs biological and cell biological nomenclature and examines analysis vs. synthesis.

"Reassessing" addresses the uncertainty of artistic method in capturing reality - in comparison with "scientific" methods and systems analysis.

"Exotic" - the implications of scientific knowledge for a limited humanity.

"Working Still" is a rumination that includes mention of atmospheric pollutants and plant-animal physiological dependence.

"Essay on Poetics" - this poetic description of a tree as an object overlaps with scientific methods; the poem comments on the ecology of host-parasite relationships, plant physiology, scientific rendering of reality, and hierarchic levels in the biosphere and in scientific methods. Quotes from biology and botany texts and a Scientific American article are included.

"Extremes and Moderations" - a long poem with passing comments on science as a method of controlling the environment and on utopia through science, belief and scientific explanation.

3. WILLIAM EMPSON This noted literary critic has also published many poems that have close affinities with the 17th-century metaphysical poets and that consciously reflect the impact of modern cosmology and physical theory, often using these metaphorically. Empson had a mathematical education before he began his literary studies.[1] His poems are set as much as puzzles as poems and his notes accompanying the poems are necessary to understanding -- even if they are occasionally confusing.

From Collected Poems (New York: Harcourt, Brace, 1949, corrected edition published in 1961; London: Chatto and Windus, 1956):

"Invitation to June" uses organ culture physiology and Darwinism metaphorically.

"The World's End" deals with a finite but unbounded universe.

"Plenum and Vacuum" - the author's note claims some relevance to matter and space in relativity theory. The poem could, however, be considered obscure.

"Dissatisfaction with Metaphysics" mentions a finite but unbounded universe and requires the author's notes for complete elucidation.

"High Dive," according to the author's notes, refers to the possibility of giving a single mathematical expression for all the movements in a pool of water; obscure without the author's notes.

"Camping Out" is a complicated poem using surface tension and relativity theory; again, it requires the author's notes.

"Letter I" uses astrophysics and cosmology.

"Earth has Shrunk in the Wash" - the author has written that this poem describes the situation in which the earth becomes an asteroid without enough gravitational force to maintain its atmosphere, using this transformation as a metaphor for the separation between individuals induced by civilised refinement and for the way in which scientific discovery has produced a strange world and given man dangerous powers. The poem also addresses the biological implications of optical isomers and biochemical physiology.

"Letter IV" is allegedly composed on a moral derived by allegorising material written by Sir Arthur Eddington, the British astronomer and popularisor of modern physics. There is mention of cosmological theory but the poem is difficult and obscure.

"Doctrinal Point" - Eddington is quoted on the philosophy of physics.

"Bacchus" - a longer and more difficult poem concerning a mythological version of distillation processes; the author's notes mention relativity theory as relevant to some sections.

4. ROBERT FROST Frost is "often falsely classified as a 'nature' poet...,"[2] but his approach to science is bare and realistic, rather than sentimental. In addition to the poems by Frost listed in the Freedman checklist,[3] the following are relevant to the present bibliography:

From A Masque of Reason (New York: Henry Holt and Co., 1945; London: Jonathan Cape, 1948):

"Any Size We Please" deals with curved space, and the invention of universes to please aesthetics or psychology.

Also see "A Wish to Comply" and "On Making Certain Anything Has Happened."

From In the Clearing (New York: Holt, Rinehart and Winston, 1962):

"Kitty Hawk" includes references to the nature and wisdom of science.
"Some Science Fiction" ruminates on science and space travel.
"A Reflex" - a humorous poem on science.
"Accidentally on Purpose" - a humorous poem on the universe, Darwin, and teleology.
"A Never Naught Song" deals with matter and its origin.

From Complete Poems of Robert Frost (New York: Henry Holt and Co., Inc., 1951; London: Jonathan Cape, 1951):

"The White-Tailed Hornet" or "The Revision of Theories" - a poem relevant to any discussion of ethology, evolution, sociobiology, or the growth of science.
"At Woodward's Gardens" or "Resourcefulness is More than Understanding" gives a pragmatic view of what constitutes knowledge.
"The Lesson for Today" describes science and religion, and the effect of science on the stature of modern man.
"A Loose Mountain" (Telescopic) is about a "star shower".
"It Is Almost the Year Two Thousand" - on the prophetic powers of science.

5. MIROSLAV HOLUB This interesting Czech poet is also a clinical pathologist. His poems are marked by an ironic wit and a modernist, analytical sensibility, and often comment on science and its social implications in an original and sophisticated way. [It should be noted that several other modern East European poets have written poems commenting on science and its applications, for example, the Czech poets Vladimír Holan and Jiří Šotola and the Polish poet Zbigniew Herbert.]

From Selected Poems, translated by Ian Milner and George Theiner (Baltimore, MD: Penguin Books, 1967):

"Wings" comments on the liberating effect of human intellectual abilities, including those involved in obtaining scientific knowledge.
"Suffering" is an imaginative description of a biological laboratory experiment involving electrophoresis and chromatography. The poem also comments obliquely on the moral and philosophical aspects of biological experimentation and, more directly, on the nature of "progress" in scientific knowledge.
"Pathology" asserts that all men are equal under the microtome's knife and the microscope's lenses, but that scientific truth is retrieved from suffering.
"Lovers in August" - includes, as metaphors, Maxwell's demons and other concepts derived from thermodynamics.
"Night at the Observatory" - in this poem, geological and astronomical time perspectives are juxtaposed with human perception.
"Zito the Magician" comments on the role of imagination in human creativity, and employs a mathematical metaphor to great effect.
"Inventions" is a mythological fable concerning Archimedes.

From Although, translated by Ian and Jarmila Milner (New York: Grossman Publishers, Inc., 1971; London: Jonathan Cape, 1971):

"Oxidation" employs a description of chemical oxidation as a metaphor.
"Discovery of Fire" uses the mythological discovery of fire to comment on social and moral implications of scientific discovery, the "unforeseen" effects of technological advances, etc.
"The Corporal Who Killed Archimedes" would be a useful poem for discussion of the relationship between science and state, particularly with respect to attempts by the state to dictate what constitutes scientific knowledge.

From The New Review, Volume 2, Number 23 (February 1976), p. 9:

"Brief Reflection on Exactness" (translated by Jarmila and Ian Milner) is a poem concerning the "essence of scientific research" -- i.e., the scientific method -- and advancing an epistemological relativism. The poem would be relevant to any discussion of empirical method, logical positivism or Popperian falsifiability.

From Modern Poetry in Translation, Volume 5, 1969 (published and distributed by Cape Goliard, 30 Bedford Square, London WC1, U.K.):

"Happy Event" describes the birth of a kitten, partly through the use of biochemistry and physiology, including acid phosphatases and nucleoles. It could be classified as both visionary and mechanistic.

6. A[lec] D[erwent] HOPE A major Australian poet with an international reputation, Hope received the Lovinson Prize for Poetry in 1968 and the Robert Frost Award in 1976. His poetry is distinguished by sophisticated form and intellectual depth.

From Collected Poems (New York: Viking Press, 1966; Sydney: Angus and Robertson, 1972):

"X-Ray Photograph" uses x-rays as a metaphor for the analytical reductionism of scientific method in order to explore the philosophical implications of a scientific world-view.
"The Age of Innocence or Darwin Moralized" is a satirical poem about the hypothetical evolution of the soul which utilizes natural selection and a peculiar form of genetics. The poem comments indirectly on science and the image of a didactic academic scientist.

7. ROBINSON JEFFERS An American poet who, in understatement, might be described as a misanthropic pessimist. Jeffers sometimes comments on the philosophical implications of the scientific world-view and applications of science and technology in modern society.[4] His poems have also been used as expositions of the viewpoints of environmental or preservationist groups.[5] There is reference to atomic theory and astronomy in some of Jeffers' long narrative poems, such as "Roan Stallion" and "Margrave", but only shorter poems are included in the following list.

From The Selected Poetry of Robinson Jeffers (New York: Random House, 1959):

"Science" - in this poem, man is seen as not morally fit to control the effects of modern scientific knowledge.
"Triad" - the poet considers that "science...has fallen from hope to confusion at her own business of understanding the nature of things."
"Nova" makes astronomical speculations.
"New Year's Eve" includes metaphorical use of a microbiological reference (i.e., organisms adapting to a culture medium in a test-tube).

From The Beginning and the End and Other Poems (New York: Random House, 1963):

"The Great Explosion" - theories of the origin of the universe are the concern of this poem, which includes discussion of the metaphysical and theological implications of such theories.
"The Beginning and the End" deals with the chemical origin of life, the origin of cells, the evolution of multicellular plants, and the origin of terrestrial life, animals and man.
"The Great Wound" proposes a theory of the origin of the moon and examines the nature of scientific knowledge.
"Star-Swirls" - the insignificance of man is demonstrated by means of astronomy and the time scales of astronomy and geology.
"The Silent Shepherds" - science and mathematics are seen as parallel to reality rather than contiguous to it.

From Harper's Magazine, Volume 252, Number 1509 (February 1976), pp. 45-46:

"Curb Science?" - one of a set of previously unpublished poems by Jeffers from the Tor House Collection at the Humanities Research Center, University of Texas at Austin. This poem defends science, from Jeffers' idiosyncratic perspective.
"Staggering Back Toward Life" deals with new applications of science to military technology and the capacity of mankind to cope with them.

8. WALTER LOWENFELS An American poet and editor. One feature of his work has been an imaginative use of verbal collage using "found" sources such as fragments from popular science books, The New York Times, and Scientific American advertisements.

From Found Poems and Others (New York: Barlenmir House, 1972):

"1. Postscript for Lillian" and "2. Postcript for Lillian" each contain geological and astronomical images.
"Epitaph for a String" is a humorous report of a Venus probe, concerning what holds the universe together.
"Epitaph for the Galaxy" contains sexual, astronomic and mathematical images.
"Epitaph for My Mules" contemplates the results of bombing a Van Allen Belt.
"I Belong" - a patriot of the Milky Way speaks up.
"Epitaph for Collagen" argues for a "new vocabulary of biological luminescence in poems;" written for collagen, the protein of connective tissue.
"The Avant-Garde Poem," "Up Against the Rocks," and "Survival Kit" contain references to astronomy or geology.

9. ARCHIBALD MACLEISH An American poet who was greatly influenced by Ezra Pound and T.S. Eliot. MacLeish served during World War II as the Director of the U.S. Office of Facts and Figures and later became Librarian of Congress. His poetry is "literary," polished, and occasionally prophetic.6

From New and Collected Poems, 1917-1976 (Boston: Houghton Mifflin, 1976):

"Signature for Tempo" is an imaginative treatment of time as fourth dimension, concentrates on possible metaphysical implications.
"Einstein," an imaginative treatment of the interrogation of reality, uses some vocabulary and concepts from physics.
"Epistle to be Left in the Earth" is a science fiction poem that contemplates the fate of men on a wandering earth.
"Dr. Sigmund Freud Discovers the Sea Shell" comments on the indifference of science to teleology and metaphysics.
"Reply to Mr. Wordsworth" - the second part of this poem deals with the concept of space-time in modern science.
"Seeing" - Part Two of this poem, subtitled "At the Saturday Club", uses a dialogue to express the implications of modern views on space and time for two characters.

10. MARIANNE MOORE Critics often call Moore's work a "highly specialized poetry for specialized tastes."7 American-born Moore was the exponent of "poetic literalism," and, as such, gained many of her poems from "the curiosa of nature or art;" Hayden Carruth has written that "From this literalness arises... a concentration of ethical concern."8

From The Complete Poems of Marianne Moore (New York: Macmillan, 1967; London: Faber and Faber, 1968):

"Four Quartz Crystal Clocks" - here, scientific accuracy is seen as synonymous with repetition.
"The Icosasphere" celebrates a technical feat.
"The Staff of Aesculapius" is a eulogy of modern medical research.

11. NORMAN NICHOLSON This British regional poet often uses concepts and vocabulary from geology in his poems and also writes on themes from astronomy. He has been quoted as saying: "Science, in fact, instead of destroying my conception of the world enriches and clarifies it, and it is when I have turned to science to help me understand the world around me that I have found much of the material for my poetry."9

From The Pot Geranium (London: Faber and Faber, 1954):

"The Unseen Centre" makes metaphorical use of lunar science.
"The Undiscovered Planet" is a poem about a planet, presumably Neptune, postulated to account for aberrations in the behaviour of Uranus and Saturn.
"The Expanding Universe" and "The Outer Planet, An Allegory" contain concepts from geology, cosmology and astronomy.
"Fossils" is an imaginative treatment of paleontology, with some use of terminology from geology and bacteriology.
"The Seven Rocks" - according to the author's notes, the seven main types of rock which form the body of the English Lake District and of the

surrounding parts of Cumberland, Westmoreland and Furness are dealt with in the poem in order of their geological antiquity.

From A Local Habitation (London: Faber and Faber, 1972):

"The Elm Decline" mentions the results of paleobotany.
"Scree" uses the vocabulary and concepts of geology.

12. KATHLEEN RAINE This British poet studied natural sciences at Cambridge University, specialising in botany and zoology.[10] She often uses biological terminology and comments on the philosophical implications of the scientific world-view. Her poems can be compared with those of A.R. Ammons, to which they bear a certain affinity.

From The Collected Poems of Kathleen Raine (New York: Random House, 1956; London: Hamish Hamilton, 1956):

"Vegetation" - passing use of cell biology imagery.
"Seen in a Glass" asserts the existence of a mystical "presence" behind ordinary reality, with passing use of cell biological entities.
"World Made Flesh" is a mystical view of the world with mention of symmetry in inorganic and organic worlds.
"Dust" - a mystical vision of geological and biological history, mixed with Christian imagery.
"The Human Divine" - an imaginative description of reductionist physiology, coupled with mystical transcendence of a reductionist world-view.
"Optical Illusion" addresses the metaphysical implications of optical illusions. Gestalt psychology, idealist philosophy, and the relation of perceived reality to scientific abstractions are relevant to the poem's content.
"The Unloved" employs images of light in empty space and stars leaving the universe.
"Three Poems on Illusion" discusses illusion and reality, with mention of physiological optics. In "Exile", poem III of the series, the poet describes her loss of a mystical vision of the natural world, and her purely intellectual attempt to capture reality with the scientific reductionist method. A very interesting work for students of the psychology of scientists, and for any discussion of mechanistic reductionism as an approach to understanding reality.
"Rock" - the poet identifies with geological and astronomical processes.
"Water" considers the origin of life and cells. The view that traces of the origin are retained is an important image.
"Message from Home" - a mystical vision of the unity of life, with support for this view from cell biological evidence for the unity of life.

From The Hollow Hill and Other Poems 1960-1964 (London: Hamish Hamilton, 1965):

"The Hollow Hill" - Parts 3 and 4 of this poem include imaginative descriptions of inorganic and organic form, and suggest possible influences from D'Arcy Thompson's On Growth and Form.

13. KENNETH REXROTH This American poet displays an interest in mathematics, geology, and biology, although the evidence of this interest often is clearer in the titles of his poems and collections than in their contents.11

From The Collected Shorter Poems (New York: New Directions, 1966):

Included in this volume under the general title "Gödel's Proof" is a collection headed by a quotation from the logician Kurt Gödel ("A self-contained system is a contradiction of terms. QED."): "Open the Blind," "Time is an Inclusion Series Said McTaggart," and "OTTPPSSENTE".

Other related poems include:

"Death, Judgment, Heaven, Hell" - imaginative use of the language of physiology and mathematics.
"Easy Lessons in Geophagy" - surreal and imaginative use of astronomy and biology, with possible reference to red-shift phenomena.
"A Lesson in Geography" - this poem uses geological language and concepts as well as astronomical references.
"Ice Shall Cover Nineveh" makes imaginative use of biological, geological and astronomical nomenclature.
"Inversely, As the Square of Their Distances Apart" uses Newton's law of gravitation imaginatively and metaphorically.
"Adonis in Summer" includes descriptions of geological time periods and geological concepts of the structure of the earth.
"Theory of Numbers" - imaginative use of astronomy and the nomenclature of mathematics and biology.
"Past and Future Turn About" contains geological concepts and nomenclature and description of lab methods in histology and zoology.
"Lyell's Hypothesis Again" - here, the subtitle of Lyell's Principles of Geology (i.e., "An Attempt to Explain the Former Changes of the Earth's Surface by Causes Now in Operation") is used as a subheading to the poem's title. The poem uses the hypothesis metaphorically.
"The Lights in the Sky are Stars" includes poems on Halley's Comet, the great nebula of Andromeda, the Cluster of Hercules, the Crab, Orion, and eclipses of the sun and moon.
"A Lemma by Constance Reid" - mathematical material based on material in Constance Reid's From Zero to Infinity: What Makes Numbers Interesting, (New York: Crowell, 1960). A "found" poem.

14. DOUGLAS STEWART A major Australian poet (New Zealand-born) of A.D. Hope's generation, Stewart focuses on landscape, achievement, and history.

From Selected Poems (Sydney: Angus and Robertson, 1973):

"Rutherford" is a moderately long poem about the New Zealand-born physicist Lord Rutherford, discoverer of the atomic nucleus; the poem contains much discussion of the social responsibility of the scientist and speculation about the motivation and psychology of the scientist, including the image of scientist as priest and ruler.
"D'Albertis" is a poem about an explorer in New Guinea and his killing of a bird of paradise for science.

15. D[onald] M[ichael] THOMAS This contemporary British poet has written a number of poems based on science fiction narratives, some suggested by stories of noted science fiction authors. Only poems with significant-science content or which comment on the social implications of scientific knowledge are included here.

From Penguin Modern Poets II: D.M. Black, Peter Redgrove, D.M. Thomas (Harmondsworth, Baltimore and Ringwood: Penguin Books, 1968):

"Tithonus" takes the reader on a guided tour of the very first immortal man, a brain without body. The poem would be relevant to any discussion of ethical problems in medicine, neuro-physiology or the applications of modern biology.
"Mercury" makes interesting use of typography to mimic the orbit of the planet, and also mentions Copernicus.
"Cygnus A" - imaginative treatment of modern astronomy and cosmology.

16. JOHN UPDIKE This American novelist and poet has used scientific concepts in very light, mostly humorous verse or in poems incorporating scientific concepts in a direct and fairly superficial way.

From Verse [including The Carpentered Hen and Other Tame Creatures and Telephone Poles and Other Poems] (Greenwich: Fawcett Publications, 1965):

"Cosmic Gall" - a humorous poem about neutrinos.
"White Dwarf" - a poem on the smallest known star in the universe.
"Seven Stanzas at Easter" uses biochemistry in a religious poem.

From Midpoint and Other Poems (London: Andre Deutsch, 1969):

"Amoeba" describes the fanciful effects of ingestion by an amoeba.
"Midpoint" - this long poem includes a section ("Canto III. The Dance of Solids") based on the September 1967 issue of Scientific American and deals with solid state physics in some detail.

NOTES

1. For critical evaluation of Empson's work, see J.H. Willis, Jr., William Empson (New York and London: Columbia University Press, 1969).

2. Louis Untermeyer, Lives of the Poets (New York: Simon and Schuster, 1959), p.629.

3. Richard Freedman, "An Annotated, Selective Checklist of Imaginative Literature Concerning the Relationship between Science, Technology and Human Values," Newsletter of the Program on Public Conceptions of Science, Number 10 (January 1975), pp.28-33. Readers unable to obtain the January 1975 issue in their library may request a copy of the Freedman article from the editorial offices of Science, Technology & Human Values.

4. For critical evaluation of Jeffers' work, see Frederic I. Carpenter, Robinson Jeffers (New York: Twayne Publishers, Inc., 1962), or Hyatt H. Waggoner,

"Science and the Poetry of Robinson Jeffers," American Literature 10 (November 1938), pp.275-288.

5. Editor's note: For example, Jeffers' poetry was used as the text to a Sierra Club publication, Not Man Apart: Photographs of the Big Sur Coast (San Francisco, CA: Sierra Club, 1965).

6. Louis Untermeyer, op. cit., p.708. For relevant critical evaluation of MacLeish, see Signi Lonea Falk, Archibald MacLeish (New York: Twayne Publishers, Inc., 1965).

7. Louis Untermeyer, op. cit. p. 702. For relevant critical evaluation of Moore, see Bernard F. Engel, Marianne Moore (New York: Twayne Publishers, Inc., 1964).

8. Hayden Carruth, ed., The Voice That is Great Within Us (New York: Bantam Books, 1970), p.126.

9. Philip Gardner, Norman Nicholson (New York: Twayne Publishers, Inc., 1973).

10. Ralph J. Mills, Jr., Kathleen Raine: A Critical Essay (Grand Rapids, Michigan: William B. Eerdmans, 1967).

11. For relevant critical evaluation of Rexroth, see Morgan Gibson, Kenneth Rexroth (New York: Twayne Publishers, Inc., 1972).

LATE NEWS ITEM

U.S. Student Pugwash Conference Scheduled for June 1979

At press time, we received word that a grant has been awarded for a Student "Pugwash" Conference on Ethics and Scientific Responsibility, 19-26 June 1979, University of California-San Diego. Participation will be limited to 75 students and 25 faculty members and other professionals. Write: Jeffrey Leifer, Political Science Department [B-023], University of California-San Diego, La Jolla, CA 92093; (714)-452-3548.

INSTITUTIONAL REVIEW BOARDS AS AN INSTRUMENT OF ASSESSMENT: RESEARCH INVOLVING HUMAN SUBJECTS IN THE U.S.*

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In the United States, an extensive, decentralized set of review committees has been established for the ethical assessment of research that involves human beings as subjects. Such committees (formally called institutional review boards, or IRBs) are located at more than 500 medical schools, hospitals, universities, and other institutions that conduct such research. Under the regulations of the U.S. Department of Health, Education, and Welfare (DHEW), IRBs review research proposals to determine whether subjects will be placed at risk and, if so, whether (1) the risks to the subjects are outweighed by the sum of the benefits to subjects and the importance of the knowledge sought, (2) the rights and welfare of the subjects are protected, and (3) informed consent will be obtained by adequate means. IRBs also bear a less well-defined reponsibility for the "continuing review" of research. The regulations require that IRBs be composed of at least five individuals from varying backgrounds who are able "to ascertain the acceptability of proposals in terms of institutional commitments and regulations, applicable law, standards of professional conduct and practice, and community attitudes."[1]

Because of interest in the value conflicts they are required to mediate, because of growing concerns about the regulation of powerful professions, and because IRBs are seen as a decentralized regulatory model that may be adaptable to other problem areas, the institutional review board is regarded as an important social invention. IRBs are located at the research institutions, rather than in central, regional, or local government offices. Thus, they are relatively close to the conduct of the research, and the government is one step removed from the actual process by which research is reviewed and approved, modified, or disapproved. An IRB is a relatively permanent feature of the institutional landscape; most boards meet regularly and have slow turnover of membership. A large proportion of the researchers who submit proposals to IRBs have done so previously, and many applicants have also served as board members. The system is sufficiently well-established and so widely accepted that, in its recent deliberations, the National Commission for the Protection of Human Subjects did not seriously consider abandoning the basic features of the institutional review system.[2]

Evolution of IRB Requirements

Throughout the years, requirements for IRB review have become increasingly formal and inclusive. Although a few institutions maintained some

* A paper prepared for the Conference on the Social Assessment of Science, University of Bielefeld, West Germany, 25-27 May 1978.

type of review procedure as early as the 1950s, Federal involvement began when the Public Health Service initiated an institutional review policy in 1966. Review requirements then evolved into DHEW policy before becoming established in Federal statute and regulations.

Originally, the review requirement applied only to research funded by the Public Health Service. Under the National Research Act of 1974, the requirement was extended to all research that both involves human subjects and is conducted at institutions receiving funds for such research under the Public Health Service Act. The National Commission for the Protection of Human Subjects, which has been looking into these matters for the past three years, has recommended that the requirement be extended to all research under the jurisdiction of the Federal Government. The review requirements have also become increasingly detailed and explicit. To cite the best example: while the original guidelines stated simply that informed consent must be obtained from subjects, the present regulations contain a list of six specific topics which must be disclosed to subjects.

The other significant change has involved the decision-making model required for IRBs. It is now acknowledged that some of the most important judgments made by the boards do not require scientific expertise, that it is desirable for research to be considered from a variety of viewpoints, and that the credibility of IRBs with the public (and with scientists) is at stake in the composition of the boards. The solution has been to include both scientific and "public" members. One author has characterized this change as a trend away from the peer review model toward a representative or jury model.[3] While this description may exaggerate the extent of movement away from review by scientific peers, it correctly indicates the direction. At present, about one-third of the members of review committees have not done research involving human subjects.[4] The Commission for the Protection of Human Subjects has suggested that such persons should comprise at least one-third (and no more than two-thirds) of every review committee.

Performance of IRBs

In the first few years after the human subjects review system was established in 1966, the general consensus was that IRBs were doing a good job. Early criticism came mainly from researchers who felt that the requirements were an unwarranted intrusion into their autonomy and were based on the assumption that scientists (or some scientists) were "bad guys." Review boards, it was argued, could never prevent an unscrupulous researcher from abusing subjects or their rights. However, the National Institutes of Health, which then (as now) administered the policy, believed that IRBs performed a valid function and were having a positive effect. The only evidence cited to support this view was that, in the years just after the review requirements were imposed, there was a decrease in the number of proposals which raised ethical questions when they were reviewed for funding by the National Institutes of Health.[5]

The information available in the literature when the Commission began its work was limited, but less reassuring. Two studies had been conducted by a

group of sociologists led by Bernard Barber at Columbia University and reported in the book, Research on Human Subjects.[6] The first study -- which was based on interviews with researchers at a major medical school and a teaching hospital -- showed that researchers vary greatly in their concern about informed consent and in their willingness to conduct research that has relatively high risk, relatively low benefit, and relatively low probability of success. These data support the view that review committees have an important role to play.

The second study reported by Barber et al. was a survey of representatives of IRBs at almost 300 biomedical institutions. Most boards were not very active: one-third reported that they had never required the modification of a single project, much less rejected one. At the most active end of the spectrum, only 16% of the respondents estimated that their committee had required revision of more than 10% of the projects reviewed.[7]

This low level of IRB activity could have been due to either the high ethical quality of the proposals being reviewed or the application of loose standards by IRBs. On the basis of my study of a single, very active review board, I argued a few years ago that the latter explanation was the most plausible -- that is, that IRBs were not doing their job.[8]

The work on which I based that argument was reported in Human Subjects in Medical Experimentation: The Conduct and Regulation of Clinical Research.[9] My interviews with research subjects revealed the existence of serious problems with informed consent. Of 51 women who had been subjects in a study of an experimental drug for inducing labor in pregnancy, twenty did not know at the time the drug infusion began that they were involved in research, despite the fact that all of the women had signed consent forms describing the research. These problems were primarily due to the circumstances under which consent was obtained (the labor room) and the lack of an adequate oral explanation to the subject.[10] Even though the study was approved by the IRB, the board had no way of knowing that the approved consent procedures were working properly. The IRB had no process for obtaining feedback.

The discovery of ethical problems in the conduct of this research at a major medical center was particularly dramatic because the IRB there was unusually conscientious. The board had cooperated fully with my study. More importantly, there were strong indications that the board took its review responsibility seriously: they were requiring modifications in three-quarters of the proposals that they reviewed, and these modifications -- while clearly varying in importance -- all appeared justified. The most common modifications were on consent forms, but 13% of the modifications were for the purpose of reducing risk. Using the standard set by this committee, I argued that Barber's evidence about the inactivity of most committees could be most plausibly explained as reflecting poor performance by IRBs.

Commission Study of IRBs

These and similar doubts about the operation of the IRB system led the Commission for the Protection of Human Subjects to undertake a major study of the current operation of IRBs, in which, as a member of the Commission's staff,

Table 1
Review Board Action on Research Proposals
(Percentage of Projects)

Type of Institution	Modified by Board	Modified Informally *	Board Sought More Information**	No Modification or Information Required	No Data Available	Total
Universities (N=514)	29%	7%	16%	46%	2%	100%
Medical Schools (N=1425)	32%	8%	9%	46%	5%	100%
Hospitals (N=254)	42%	4%	10%	37%	7%	100%
Institutions for the mentally infirm (N=101)	33%	6%	11%	43%	7%	100%
Other (N=95)	28%	4%	3%	52%	13%	100%
All (N=2389)	33%	7%	10%	44%	6%	100%

* Includes projects modified not by formal board action, but as a result of informal discussions with IRB members.
** Includes projects not modified by formal actions or informal discussion, but for which the IRB requested additional information. In some cases, such requests could be considered equivalent to a request for modification.

Table 2
Actions Formally Required of the Investigator by the Review Board: Type of Institution
(Percent of Projects)*

	Type of Institution					
	Universities (N=514)	Medical School (N=1425)	Hospitals (N=254)	Institutions for Mentally Infirm (N=101)	Other (N=95)	All (N=2389)
More information	33%	30%	39%	28%	21%	32%
Modification in consent forms and procedures	19%	25%	31%	14%	13%	24%
Modification in scientific design	- ***	2%	6%	8%	1%	3%
Modification in subject selection	-	3%	5%	7%	1%	3%
Modification regarding risks, discomfort	3%	4%	4%	7%	9%	4%
Modification regarding confidentiality	6%	2%	3%	6%	6%	3%
Other modifications	5%	3%	7%	7%	9%	5%
Informal suggestion for modifications **	15%	15%	13%	19%	15%	15%

* Percentages need not add to 100% since respondents may have indicated fewer or more than one required action. N's vary slightly within columns due to missing data. The percentages exclude missing data.
** Row includes all projects modified as a result of informal discussions with IRB members, whether or not the review board formally requested modifications.
*** Less than 0.5% but greater than zero.

I was heavily involved. This study, which was conducted by the University of Michigan on a sample of 61 institutions, involved interviews with more than 2,000 investigators who had had proposals reviewed by IRBs, more than 800 IRB members, and more than 1000 research subjects. Although the evidence is not uniformly positive, the findings generally support the belief that the institutional review board approach is useful in mediating some of the difficult ethical problems raised by research involving human subjects.11

First, review boards have become more active since the time of the 1969 Barber study. More than 40% of the researchers whose proposals were approved by the review committee reported that their proposal had been modified as a result of formal or informal IRB actions. (Table 1) By far the most frequent substantive change pertained to informed consent (Table 2). Such changes were reported in one-fourth of all proposals approved by the review boards. Modifications regarding scientific design, selection of subjects, risks and discomforts, and confidentiality were made in a small number of projects (around 3% in each case).

Research investigators were by and large supportive of the existing review process (Table 3). Almost all said that the human subjects review procedure had protected the rights and welfare of human subjects, at least to some extent; two-thirds said that the review procedure had improved the quality of the research done at the institution; and, interestingly enough, almost all said that the procedure was running with reasonable efficiency. However, substantial minorities -- running from one-quarter to nearly one-half -- believed that the review process is an unwarranted intrusion on the investigator's autonomy, that the IRB gets into areas that are inappropriate to its function, that it makes judgments that it is unqualified to make, and that it has impeded the progress of research. Despite these complaints, fewer than 10% of the investigators felt that the difficulties of the review procedure outweigh its benefits in protecting human subjects.

Finally, tabulation of the distribution of risks and benefits in IRB-approved research demonstrates that, as the risk to subjects increases, the expectation that they will benefit directly from the research also increases (Table 4). Such a relationship between risks and benefits is of particular concern with regard to subjects who have limited ability to give informed consent. In research involving children or the mentally ill or retarded, the positive relationship between risks and benefits was stronger than in research involving other populations. By and large, the most vulnerable populations are exposed to risk only when the research is expected to provide some direct benefit to the subjects. Whether this risk/benefit relationship can be attributed directly to the efforts of review committees is questionable. Modifications regarding risk or subject selection were required too infrequently to explain the overall distribution of risks and benefits. It is possible, however, that the presence of review committees may itself have some impact, particularly as the number of investigators who have had experience with IRBs increases. For whatever reason, in research approved by review committees, risks and benefits are not distributed in a way that raises serious concern.

In addition to such positive evidence about research and review procedures, the Commission's study also discloses some reasons for concern. First, although evaluations by investigators were generally favorable, opinions

Table 3
Attitudes of Different Types of Investigators and Review Committee Members Toward the Review Procedure and Committees

	Percent Agreeing With Each Statement					
	Review Board Members			Research Investigators		
	Biomedical Sciences (N=370)*	Behavioral & Social Sci. (N=135)*	Other (N=220)*	Biomedical Sciences (N=940)*	Behavioral & Social Sci. (N=395)	Other (N=180)
The human subjects review procedure has protected the rights and welfare of human subjects -- at least to some extent.	99%	99%	99%	99%	96%	98%
The review procedure has improved the quality of scientific research done at this institution -- at least to some extent.	78%	62%	70%	69%	55%	83%
The review procedure runs with reasonable efficiency -- at least to some extent.	99%	96%	99%	96%	94%	94%
The review procedure is an unwarranted intrusion on an investigator's autonomy -- at least to some extent.	13%	11%	6%	25%	38%	23%
The review committee gets into areas which are not appropriate to its function -- at least to some extent.	39%	24%	27%	50%	49%	39%
The review committee makes judgments that it is not qualified to make -- at least to some extent.	28%	21%	20%	43%	49%	25%
The review procedure has impeded the progress of research done at this institution -- at least to some extent.	26%	30%	22%	43%	54%	36%

* N's are approximate since non-response varied from item to item.

Table 4
Risk, Benefit, and Availability of Treatment for Harmful Effects
(Percent of Projects)

Relative Risk* Level	Expected to Benefit Subjects	Harmful Effects Reported	Treatment Reported Available
No risk (N=710)	34%	0%	14%
Very low risk (N=446)	52%	1%	31%
Low risk (N=450)	63%	3%	52%
Moderate risk (N=483)	80%	12%	81%

* Medical and psychological risks, as assessed by investigators. The risk index was constructed by arraying the studies in which risk was reported ("no risk" studies thus represent a distinct category), using weighting procedures that reflect both the seriousness and probability of harm. The resulting arrayal was then, to the degree possible, trichotomized. Studies are thus categorized according to their risk in relation to other studies, not according to an independent standard of "very low risk," "low risk," and moderate risk."

** In some cases, investigators probably reported institutional policies regarding treatment of injuries, rather than provisions made for a specific study; hence, provisions for treatment for harm were reported in some studies that the investigators indicated were free of risk.

differed among types of researchers. In particular, social and psychological researchers were more likely than biomedical researchers to claim that committees are unnecessarily intrusive, make judgments beyond their competence, and impede the progress of research. Since any system for protecting the rights of human subjects must depend to a substantial degree on the good faith of investigators, negative attitudes of investigators should be taken seriously, and a substantial minority of investigators are critical about the performance of IRBs.

The study also revealed more important reasons for concern about the current system of review, most pertaining to informed consent. As I noted previously, consent modifications were made in one-fourth of the proposals. Virtually all of these modifications were in the pieces of paper that subjects are asked to sign -- the consent forms. Almost none of the changes required by an IRB pertained to the way in which consent would be obtained -- the setting, the timing, or who would obtain or witness it. Yet we know from previous research that the manner in which consent is sought may be more important than the consent form itself and that a signature on a consent form should never be confused with informed consent.

Since consent forms were such a primary focus of IRB activity, they provide us with a convenient objective indicator of IRB effectiveness. We constructed two measures of the quality of such forms. The first was readability, using a standard reading-ease formula.[12] The second was the degree of completeness according to an index based upon the elements of disclosure required in the DHEW regulations: the purpose of the research, the procedures involved, the benefits (or absence of benefits) for subjects, the risk (or absence of risk) for subjects, a statement that participation was voluntary or that subject could withdraw at any time, and an invitation to ask questions about participation.

Most consent forms approved by review committees were found to be difficult to read: they were couched in scholarly, academic language, and few medical and technical terms were explained. Only about 15% of the forms were written in language as simple as that used in Time magazine (Table 5). Fewer than one-fifth of the consent forms were complete (or nearly so) on the index used.

We next examined the changes made by the review committees to see if these had improved the consent forms. The readability and completeness of the original, rejected consent forms were compared with those features of the modified approved versions. No measurable change was apparent. Further analysis showed that -- from the standpoint of completeness or readability -- bad original consent forms were no more likely than good forms to have been modified by review committees.

This pattern of "dynamics without change"[13] cannot readily be explained. Additional data analysis may increase our understanding of why no measurable improvements resulted from IRB review. However, we may plausibly speculate that the reason is connected to existing assumptions about the proper composition of IRBs. The establishment of IRBs has been predicated on the assumption that the desired result will follow automatically from the creation of a diverse group of scientists and others for the purpose of reviewing proposals. This assumption may well be justified for decisions about risks and benefits

Table 5
Readability of Consent Forms Approved by IRBs *

Type of Institution	Very Difficult (Scientific, Professional)	Difficult (Scholarly academic)	Fairly Difficult (Atlantic)	Standard (Time)	Fairly easy (Slick fiction)	Easy (Pulp fiction)	Very easy (Comics)	Total
Universities (N=219)	18%	49%	20%	10%	3%	**	1	100%
Medical Schools (N=1011)	21%	56%	19%	4%	-	-	0%	100%
Hospitals (N=159)	22%	61%	8%	8%	-	0%	0%	100%
Other (N=137)	24%	55%	16%	2%	3%	0%	0%	100%
All (N=1526)	21%	56%	17%	5%	1%	-	0%	100%

* Table is based on those projects for which a consent form was available. Percentages exclude missing data. Readability is measured by the Flesch Readability Yardstick. The "reading-ease" score for a selected passage is based on word length (the average number of syllables per 100 words) and sentence length (the average number of words per sentence). Rudolf Flesch, "A New Readability Yardstick," Journal of Applied Psychology Vol. 32, p. 221 (1948).

** Less than 0.5% but greater than zero.

where matters of both value and fact are involved.*.

When it comes to review of an investigator's plans for securing informed consent, it may be unrealistic to expect automatic good results from a group of people who have no special training and who have not necessarily given the topic any special thought, no matter how intelligent or well-intentioned they may be. Our findings about the lack of improvement in consent forms may be the result of an implicit assumption that no special knowledge is needed to assure that informed consent will happen. The requirements regarding the composition of IRBs recognize the knowledge component in risk/benefit decisions, even though the decision itself is ultimately a value-choice; yet there is no recognition of a knowledge component to the adequate review of plans to obtain informed consent. The exclusive concern with consent forms rather than the consent process suggests that IRBs may be acting more to protect institutions from liability than to promote intelligent decision-making by research subjects.**

To summarize briefly our findings about IRBs: we found them to be more active than in past years, to be very concerned with informed consent, to

* However, IRBs rarely reject a project because it is too risky. This may be because investigators are not interested in conducting risky research or are hesitant to seek an IRB's approval of such research except in situations in which the risks are in some sense balanced by expected benefits to subjects, as in cancer chemotherapy programs using experimental drugs. It may also be because the IRB's determinations do not entail the imposition of a risk on anyone; rather, the IRB's determinations authorize an investigator to ask people if they are willing to accept a risk.

** This may be due to the presence on IRBs of lawyers who may be particularly aware of the potential for liability and of ways to minimize that potential.

approve research that in the aggregate had appropriate risk/benefit ratios, and to be generally accepted by researchers and by IRB members. However, we also found that negative attitudes toward IRBs are clustered in certain fields, that IRB concern with informed consent is focused too exclusively on consent forms per se, that even approved consent forms have serious deficiencies, and, finally, that IRB impact on consent forms is, at best, rather subtle.

The Commission's Recommendations

The Commission's recommendations[14] regarding the future of the IRB system reflect a belief that the IRB is the most suitable mechanism for protecting the rights and welfare of human research subjects. The Commission made numerous recommendations to improve the functioning of the IRB system, including increasing the amount of monitoring in the system. The recommendations would require IRBs to make themselves more aware of the actual conduct of the research that they approve, for example, by establishing mechanisms for monitoring the consent process in certain situations. The Commission also recommended that DHEW should begin to monitor the performance of IRBs through a system of site visits. Present administration of the regulations by DHEW is limited to its initial approval of an IRB. The Commission would also introduce uniformity across governmental agencies in their requirements and procedures for the review of research involving human subjects. The Commission made other recommendations concerning specific details of IRB operation, but these need not be reviewed here.

However, we should also note that recommendations having important implications for IRBs were contained in earlier Commission reports regarding research on special subject populations -- the human fetus, children, prisoners, and the institutionalized mentally infirm -- and psychosurgery.[15] First, the recommendations identify activities that cannot be conducted without the approval of a national review body. Although the activities that require national review vary for the different subject populations, they generally pertain to the presence of significant risk, the absence of benefits to subjects, and, of course, questions about consent. The key point is that, with regard to every type of activity it has considered, the Commission has felt that an IRB should not be able to authorize the conduct of all practices that might be justifiable, and has recommended that the hard cases be handled at a national level, under conditions of high visibility.

The second significant feature of the Commission's recommendations on different subject populations consists of specific guidelines to be enforced by IRBs. For example, the Commission's recommendations for certain non-therapeutic research involving the human fetus would require that the fetus be less than 20 weeks gestational age and that no intrusion be made into the fetus that would alter the duration of life. Thus, the IRBs are being told with great specificity that there is certain research that cannot be approved. It seems to me that there is a qualitative difference between being asked to weigh the risks and benefits of research on the one hand, and being directed not to approve research that falls outside of certain specific parameters on the other. One is a matter of judgment that seems well suited to group evaluation; the other attempts to minimize the role of judgment by stating a clear decision rule.

As such, the Commission's recommendations are consistent with the trend to limit as much as possible the need for IRBs to exercise judgment. In a number of places, the Commission's reports attempt to provide an objective standard against which proposed projects should be evaluated. The discretion of the IRB is accordingly limited.

Continuing Issues in the Ethical Assessment of Research Involving Human Subjects

No widespread sentiment seems to exist for abandoning the IRB approach to the protection of human subjects. The Commission has concluded that the IRB is the most suitable mechanism for this purpose, and has made recommendations to improve it. However, there are continuing tensions, some of which may be inherent in a regulatory approach that requires a high degree of credibility and legitimacy both with researchers and with the public and its representatives. A diverse committee located at each institution that conducts research probably best fits that requirement at the present time. Nevertheless, the institutional locus of IRBs makes them potentially vulnerable to certain forms of corruption and to charges of conflict of interest. Questions have been raised whether institutions that conduct research can realistically be expected to carry out the regulatory function effectively. The Commission's recommendations regarding the increased monitoring of IRBs are in part a response to this concern.

Monitoring itself is likely to be source of tension. An alternative to the site visit approach recommended by the Commission would be subsequent review of proposals approved by IRBs. There are strong pressures to have the review panels that make recommendations regarding government funding of research also review the ethics of those proposals and assess whether human subjects are adequately protected. Some see this as an obvious responsibility of the government; others see it as a downgrading of IRBs that would diminish both the willingness of well-qualified people to serve on the boards and the sense of responsibility felt by those who do serve. The relationship between the federal government and local IRBs will undoubtedly be a continuing source of problems.

Another potential problem is the continuing pressure for expanding the duties of IRBs. IRB jurisdiction over research involving human subjects has continually increased; but, aside from the additional workload, this expansion has not caused significant problems. However, serious legal and philosophical questions have been raised about government regulation of research not supported by the government. In addition, there is new pressure for IRBs to expand into other areas such as the regulation of research that involves biohazards. The IRB is a body that seems to attract tasks--all of which increasingly require that new and specific types of expertise be represented on the IRB. It seems possible that these trends may have negative consequences for the basic functions of the IRBs by diffusing their purpose and overloading their capacities.

Another proposed expansion of IRB duties raises deeper questions: that is, the continuing pressure to consider not only the risks of participating in research but also any harm that might be done with potential research findings. Proposals include: a) investing IRBs with authority to block proprosed research on the basis of an expanded risk/benefit assessment, b) the requirement that possible findings be disclosed to prospective subjects, and c) when findings

might reflect badly on a particular group or community, to require IRBs to seek a form of group or community consent. Although these ideas have appeal in certain situations, they also raise troublesome questions about the delineation of those situations and, fundamentally, about freedom of inquiry. Having the review boards consider such factors as the possible policy implications of research, or whether research would be inconsistent with some standard of community morality, or whether the interests of certain organizations or groups would be adversely affected by the conduct of research, would fundamentally change the nature of IRBs.[16] The legitimacy they presently enjoy would be seriously threatened. Nevertheless, we seem to be encountering, with increasing frequency, problems whose solutions would push IRBs in that direction.

Conclusion

The IRB is a mechanism that was created in great part as a response to a major scandal in the early 1960s -- the case in which live cancer cells were injected beneath the skin of unconsenting geriatric patients in a Brooklyn hospital.[17] Later developments -- including the creation by Congress of the National Commission for the Protection of Human Subjects -- were also spurred by abuse. A systematic study has now shown that, although IRB performance has some clear shortcomings (e.g., regarding informed consent), the system is functioning reasonably well, IRBs are active in the review of proposed research, and the IRB system has gained wide acceptance by and cooperation from researchers. Problems clearly remain, as is reflected in the many recommendations for improvement made by the National Commission; but these recommendations would nonetheless retain most of the major features of the system. Finally, involvement of IRBs has sharply limited the occurrence of the type of serious ethical lapse that has punctuated research involving human subjects. Such events have not developed in IRB-approved research during the 12 years that the IRB system has been in place. In itself, the lack of scandal may be viewed as significant evidence about the basic soundness of this social invention.

NOTES

1. 45 Code of Federal Regulations, Part 46.106.

2. The National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research was established by Congress in the National Research Act of 1974. By law, no more than five of its eleven members could be scientists who had conducted research with human subjects. The Commission was created after Congressional hearings that drew attention to a number of questionable practices in research [U.S. Senate, Hearings on the Quality of Health Care -- Human Experimentation (Washington, D.C.: Government Printing Office, 1973)]. The Commission was established to study the current situation and to make recommendations to DHEW and Congress about a series of matters, ranging from such general questions as the "basic ethical principles that should underlie the conduct of research involving human subjects," to the specific conditions under which it is justifded to do research involving human fetuses, children, prisoners, and the

institutionalized mentally ill and mentally retarded. One part of the Commission's mandate called for recommendations regarding the system of institutional review boards.

3. Robert M. Veatch, "Human Experimentation Committees: Professional or Representative?" 5 Hastings Center Report (1975) 31-40.

4. Robert A. Cooke, Arnold S. Tannenbaum, and Bradford H. Gray, "A Survey of Institutional Review Boards and Research Involving Human Subjects," published in the Appendix to the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, Report and Recommendations [on] Institutional Review Boards (Washington, D.C.: U.S. Government Printing Office, 1978).

5. This history is reviewed in more detail in the first chapter of Bradford H. Gray, Human Subjects in Medical Experimentation: A Sociological Study of the Conduct and Regulation of Clinical Research (New York: Wiley-Interscience, 1975). For other accounts of the origins of governmental activity in this area, see Mark S. Frankel, "The Development of Policy Guidelines Governing Human Experimentation in the United States, " 2 Ethics in Science and Medicine (1975), 43-59; and William J. Curran, "Governmental Regulation of the Use of Human Subjects in Medical Research: The Approach of Two Federal Agencies, " 98 Daedalus (Spring 1969), 542-593.

6. Bernard Barber, John Lally, Julia Makarushka, and Daniel Sullivan, Research on Human Subjects: Problems of Social Control in Medical Experimentation (New York: Russell Sage, 1973).

7. Ibid, p. 160.

8. Bradford H. Gray, "An Assessment of Institutional Review Committtees in Human Experimentation," 13 Medical Care (1975), 318-328.

9. Gray, op. cit. (Note 5).

10. For a detailed examination of the ways in which such consent problems can arise, see Gray, op. cit. (Note 5), Chapter 8 ("The Vagaries of Consent").

11. These findings are presented in more detail in Bradford H. Gray, Robert A. Cooke, and Arnold S. Tannenbaum, "Research Involving Human Subjects," 201 Science (23 September 1978), 1094-1101.

12. Rudolf Flesch, "A New Readability Yardstick," 32 Journal of Applied Psychology (1948),221-233.

13. This phrase comes from Robert Alford's description of the U.S. health care system in Health Care Politics (Chicago: University of Chicago Press, 1976).

14. National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, op. cit. (Note 4),

15. These recommendations were contained in previously released Commission reports on Research on the Fetus (1975), Research Involving Prisoners (1976),

Psychosurgery (1977), Research Involving Children (1977), and Research Involving Those Institutionalized as Mentally Infirm (1978). All were published by the U.S. Government Printing Office, Washington, DC.

16. Bradford H. Gray, "The Functions of Human Subjects Review Committees," 134 American Journal of Psychiatry (1977): 907-910.

17. Jay Katz, Experimentation With Human Beings (New York: Russell Sage Foundation, 1972), pp. 9-65.

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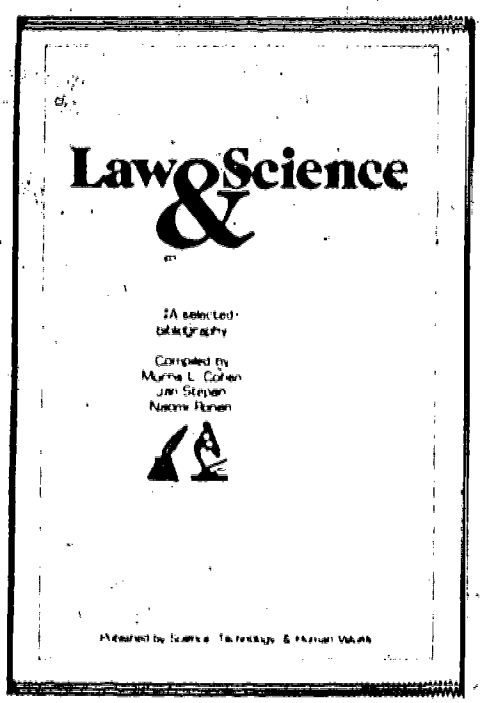

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Bibliography

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Abelson, Philip H., and Allen L. Hammond, eds. Energy: Use, Conservation and Supply, Volume II. Washington, DC: American Association for the Advancement of Science, 1978.

Updates an earlier compendium. Includes articles on the principal contemporary energy-related issues, such as supplies of available fuels, prospects for energy development, and effective conservation measures. The 27 articles, reprinted from a special issue of Science, examine energy use from the perspectives of industry, the environment, and international relations, predict probable directions in conservation policy, and outline the prospects and sources for energy in the future. Available from Dept. E-9, AAAS, 1515 Massachusetts Avenue NW, Washington, DC 20005; $14.00 (casebound), $6.00 (paper).

Albert, Jeffrey M. "Some Epistemological Aspects of Cost-Benefit Analysis." 45 The George Washington Law Review 5 (August 1977): 1025-1036.

Designed to acquaint lawyers and others interested in cost-benefit questions with relevant and essential concepts of statistical inference and confirmation theory.

Allen, Thomas J., James M. Utterback, Marvin A. Sirbu, Nicholas A. Ashford, and J. Herbert Hollomon. "Government Influence on the Process of Innovation in Europe and Japan." 7 Research Policy 2 (April 1978): 124-149.

The authors outline the types of government policies that can seriously affect the process of innovation, either directly (as in policies aimed at stimulating innovation) or indirectly (as in the secondary effects of general fiscal or trade policies). The research project examined 164 projects in five major industries in Europe and Japan. They found government involvement, in general, to be high, but there were "striking" differences between countries in the methods employed by various governments, and, moreover, the study failed to detect "any effect, on project performance, of government attempts to stimulate innovation."

Ashford, Nicholas J. "The Role of Occupational Health and Safety in Industrial Relations: Where We Are and Where We're Going." 15 Labor Relations in Transition 2 (Spring 1978): 1-4; a Cornell University Industrial and Labor Relations Report.

Focuses on four sources of major conflicts in the occupational health and safety issue: 1) differing self-interests of labor and management; 2) appropriate standards of proof of causality of occupational disease;

3) how to make the efficiency-equity tradeoff; and 4) whether the mandatory standards approach is the best way to reduce occupational disease and injury. The OSH Act, the employee's right to refuse hazardous work, and increased numbers of worker-initiated civil suits, all exemplify the conflicts produced by the interaction in the economic marketplace of scientific evidence, the law, undesirable side effects of technological development, private enterprise, and the rights of individuals.

Barass, Robert. Scientists Must Write: A Guide to Better Writing For Scientists, Engineers and Students. London, England: Chapman and Hall, 1978; New York: John Wiley & Sons, 1978.

"Science and writing are not separate tasks" -- that is the primary message of this useful communications guide for scientists and science students. Although we disagree with a few of Mr. Barass' instructions, we applaud his clear (and occasionally witty) prose and his organized presentation of guidelines. The book begins with extensive tips for record-keeping and intra-scientific communication and then concentrates on the specific qualities of accurate and well-presented scientific writing. Separate chapters on the use of numbers, illustrations, reading (what and how), and oral presentations should prove especially useful for researchers.

Despite its completeness, this book is not necessarily appropriate for courses in science writing. It could, however, be recommended for three other audiences: first-year college science majors (but not all students in an introductory course); working scientists in need of a "refresher course" or a good guidebook; and science students who need specific help in sharpening communications skills. If there are major flaws to the book, they are largely connected to its use of British terms and examples. (An American version would certainly enhance its usefulness for college courses.) The philosophy behind the book is one that should, however, find a sympathetic American audience: "It is not enough to teach scientists about science. We must help them to be effective as scientists ... [T]here is a certain irony in teaching students...to use techniques and instruments, some of which they may never use in their working lives, and yet not teaching them to write -- the one thing that they must do every day as students, and as administrators, executives, managers, scientists and engineers." (4)

Barber, Bernard, ed. "Medical Ethics and Social Change," Special issue. 437 The Annals of the American Academy of Political and Social Science (May 1978).

The essays in this special issue confront some of the changes now taking place in medical ethics and record the confrontations between laypersons who encourage more change and medical professionals who fear that the pace of change may be too fast. Barber's introduction stresses the roles of internal change agents and of cultural values such as rationality and egalitarianism. Individual essays include: Stanley J. Reiser, "Human Experimentation and the Convergence of Medical Research and Patient Care," 8-18; Frank P. Grad, "Medical Ethics and the Law," 19-36; Bradford H. Gray, "Complexities of Informed Consent," 37-48; Jeffrey L. Berlant,

"Medical Ethics and Professional Monopoly," 49-61; Amitai Etzioni, "Individual Will and Social Conditions," 62-73; David Mechanic, "Ethics, Justice, and Medical Care Systems," 74-85; John J. Lally, "The Making of the Compassionate Physician-Investigator," 86-98; Diana Crane, "Consensus and Controversy in Medical Practice: The Dilemma of the Critically Ill Patient," 99-110; John D. Arnold, "Ethical Considerations in Selecting Subject Populations for Drug Research," 111-115; Daniel Callahan, "Abortion and Medical Ethics," 116-142.

Board on Human-Resource Data and Analyses, Commission on Human Resources, National Research Council. A Century of Doctorates: Date Analyses of Growth and Change, U.S. Ph.D.'s - Their Numbers, Origins, Characteristics, and the Institutions From Which They Come. Washington, DC: National Academy of Sciences, 1978.

A new report on the production of Ph.D.'s. Available from the Printing and Publishing Office, NAS, 2101 Constitution Avenue NW, Washington, DC 20418; $10.50, order by ISBN 0-309-02738-1.

Boorstin, Daniel J. The Republic of Technology: Reflections on Our Future Community. New York: Harper & Row, 1978.

Boorstin's essay examines the roots of American attitudes toward science and technology -- in particular, the democratic concept of "shared knowledge" -- and the political consequences of such attitudes. "Never before has a people been so tempted ... to believe that anything is *technologically* possible." (34)

Boulding, Kenneth E. Ecodynamics: A New Theory of Societal Evolution. Beverly Hills, CA: Sage Publications, Inc., 1978.

Explores the relationship between physical, biological, and social evolution and the relevance of this interaction to current social issues.

Boulez, Pierre. "Technology and the Composer." 11 Leonardo 1 (Winter 1978): 59-62.

This famous composer and conductor argues that an understanding of contemporary technology "ought to form part of the musician's invention; otherwise, scientists, technicians and musicians will rub shoulders and even help one another, but their activities will be only marginal one to the other." Originally printed in The Times Literary Supplement (London), 6 May 1977.

Bowers, Raymond, Alfred M. Lee, and Cary Hershey, eds. Communications for a Mobile Society, An Assessment of New Technology. Beverly Hills, CA: Sage Publications, 1978.

Third in a series of assessments of emerging technologies from the Cornell Program on Science, Technology, and Society. The uses of land mobile communications could have "extensive and significant" social effects far beyond the current popularity of CB radios. The economic, legal, and

social implications for industry, medical services, public safety, and the like are explored in exhaustive detail by the contributors to this volume. There are comprehensive examinations of the history, technical features, Federal regulation, and economics of the technology, as well as analyses of current commercial, governmental, and personal uses of the communications system. Chapters that outline specific probable policy issues should prove especially useful in setting productive agendas for discussion and action.

Bureau of Biomedical Sciences (CPSC) Review Committee, Committee on Toxicology, National Research Council. A Review of the Role of Health Sciences in the Consumer Product Safety Commission. Washington, DC: National Academy of Sciences, 1977.

Committee report urges Federal inter-agency development of a "strong scientific base to undergird regulatory decisions" so that such decisions will better withstand challenges in the courts. Emphasizes the importance of anticipation of hazards from toxic substances, epidemiological studies, and increased Federal agency access to existing scientific information through channels other than computerized data bases, which cover only recent literature and omit "information on many chemicals present in household products." The report is available from the National Technical Information Service, Springfield, VA 22161; AD/A-048-668; $4.50.

Calabresi, Guido and Philip Bobbitt. Tragic Choices. New York: W.W. Norton & Co., 1978.

Focuses on the allocation of scarce but necessary resources, and analyzes various approaches for dealing with such crises as the understocked and overcrowded lifeboat.

Caplan, Arthur L., ed. The Sociobiology Debate: Readings on Ethical and Scientific Issues, Foreword by Edward O. Wilson. New York: Harper & Row, 1978.

Caplan has assembled many of the principal documents and actors in the controversy surrounding sociobiology. The writings of the historical "forerunners" -- Darwin, Huxley, Spencer, Allee -- and contemporaries such as Lorenz provide useful backdrop to the drama: first, the scientific development of sociobiology, then the early debates and, finally, the divisiveness and critical reaction. Readings include not only selections from the pertinent books and articles, but also public letters, reviews, study group statements, and news analyses. As the editor notes: "... what began as one more version of the old nature/nurture argument between defenders and critics of sociobiology quickly evolved into a more fundamental debate about the nature of scientific theories, the scientific study of human differences, and axiomatic commitments to a set of valuational and ethical precepts." (12)

Carter, Luther J. "Costs of Environmental Regulation Draw Criticism, Formal Assessment." 201 Science (14 July 1978): 140-144.

The relation between environmental regulations and inflation is receiving

close attention from the Congress as well as the Regulatory Analysis Review Group, a unit charged with the study of regulatory actions that could have potentially large economic effects.

Casper, Barry M., and Paul D. Wellstone. "The Science Court on Trial in Minnesota." 8 The Hastings Center Report (August 1978): 5-7.

Describes a recent effort in Minnesota to establish and use a "science court" to resolve the controversy between farmers and electric power cooperatives about the building of a high-voltage transmission line. In the authors' view, the failure of the effort reveals both the extent of the practical difficulties in instituting such a tribunal as well as the "political naiveté" of the original science court idea.

Chargaff, Erwin. Heraclitean Fire. New York: Rockefeller University Press, 1978.

This literate autobiography by a self-proclaimed "outsider on the inside of science" opens with the year 1945, a year that "changed [Chargaff's] entire attitude towards science." From that vantage point, he looks back on his life in Vienna between two world wars, his introduction to the U.S. educational system and its ambiance, his research and its ramifications, and contemporary "big science."

Comar, Cyril. "Bad Science and Social Penalties" (editorial). 200 Science (16 June 1978): 1225

Calls for more vigilant efforts to prevent, correct and expose "bad science" and the "socioeconomic penalties" it imposes.

Committee on Evaluation of Research on Surrogates for Humans in Motor Vehicle Crashes, Division of Medical Sciences, National Research Council. Evaluation of Research on Surrogates for Humans in Motor Vehicle Crashes. Washington, DC: National Research Council, 1978.

Is the use of cadavers necessary for research aimed at saving human life, or is it a form of "ultimate insult"? The NRC Committee appointed to examine the technical and ethical issues involved in such testing found "no satisfactory alternative" to cadavers in certain types of necessary crash testing.

Committee on Private Sector Participation in Government Energy RD & D Planning, Commission on Natural Resources, National Research Council. Private Sector Participation in Federal Energy RD & D [Research, Development and Demonstration] Planning. Washington, DC: National Academy of Sciences, 1978.

An NRC report available from the Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue NW, Washington, DC 20418; 121 pp; $6.50; order by ISBN 0-309-02783-7.

Cravens, Hamilton. The Triumph of Evolution: American Scientists and the Heredity-Environment Controversy, 1900-1941. Philadelphia, PA: University of Pennsylvania Press, 1978.

A scholarly history of the heredity-environment controversy in the American natural and social sciences.

Culliton, Barbara J. "China's 'Four-Modernizations' Lead to Closer Sino-U.S. Science Ties." 201 Science (11 August 1978): 512-513.

A brief account of the recent trip to China by an official delegation of U.S. scientists -- the first such government-to-government exchange between the U.S. and the People's Republic.

Culliton, Barbara J. "The Clone Ranger; A Review of David Rorvik's In His Image: The Cloning of a Man." 17 Columbia Journalism Review 2 (July/August 1978): 58-62.

Science's "News and Comment" Editor dissects the quasi-scientific best-seller. Culliton asks "If scientists are willing to admit that human cloning is theoretically possible, why are they so sure that Rorvik is lying?" and then proceeds to explain why. She also chronicles Rorvik's successful exploitation of the American mass media, an account in which the scientific naiveté and gullibility of many of the media masters is as obvious as Rorvik's ability to use the resulting confusion to best advantage. In the end, as the brief Congressional hearings and this summer's "test-tube baby" coverage have shown, In His Image has fostered little serious public discussion and "serves neither science nor public policy nor journalism very well." (62)

D'Ambrosio, Ubiratan. "Science and Technology in Latin America During Its Discovery." 27 Impact of Science on Society 3 (1977): 267-274.

A brief history of pre-Columbian science and technology, relying on the South American oral traditions and current archaeological and ethnographic research.

Denny, Brewster C. "Renegotiating The Society-Academy Contract" (editorial). 201 Science (25 August 1978): 677.

A plea for responsible renegotiation of the "contract between society at large and the academy -- the learned professions and the institutions in which they work..." Denny argues that "the new contract must include as much recognition of the autonomy of the academy as possible ...," and that "in return, the academy must prove that its autonomy will be exercised with a new sense of accountability for the resources made available by society and with a demonstrated capacity to use these resources wisely."

Eisemon, Thomas O. and Yakov Rabkin. "Science in a Bilingual Society: The Case of Two Engineering Schools in Quebec." 8 Social Studies of Science (May 1978): 245-256.

Engineers at two academic institutions in Quebec -- one French-speaking, the other English-speaking -- were studied in an effort to understand the influence of language of work on the professional attitudes and activities of scientists. Among the issues considered are the relationship between language of work and research activity, scientific communication, and professional recognition.

Ellison, Craig W., ed. Modifying Man: Implications and Ethics. Washington, DC: University Press of America, 1977.

Proceedings of a 1975 conference convened to address theological considerations in issues raised by the advent of human engineering (genetic and psychological control, biopsychological intervention, and environmental manipulation). Representatives from the philosophical, theological, scientific and governmental communities met to discuss the values, conflicts and ethical issues presented by new developments. The 21 papers and other commentaries address particular issues of justice, interaction of church and state, and human dignity.

Farley, Philip J., Stephen S. Kaplan, and William H. Lewis. Arms Across the Sea. Washington, DC: The Brookings Institution, 1978.

An assessment of U.S. policy toward the international weapons trade. How might military assistance, government and commercial sales, and technological contributions to foreign production capabilities be used to promote U.S. interests and international security? Despite domestic and international pressures that might make such a course difficult, the authors advocate discriminating judgment and selectivity in filling requests for military assistance and/or advice, abolition of the promotion of arms sales, and diminished export of military-related technology. Available from Brookings; $7.95 (cloth), $2.95 (paper).

Fowles, Jib, ed. Handbook of Futures Research. Westport, CT: Greenwood Press, 1978.

These 41 essays have been assembled in an attempt to build a theoretical and methodological foundation for the field of futures research. Many of the essays address the specific methodological problems or methods of futures research; others offer more speculative ideas on typical issues or research agenda.

Frankel, Mark S. "Ethics and Responsibility in Political Science Research." 30 International Social Sciences Journal 1 (1978): 173-180.

Explores some of the ethical questions raised by political science research, especially those regarding access and disclosure in studies of the organization, operation and products of government.

Franzen, Don Erik. "Science and the First Amendment: The Case of Wilhelm Reich." 4 Law and Liberty Newsletter 2 (Spring 1978): 1-3, 6-7.

An analysis of the confrontations between Wilhelm Reich (proponent of "orgone energy") and the U.S. Federal Government. Presents the legal

arguments for application of the First Amendment to scientific thought and research under certain restrictive conditions (such as "if the devices are not held out for sale to the general public"). Franzen points out that scientific thought often forms the basis of protected speech: "Suppression of scientific thought may then amount to suppression of political expression and, unquestionably, the views of science are critical to the informed decisions of a public in a democratic society" (p.6). A thoughtful and intriguing article. [The periodical cited is available from the Law and Liberty Project, Institute for Humane Studies, 1177 University Drive, Menlo Park, CA 94025.]

Fraser, Barry J., and Andrew G. Remenyi. "Stability of the Physicist's Image." 46 American Journal of Physics 5 (May 1978): 522-524.

Study of the physicist's image among Australian junior high school students, university students, and teachers -- before and after a presentation of information on the nature of the physicist's work. In contrast to results obtained for other occupations, the physicist's image remained "remarkably stable," despite the provision of information. Builds on the 1956 study of Mead and Metraux. [Also see similar recent U.S. study, reported in "Pupils' attitudes on scientists surveyed," 56 C & E News 35 (28 August 1978): 7-8.]

Freeman, Christopher. Innovation and Size of Firm, Occasional Paper No.1. Queensland, Australia: Science Policy Research Centre, School of Science, Griffith University, 1978.

First in a series of occasional publications on science and technology policy. Freeman analyzes the process of industrial concentration in the U.S. and Britain, linking this to the question of how the size of a firm may affect the expectation of technical innovation. Is small productive and innovative as well as beautiful? Available from the Science Policy Research Centre, School of Science, Griffith University, Nathan, Brisbane, Queensland 4111, Australia.

Fye, W. Bruce. "The Literature and History of Internal Medicine: An Annotated Bibliography." 87 Annals of Internal Medicine 1 (July 1977): 123-128.

This bibliography of fundamental sources is a useful introduction to the literature on the history of various medical subspecialties.

Gaston, Jerry. The Reward System in British and American Science. New York: Wiley-Interscience, 1978.

A study of "how the internal organization of the reward system is affected by the nature of the organization of scientific activities and by the content of science" (16), that is, "whether or not people get what they deserve" (ix). Gaston's objective is to describe current research on the recognition and honor afforded to scientists within a specialist community; he includes analysis of the dissensus as well as the consensus in the study of scientific rewards and deftly outlines new comparative work on this subject.

George, Frank. Machine Takeover: The Growing Threat to Human Freedom in a Computer-Controlled Society. Oxford, England: Pergamon Press, 1977.

Attends to social effects of large data bases, and the potential for criminal or unethical acts made possible by the lack of adequate security.

Gray, Bradford H., Robert A. Cooke, and Arnold S. Tannenbaum. "Research Involving Human Subjects." 201 Science (22 September 1978): 1094-1101.

Describes and reports the results of the most comprehensive empirical study to date of the performance of institutional review boards to protect human research subjects.

Green, Martin. "The Visible College in British Science." 47 American Scholar 1 (Winter 1977/78): 105-117.

Places C.P. Snow's Rede lectures in the context in which they were delivered -- the general cultural attitudes toward British science and the visible scientific community (e.g., Haldane, Bernal, Waddington, Needham).

Greenberg, Daniel S. "New Washington Favorite: Nutrition Research." 8 Science & Government Report 10 (1 June 1978): 1-3.

Analysis of the impact of the "herd effect" in the choice of government-funded research.

Gregory, Michael S., Anita Silvers, and Diane Sutch, editors. Sociobiology and Human Nature. San Francisco, CA: Jossey-Bass Publishers, October 1978.

Seventeen edited and revised papers from a NEXA conference on sociobiology (San Francisco State, June 1977) form the backbone of this ambitious effort to discuss the questions raised in and by sociobiological research. The diversity of the topics and authors lend depth to the contents. The introduction was delivered by E.O. Wilson and served as a counterpoint against which the themes of many disciplines are displayed. Contents include: "Evolution as a Paradigm for Behavior," David P. Barash; "Bridging the Paradigms: Biology and the Social Sciences," Pierre L. van den Berghe; "The New Synthesis?", Gerald Holton; "Scientific Bandwagon or Traveling Medicine Show?" David L. Hull; "Ethical and Social Implications," Joseph S. Alper; and essays by Garrett Hardin, Kenneth Boulding, and George Wald.

Grenander, M.E., compiler. Proceedings of "Helios: From Myth to Solar Energy," a conference held at SUNY-Albany, 16-18 March, 1978. 2 volumes; 429 pp. Albany, NY: Institute for Humanistic Studies, 1978.

This multidisciplinary assembly focused on: the images of the sun in myth and legend; the sun in literature, art, and music; and solar energy projections--social, economic, legal, and political. The unedited proceedings are published as a quick-print but are well-presented and a good model for such publication.

Haas, Ernst B., Mary Pat Williams, and Don Babai. Scientists and World Order: The Uses of Technical Knowledge in International Organizations. Berkeley, CA: University of California Press, 1978.

Examination of the specific roles of scientists in shaping international technical institutions (e.g., energy, health, agriculture) and of their contributions to international policy development.

Haberer, Joseph, editor. Science and Technology Policy. Lexington, MA: Lexington Books, D.C. Heath and Co., 1978.

A collection of 17 essays assembled for a special issue of Policy Studies Journal. In his introduction, editor Haberer asserts that science/technology policy studies are still, to some extent, "a body of literature in search of a field." Nevertheless, he has discerned some common questions that are being examined by policy researchers and around which a cohesive field may be developing: 1) growth, progress, and planning; 2) normative and ethical issues; 3) a skeptical assessment of large-scale institutions and 4) challenge of the "long-prevailing model of a 'partnership between science and government'."

Haskell, Thomas L. The Emergence of Professional Social Science: The American Social Science Association and the Nineteenth-Century Crisis of Authority. Urbana, IL: University of Illinois Press, 1977.

History of the transition of the social sciences from amateur efforts to professionalization and the role of the social sciences in American intellectual and cultural life at the turn of the century.

Holden, Constance. "Animal Rights Advocate Urges New Deal." 201 Science (7 July 1978): 35.

An interview with the director of the Humane Society's research unit, the Institute for the Study of Animal Problems.

Holden, Constance. "California Court Is Forum for Latest Round in IQ Debate." 201 Science (22 September 1978): 1106-1109.

A case before a California court focuses on the use of intelligence tests for placement of children in special classes for the mildly mentally retarded. This article sketches the positions of the different parties and sets the case in the context of other IQ-test controversies.

Holden, Constance. "Senate Approves a Permanent Ethics Commission." 201 Science (14 July 1978): 138.

The Senate has recommended that a permanent presidential commission be established to continue the functions of the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research.

Holton, Gerald. "The Physicists: Reshaping a Profession." 8 The Hastings Center Report (June 1978): 42-43.

In this essay-review of Daniel Kevles' recent book on the rise of the physics community in the United States, The Physicists, Holton suggests that the fusion of social purpose and basic research may require "a completely different style of looking for research problems--one based on the proposition that at the heart of any social problem there is likely to be an area of ignorance about basic scientific facts."

Horowitz, Donald L. The Courts and Social Policy. Washington, DC: The Brookings Institution, 1977.

Even in a society uncommonly prone to "think of social problems in legal terms," the proclivity of court adjudication of social problems has reached alarming proportions. The author argues that "the adjudicative format is less and less an inhibition on judicial action and that the lawsuit can increasingly be thought of [as] an option more or less interchangeable with options in other forums, except that it has advantages the other forums lack... (10)." His quarrel is that in many ways the nature of the adjudication process also presents disadvantages that may act to separate the judge from the true social context of the issue: 1) judges must examine the "rights" or "duties" of the litigants--legislators traditionally may consider alternative actions; 2) adjudication is "incremental decisionmaking," thus possibly obscuring the true nature of the general issue if policy is made on a "piecemeal" basis; 3) the judicial process is passive--it reacts, rather than initiates action; 4) the breadth of most social issues renders them resistant to accurate and complete analysis via the judicial methods of fact-finding; and 5) adjudication may rectify the injustices of the past and present but it is ill-suited to planning for changes in the future, thus there is no provision for the review of court-made social policies. As more biomedical ethical issues reach the courts in future years, these questions will become increasingly important to the scientific and medical communities.

Hovenkamp, Herbert. Science and Religion in America, 1800-1860. Philadelphia, PA: University of Pennsylvania Press, 1978.

Nineteenth-century attempts to unify scientific knowledge and American Protestant beliefs provide an excellent example for this study of the interaction of science and religion, particularly the philosophers, religious writers, and scientists of that time.

Jastrow, Robert. "Have Astronomers Found God?" The New York Times Magazine (25 June 1978): 18-24.

An astronomer-writer chronicles the contemporary conflicts between theologians and astronomy--if modern evidence supports historical theological assumptions, why should it matter to astronomers? Excellent example of science presented to laypersons in a natural and interesting context.

Kates, Robert W. "Human Issues in Human Rights." 201 Science (11 August 1978): 502-506.

This informative article describes the activities undertaken by the National Academy of Sciences' Committee on Human Rights on behalf of severely repressed scientists, engineers, and medical personnel. Of particular interest is the author's perceptive account of the complex issues faced by the committee: the choice of cases, the nature of human rights, and the form of protest.

Katz, James E. Presidential Politics and Science Policy. New York: Praeger, 1978.

A political analysis of presidential involvement in U.S. science policy, from the end of World War II, to the present. [See the review by R. Rettig in 200 Science (30 June 1978): 1474-1475.]

Kling, Rob. "Automated Welfare Client-Tracking and Service Integration: The Political Economy of Computing." 21 Communications of the ACM 6 (June 1978): 484-493.

The social impact of computer technology: although some features of this computing system have increased the efficiency of welfare office administration, the author admits that clients "may still be 'lost' through their own desire or the negligence of caseworkers." The system may, indeed, be only giving the impression of saving social resources while undoubtedly affording increased opportunity for social abuse. At the time this article was written (September 1977), the system was used by most (but not all) of the "Riverville" social assistance agencies; it was then storing records for 42,000 clients from the town of 170,000 and surrounding rural counties.

Kneller, George F. Science as a Human Endeavor. New York: Columbia University Press, 19[illegible]

For students and general readers, this book provides an engagingly written and highly personal overview of science: its history, its methods of inquiry, and its community of inquirers. Kneller's principal message is that science -- which he regards as not only an indispensable source of information but also as a "cultural force of overwhelming importance" -- is a human endeavor and not an "impersonal juggernaut." In the concluding chapter, "The Scientist's Responsibility," Kneller synopsizes and responds to critiques of science by Ravetz, Habermas, Marcuse, and Roszak.

Kolata, Gina Bari. "In vitro Fertilization: Is It Safe and Repeatable?" 201 Science (25 August 1978): 698-699.

Two scientists familiar with the British laboratory that achieved in vitro fertilization discuss various aspects of the event. Because the British team has neither published its findings nor shared details of unpublished findings, it is difficult to know whether the success was due to a breakthrough or a lucky accident.

Krohn, Wolfgang, Edwin T. Layton, Jr., and Peter Weingart, eds. The Dynamics of Science and Technology, Social Values, Technical Norms and Scientific Criteria in the Development of Knowledge. Boston, MA: D. Reidel Publishing Co., 1978.

Volume Two in the Sociology of the Sciences Yearbook series. This book concentrates on the dynamic interaction between science and technology -- at the research level, in the technological implementation of knowledge, and in the disappearance of the demarcation between fundamental and applied research.

La Porte, Todd R. "Nuclear Waste: Increasing Scale and Sociopolitical Impacts." 201 Science (7 July 1978): 22-28.

This article contends that inadequate attention has been paid to the operational requirements for large-scale management of radioactive wastes. The types of information needed to provide a basis for estimating the costs and consequences of radioactive waste management are outlined.

Leiman, Sid Z. "The Ethics of Lottery." 4 Kennedy Institute Quarterly Report 2 (Summer 1978): 8-11.

One of the most thought-provoking commentaries we've read on the question of life-death decisions. Rabbi Leiman uses the case of a 19th-century seaman who was ordered to throw survivors overboard from an overcrowded lifeboat and was later tried for manslaughter. The author outlines the four options that the lifeboat's occupants could have taken and then argues the case against the casting of lots. In an age and society that increasingly turns to random selection as a means for remedying past selective discrimination, the discussion of the ethics of lotteries has significance beyond the "lifeboat" situation. This article would provide an interesting supple springboard for class or roundtable discussion.

Lewin, Leonard C. "Bioethical Questions." 257 Harper's (August 1978): 21-29.

Examines some of the prime questions, institutions, and philosophical frameworks in the field of bioethics. The author attempts to make clear, in layperson terms, that "Social ethics are political; conflicting class and economic interests are inevitably involved."

Mazur, Allan and Beverlie Conant. "Controversy over a Local Nuclear Waste Repository." 8 Social Studies of Science (May 1978): 235-243.

A report of public attitudes toward the proposed siting of a long-term nuclear waste repository. Focuses on differences between the roles of men and women, and offers speculations on the reasons for these differences.

Melnick, Vijaya L., and Franklin D. Hamilton, eds. Minorities in Science: The Challenge for Change in Biomedicine. New York: Plenum Publishing Co., 1977.

Proceedings of a conference on Minorities in Science, held in conjunction with the AAAS Bicentennial Meeting in February 1976. The 34 papers and summaries review the past, present and future efforts to open the biosciences to full participation by minority students. The edited proceedings create a composite portrait of the past gains and present opportunities for minority scientists, with attention to secondary education.

Morgan, M. Granger. "Bad Science and Good Policy Analysis." 201 Science (15 September 1978): 971.

To reduce the social penalties of "bad science" requires the promotion of good policy analysis as well as good science. Scientists who find policy analysis "alien" are urged to try to "understand its value and importance, even if they cannot bring themselves to engage in its practice."

National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. Psychosurgery. Washington, DC: U.S. Government Printing Office, 1978.

The 76-page report and 485-page appendix address the practices and policies that govern the use of psychosurgery. Report and Recommendations, $2.30, stock number 052-003-00347-3; Appendix, $6.25, Stock number 052-003-00348-1.

National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. Research Involving Those Institutionalized as Mentally Infirm. Washington, DC: U.S. Government Printing Office, 1978.

The Commission's recommendations, based on background reports, analysis of the law, and review of various ethical arguments, are all contained in this 125-page primary report. The 354-page Appendix contains the texts of reports and papers prepared under contract to the Commission, other materials reviewed by the Commission, and a selective bibliography. Report and Recommendations, $3.25, Stock number 017-040-00418-4; Appendix, $5.25, Stock number 017-040-00419-2.

National Science Board. Basic Research in the Mission Agencies: Agency Perspectives on the Conduct and Support of Basic Research. Washington, DC: U.S. Government Printing Office, 1978.

This Tenth Annual Report of the National Science Board concentrates on basic scientific research in the Federal agencies, using detailed self-assessment and comparative analysis of the mission agencies and the historical trends in their support of basic research. $5.75; Stock number 038-000-00365-8.

On the Shoulders of Titans: A History of Project Gemini. Washington, DC: U.S. Government Printing Office, 1977.

Official chronicle of the Gemini intermediate manned space flight program, from inception to splash-down. The 630-page book is not intended as a technical document but does explore the project's political and economic

problems as well as the mechanical and technical ones. $8.25; Stock number 033-000-0643-8.

Passmore, John. Science and Its Critics. New Brunswick, NJ: Rutgers University Press, 1978.

Acknowledging that "antiscience is almost as old as science," Passmore examines the various forms of antiscience and responds to contemporary critics. Throughout the four chapters -- "Antiscience and Scientific Explanations," "Antiscience and Antitechnology," "Antiscience and the Scientific Spirit," and "Uniqueness, Imagination, and Objectivity" -- Passmore argues for a proper discernment of the place of science in modern life and maintains that most (but not all) of the major charges that have been levelled against it cannot be sustained.

Pernick, Martin S. "Thomas Edison's Tuberculosis Films: Mass Media and Health Propaganda." 8 The Hastings Center Report (June 1978): 21-27.

One of the major strategies of modern preventive medicine is mass persuasion, a strategy which began in the early years of the 20th century following the development of the technologies of mass propaganda: photoengraving, high-speed presses, motion pictures, etc. In this study, Pernick shows what the health propaganda films made in 1910 by Thomas Edison for the Tuberculosis Association reveal about the turn-of-the-century approach to the ethics of mass persuasion.

"Pupils' attitudes on scientists surveyed." 56 Chemical and Engineering News 35 (28 August 1978): 7-8.

Highlights conclusions of a study of 933 pupils and teachers in grades 7-12, which replicates the 1956 Mead and Metraux survey in both types of questions and findings. Although almost all participants regarded scientists as intelligent and as engaged in important and essential work, only 25% would consider a career in science and most would not marry a scientist. The prevalent stereotype, which is duplicated in popular culture, is that of the scientist as a "solitary" person, who possesses less than ordinary social attributes and participates less in normal social interaction than the non-scientist. [Also see report on similar recent Australian study by Barry J. Fraser and Andrew G. Romenyi, on page 55 of this Bibliography.]

Pyenson, Lewis. "The Incomplete Transmission of a European Image: Physics at Greater Buenos Aires and Montreal, 1890-1920." 122 Proceedings of the American Philosophical Society 2 (April 1978): 92-114.

The author examines those instances "where auspicious circumstances did not result in establishing major, permanent centers of physics research," and concludes that some ideological settings may be "more favorable to certain scientific disciplines than to others" (e.g., "Both Canada and Argentina received the European image of chemistry with far greater sympathy than they did physics.")

Ramsey, Paul. Ethics at The Edges of Life. New Haven, CT: Yale University Press, 1978.

Ramsey's point of departure is the body of recent laws and court decisions pertaining to the practice of medicine. In addition to analyzing the reasoning behind the decisions and laws, Ramsey also provides a critical assessment of the current discourse on issues of medical practice and public policy.

"Report of a Workshop on Ethics and Values in Policy Research and Analysis," 18-19 January, 1978 hosted by the Graduate Program in Science, Technology and Public Policy, George Washington University. Washington, DC: George Washington University, 1978.

The intent of this workshop was to identify the need for increased attention in policy research to questions of ethics and values.

Schmitt, Harrison. "A Scientist-Senator on Recombinant DNA Research" (letter). 201 Science (14 July 1978): 106-108.

Expresses "great concern about the broad implications for scientific research in this country" if actions are taken which would restrict recombinant DNA research activities more severely than do the current NIH guidelines.

Schoenfeld, Clay, and John E. Ross. "Environmental Communication Programs 'Come of Age.' " 33 Journalism Educator 2 (July 1978): 3-6.

In the last ten years, many academic journalism departments have added courses devoted solely to communication of environmental information or discussion of environmental policy issues. This article describes one such program at the University of Wisconsin-Madison. The UW-M program offers three concentration sequences that may be included in a master's degree program in either agricultural journalism, journalism/mass communications, or resource planning and management.

"Science-Religion Relations." 1 Journal of the Society for Common Insight 1(1977).

Special issue includes: "Sociology and Global Theology," Alvin M. Johnson; "Rational Theology and Value Evaluation in Science," M. Craig Johnson; "Ecology and Theology," Russell Goodwin; and other articles. This new journal will also devote two forthcoming issues (Vol. 3, No.2, and Vol.4, No.1) to the topic of "Science-Religion Relations."

Shapley, Deborah. "DOD Vacillates on Wisconsin's Cryptography Work." 201 Science (14 July 1978): 141.

A professor's application for a patent on a new cryptographic scheme led the government to place, and then lift, a secrecy order - actions which again raise questions about the implications of academic research on cryptography. Also see Deborah Shapley, "NSA Slaps Secrecy Order on Inventor's Communications Patent," 201 Science (8 September 1978): 891-894.

Sinsheimer, Robert L. "Humanism and Science." 10 Leonardo 1 (Winter 1977): 59-62.

An abridged version of an article that first appeared in Engineering and Science (October/November 1975). The vision of the scientist is that the sciences and humanities are indeed complementary and need not be antithetical.

Smith, Jeffrey R. "Assumptions About R & D's Link to Economic Growth Questioned." 201 Science (7 July 1978): 32-33.

A brief summary of the discussions at the Third Annual AAAS Colloquium on Research and Development in the Federal Budget, June 1978.

"Special Issue on SIA in Canada." Social Impact Assessment, 32 (August 1978).

SIA devotes its entire issue to news and articles about Canadian efforts in social impact assessment. Includes articles on current research projects, Canadian government activities, public participation, and Canadian conferences.

Study Project on Social Research and Development, Assembly of Behavioral and Social Sciences, National Research Council. The Federal Investment in Knowledge of Social Problems. Washington, DC: National Academy of Sciences, 1978.

Volume 1 of the Study Project's report; available from the Printing and Publishing Office, NAS, 2101 Constitution Avenue NW, Washington, DC 20418; $7.00, ISBN 0-309-02747-0.

Tarbell, D. Stanley. "Perfectibility vs. Entropy in Recent Thought." 1 Science/Technology and the Humanities 2 (Spring 1978): 103-113.

Analysis of the 19th-century origins of current conflicts between the belief in unlimited permanent progress and the assumption of entropy, that "all real processes lead to an increase in disorder."

Teich, Albert H. "Trends in the Organization of Academic Research: The Role of ORU's and Full-Time Researchers." Washington, DC: Graduate Program in Science, Technology and Public Policy, George Washington University, June 1978.

This study reviews the major issues surrounding the development of organized research units (ORU's) within the universities but outside the regular academic, tenure-track faculty system. ORU's have been proposed as a way to assist young scientists and develop new fields of research. The investigators have concluded that increased roles for ORU's could alter the character of the university in important ways, that ORU appointments would, in essence, create a "two-tiered academic world," but that there are two possible and likely models for ORU's (the "medical school model" and the "national laboratory model"). The 90-page report includes an annotated bibliography and case-study appendices. Limited copies available at no cost from the GWU Program (see above).

Thomas, Lewis. "Hubris in Science?" 200 Science (30 June 1978): 1459-1462.

In this reflective tour of the scientific landscape, Thomas provides insight and thoughtful opinion on a variety of issues. He ranges from the problem of communication, both between scientists and the public and among scientists themselves, to the "myth" of the power of science and why it persists, to the regulation of science and technology. His ultimate message is that " we have not reached the end of knowledge: we have only just begun...," and it would be an "offense against nature" to abandon or limit the quest.

Tobias, Sheila. Overcoming Math Anxiety. New York: W.W. Norton & Co., 1978.

Since 1975, Tobias has been attempting to change the "math avoidance" reaction by many young women in high school and college. Although this book is obviously aimed at women, math anxiety can certainly be experienced by both men and women. For that reason, we would be more enthusiastic about this book if it were not so blatantly sex-linked. Some readers of the book have questioned the precision of some of the examples and mathematical terms used, and this reviewer suspects that the illustrations may perpetuate certain undesirable stereotypes rather than serve as examples of sexism (as they may have been intended to do). If you are already convinced of the importance of the problem, be advised that this is not a scholarly reference work. If you are not convinced (or if you have a teenager in need of help), then you will find that Tobias has assembled an overwhelming case for biases in counseling, in textbook examples, and in general cultural myths. (MCL)

Tucker, William. "Of Mites and Men." 257 Harper's (August 1978): 43-58.

Analysis of the effect of the environmental movement, the attitudes of government officials and, in particular, the actions of USDA and EPA on agricultural pesticide use. The battle to prohibit the use of certain toxic chemicals may have resulted in needless obstacles to widespread use of biological insect-control (such as insect chemical mating signals, "juvenile" and "anti-juvenile" hormones, and isolated bacterial or virus insect diseases), obstacles that occur in preliminary research and testing and in EPA registration procedures, as well as in the type and location of use.

Union of Concerned Scientists. "Declaration on the Nuclear Arms Race." Bulletin of the Atomic Scientists (March 1978).

Text of a UCS declaration signed by over 12,000 scientists, engineers, and other professionals. Also reprinted in the IEEE publication Technology and Society, No. 21 (March 1978)

VandenBroeck, Goldian, ed. Less is More: The Art of Voluntary Poverty; Preface by E.F. Schumacher. New York: Harper & Row, Harper Colophon Books, 1978.

A book of quotations -- pleasing in design, with paper cover and modest

price, yet a rich and thoughtful anthology. The 300 pages of quotations--from such varied sources as Plutarch, Roman de la Rose, Veblen, Emily Dickinson, William James, Galbraith, and Robert Graves--convey the message of voluntary simplicity with more power and effect than a thousand speeches, a thousand printed diatribes. There are fourteen chapters (e.g., "Voluntary Poverty and the Monopoly of Values," "Lady Pecunia," "Voluntary Poverty and Time"), many of which are further subdivided into sections that concentrate on individual, institutional, or societal actions and attitudes, as in "Alternative Energies," and "Holding Back: The Limits of Growth."

Veatch, Robert M. "Medical Ethics Anthologies: Alternatives for Teaching." 8 The Hastings Center Report (June 1978): 14-16.

This review compares the contents, organization, and approaches of five recently-published anthologies pertaining to medical ethics.

Walsh, John. "IRS Questions Tax Status of Six Science, Engineering Groups." 200 Science (23 June 1978): 1369-1370.

The IRS wishes to revoke the tax-exempt status of two scientific societies, and to re-classify four others as "business leagues." The thrust of the argument for reclassification is that the activities of the groups benefit their members rather than the public at large (as required by the relevant section of the tax law).

Walsh, John. "President and Science Adviser Push for a Foundation for Development." 200 Science (16 June 1978): 1252-1253.

Describes efforts by the administration to create a foundation to assist less-developed countries to make more effective use of science and technology.

Walsh, Mary Roth. Doctors Wanted: No Women Need Apply; Sexual Barriers in the Medical Profession, 1835-1975. New Haven, CT: Yale University Press, 1978.

A systematic historical analysis of sex differentiation and discrimination in the medical profession, focusing on the women who attempted to enter and practice medicine via the standard, establishment routes. The author concludes that much of the discrimination has been deliberate, part of a conscious effort by the medical establishment to limit the numbers of women physicians.

Wilson, Edward O. On Human Nature. Cambridge, MA: Harvard University Press, 1978.

Wilson's third ring in his sociobiology trilogy: "I became more persuaded than ever that the time has at last arrived to close the famous gap between the two cultures, and that general sociobiology, which is simply the extension of population biology and evolutionary theory to social organization, is the appropriate instrument for the effort" (ix-x). Wilson

refers to the core of the book as a "speculative essay," not a scientific text, as he treats heredity, aggression, sex, altruism, and religion from the perspective of sociobiology.

Wolff, Kathryn, and Jill Storey, eds. AAAS Science Book List Supplement. Washington, DC: American Association for the Advancement of Science, 1978.

A selected and annotated list of science and mathematics books, which supplements the AAAS Science Book List (third edition issued in 1970) for secondary school students, college undergraduates, teachers, and nonspecialist readers.

Zuckerman, Harriet. "The Sociology of the Nobel Prize: Further Notes and Queries." 66 American Scientist (July-August 1978): 420-425.

Some addenda to Zuckerman's recent book, Scientifit Elite, focusing in particular on: 1) what makes the Nobel Prize so special and prestigious; 2) the occupants of the "forty-first" chair (persons acknowledged to have performed research worthy of the Prize yet who have not yet received it); and 3) the effect of the Prize on recipients. Zuckerman's clear, precise language and her selection of anecdotal evidence provide a solid foundation to her research results. The Prize has changed many lives and careers and, for some, represents a life-long goal; yet, because of its exclusion of entire fields (e.g., mathematics) and its limiting rules (such as the prohibition of posthumous award), it cannot be said to identify all scientific excellence. And, as the author stresses, its larger effect on the quality or direction of science is as yet unmeasured and unproven.

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