MEMORANDUM FOR DISCUSSION
AT THE OCTOBER PSAC MEETING

The approaching end of my PSAC term has caused me to reflect upon my experiences as a member from 1962 to 1965 and 1969 to 1972, together with my contact with the Committee since 1956 as a consultant when I was not a member. I propose that we devote several hours during the November meeting to a discussion of the role of PSAC. In discussing what PSAC should be, we will of course become involved in what it is, has been, and could be.

The discussion might be organized somewhat as follows, although the list of topics is by no means complete:

ORGANIZATION

The Vice Chairmanship. In the past, it was found desirable for PSAC to have a Vice Chairman who was not a full-time government employee and so was not under the same constraints as the Chairman. The ultimate utility of the Vice Chairman would be to carry the conclusions and recommendations of the Committee to the President even when these conflicted with expressed Administration policy. But the Vice Chairman has a more important role to fill in leading the discussions of the Committee in those cases in which the Chairman feels constrained by the privileged nature of his relationship with the President. In recent times, John Baldeschwieler has been Acting Chairman in Ed David's absence, not a Vice Chairman of the Committee.

MECHANICS

The process of clearance of new members and panel members takes so long that it interferes seriously with the work of the Committee. Furthermore, no explanation is given for the delay. What steps have been taken or could be taken to ensure that the clearance process occurs on a schedule adequate for the purposes of the Committee?

PSAC AS SPOKESMAN FOR SCIENCE

The Committee at times has expressed reluctance to speak out for science in part because it would be accused of "special pleading." On the other hand, no other organization can speak to the President or to OMB for all of science. I think that we should get straight in discussion a consensus as to our role in this regard.

a spending

QUALITY OF LIFE

The GNP and the distribution of wealth provide an indication of progress and an orientation of goal which can be fairly readily understood. For at least ten years, we have recognized the desirability of modifying the GNP indicator so that it would include quality. For instance, one could include pollution as a negative component of the GNP, so that its removal would be reflected as an increase in GNP. So long as these other aspects of product and life are unquantified, they will be ignored in comparison with those aspects which are not only "nice to have" but also reflected in numbers as in the current GNP. However, much of the "product" in the current GNP is also only "nice to have," and we ought to determine by discussion to what extent a panel activity in this area might have important impact. This can be connected, of course, to the whole question of fines and incentives for pollution, etc.

MILITARY PANELS

PSAC panels in the military area have traditionally had a dual function -- (1) to be aware of and to contribute to military R&D, and (2) to review for the President our current capabilities and the performance of the Defense Department in matters not necessarily restricted to R&D. Discussion and self-criticism on this subject should reassure us that our panels are performing this function as well as ever, or alternatively should lead to changes in our operation.

OST-PSAC RELATIONS

A panel chaired by an OST staff man and a panel chaired by a PSAC member might be alternatives for investigations in the same field. The arguments for and against the two approaches ought to be reviewed, as well as our experience in this regard.

This is only a suggestion of some items for a discussion of the future of PSAC. I hope that a fuller agenda may be agreed at the October meeting.

Richard L. Garwin
October 9, 1972

GUEST LIST

Dinner in Honor of Academician M. V. Keldysh
Tuesday, October 17, 1972, at 7:00 p.m.

THE LOUNGE OUTSIDE "THE COMMONS"
THE SMITHSONIAN INSTITUTION
1000 Jefferson Drive

Hosted by
Dr. Edward E. David, Jr., and Dr. S. Dillon Ripley

Soviet Guests

Academician Mstislav V. Keldysh
President of the Academy of
Sciences of the USSR

Ambassador Anatoliy Dobrynin

Aleksandr M. Prokhorov
Deputy Director
Physics Institute

G. I. Marchuk
Director, Computing Center
Akademgorodok

Yuriy A. Ovchinnikov
Director
Institute of Chemistry of Natural Compounds

Igor M. Makarov
Deputy Chairman
USSR National Committee for Automation

S. G. Korneev, Head
Administration for External Relations
USSR Academy of Sciences

The White House

Mr. Peter Flanigan
Assistant to the President for
International Economic Affairs

Dr. Edward E. David, Jr.
Science Adviser to the President
and Director, Office of Science and Technology

Dr. John D. Baldeschwieler
Deputy Director
Office of Science and Technology

President's Science Advisory Committee

Dr. Gerald F. Tape
President
Associated Universities, Inc.

Mr. Kenneth H. Olsen
President
Digital Equipment Corporation

Department of State

Mr. Herman Pollack
Director, Bureau of International
Scientific and Technological Affairs

Mr. Richard Davies
Deputy Assistant Secretary of State
for European Affairs

Smithsonian Institution

Dr. S. Dillon Ripley
Secretary

Dr. David Challinor
Assistant Secretary for Science

Dr. Fred Whipple
Director, Smithsonian Astrophysical Observatory

Woodrow Wilson Center for International Scholars

Mr. William J. Baroody
Chairman of the Board

Dr. Eugene Rabinowitch
Fellow

Dr. Benjamin H. Read
Director

National Academy of Sciences

Dr. Philip Handler
President

National Science Foundation

Dr. H. Guyford Stever
Director

92D CONGRESS } HOUSE OF REPRESENTATIVES { REPORT
2d Session } { No. 92-1403

EXECUTIVE BRANCH ADVISORY COMMITTEES

SEPTEMBER 18, 1972.—Ordered to be printed

Mr. HOLIFIELD, from the committee of conference, submitted the following

CONFERENCE REPORT

[To accompany H.R. 4383]

The committee of conference on the disagreeing votes of the two Houses on the amendment of the Senate to the bill (H.R. 4383) to authorize the establishment of a system governing the creation and operation of advisory committees in the executive branch of the Federal Government, and for other purposes, having met, after full and free conference, have agreed to recommend and do recommend to their respective Houses as follows:

That the House recede from its disagreement to the amendment of the Senate to the text of the bill and agree to the same with an amendment as follows:

In lieu of the matter proposed to be inserted by the Senate amendment insert the following:

That this Act may be cited as the "Federal Advisory Committee Act".

FINDINGS AND PURPOSES

SEC. 2. (a) The Congress finds that there are numerous committees, boards, commissions, councils, and similar groups which have been established to advise officers and agencies in the executive branch of the Federal Government and that they are frequently a useful and beneficial means of furnishing expert advice, ideas, and diverse opinions to the Federal Government.

(b) The Congress further finds and declares that—

(1) the need for many existing advisory committees has not been adequately reviewed;

(2) new advisory committees should be established only when they are determined to be essential and their number should be kept to the minimum necessary;

(3) advisory committees should be terminated when they are no longer carrying out the purposes for which they were established;

(4) standards and uniform procedures should govern the establishment, operation, administration, and duration of advisory committees;

(5) the Congress and the public should be kept informed with respect to the number, purpose, membership, activities, and cost of advisory committees; and

(6) the function of advisory committees should be advisory only, and that all matters under their consideration should be determined, in accordance with law, by the official, agency, or officer involved.

DEFINITIONS

SEC. 3. For the purpose of this Act—

(1) The term "Director" means the Director of the Office of Management and Budget.

(2) The term "advisory committee" means any committee, board, commission, council, conference, panel, task force, or other similar group, or any subcommittee or other subgroup thereof (hereafter in this paragraph referred to as "committee"), which is—

(A) established by statute or reorganization plan, or

(B) established or utilized by the President, or

(C) established or utilized by one or more agencies,

in the interest of obtaining advice or recommendations for the President or one or more agencies or officers of the Federal Government, except that such term excludes (i) the Advisory Commission on Intergovernmental Relations, (ii) the Commission on Government Procurement, and (iii) any committee which is composed wholly of full-time officers or employees of the Federal Government.

(3) The term "agency" has the same meaning as in section 551(1) of title 5, United States Code.

(4) The term "Presidential advisory committee" means an advisory committee which advises the President.

APPLICABILITY

SEC. 4. (a) The provisions of this Act or of any rule, order, or regulation promulgated under this Act shall apply to each advisory committee except to the extent that any Act of Congress establishing any such advisory committee specifically provides otherwise.

(b) Nothing in this Act shall be construed to apply to any advisory committee established or utilized by—

(1) the Central Intelligence Agency; or

(2) the Federal Reserve System.

(c) Nothing in this Act shall be construed to apply to any local civic group whose primary function is that of rendering a public service with respect to a Federal program, or any State or local committee, council, board, commission, or similar group established to advise or make recommendations to State or local officials or agencies.

RESPONSIBILITIES OF CONGRESSIONAL COMMITTEES

SEC. 5. (a) In the exercise of its legislative review function, each standing committee of the Senate and the House of Representatives shall make a continuing review of the activities of each advisory committee under its jurisdiction to determine whether such advisory committee should be abolished or merged with any other advisory committee, whether the responsibilities of such advisory committee should be revised, and whether such advisory committee performs a necessary function not already being performed. Each such standing committee shall take appropriate action to obtain the enactment of legislation necessary to carry out the purpose of this subsection.

(b) In considering legislation establishing, or authorizing the establishment of any advisory committee, each standing committee of the Senate and of the House of Representatives shall determine, and report such determination to the Senate or to the House of Representatives, as the case may be, whether the functions of the proposed advisory committee are being or could be performed by one or more agencies or by an advisory committee already in existence, or by enlarging the mandate of an existing advisory committee. Any such legislation shall—

(1) contain a clearly defined purpose for the advisory committee;

(2) require the membership of the advisory committee to be fairly balanced in terms of the points of view represented and the functions to be performed by the advisory committee;

(3) contain appropriate provisions to assure that the advice and recommendations of the advisory committee will not be inappropriately influenced by the appointing authority or by any special interest, but will instead be the result of the advisory committee's independent judgment;

(4) contain provisions dealing with authorization of appropriations, the date for submission of reports (if any), the duration of the advisory committee, and the publication of reports and other materials, to the extent that the standing committee determines the provisions of section 10 of this Act to be inadequate; and

(5) contain provisions which will assure that the advisory committee will have adequate staff (either supplied by an agency or employed by it), will be provided adequate quarters, and will have funds available to meet its other necessary expenses.

(c) To the extent they are applicable, the guidelines set out in subsection (b) of this section shall be followed by the President, agency heads, or other Federal officials in creating an advisory committee.

RESPONSIBILITIES OF THE PRESIDENT

SEC. 6. (a) The President may delegate responsibility for evaluating and taking action, where appropriate, with respect to all public recommendations made to him by Presidential advisory committees.

(b) Within one year after a Presidential advisory committee has submitted a public report to the President, the President or his delegate shall make a report to the Congress stating either his proposals for action or his reasons for inaction, with respect to the recommendations contained in the public report.

(c) The President shall, not later than March 31 of each calendar year (after the year in which this Act is enacted), make an annual report to the Congress on the activities, status, and changes in the composition of advisory committees in existence during the preceding calendar year. The report shall contain the name of every advisory committee, the date of and authority for its creation, its termination date or the date it is to make a report, its functions, a reference to the reports it has submitted, a statement of whether it is an ad hoc or continuing body, the dates of its meetings, the names and occupations of its current members, and the total estimated

annual cost to the United States to fund, service, supply, and maintain such committee. Such report shall include a list of those advisory committees abolished by the President, and in the case of advisory committees established by statute, a list of those advisory committees which the President recommends be abolished together with his reasons therefor. The President shall exclude from this report any information which, in his judgment, should be withheld for reasons of national security, and he shall include in such report a statement that such information is excluded.

RESPONSIBILITIES OF THE DIRECTOR, OFFICE OF MANAGEMENT AND BUDGET

SEC. 7. (a) The Director shall establish and maintain within the Office of Management and Budget a Committee Management Secretariat, which shall be responsible for all matters relating to advisory committees.

(b) The Director shall, immediately after the enactment of this Act, institute a comprehensive review of the activities and responsibilities of each advisory committee to determine—

(1) whether such committee is carrying out its purpose;

(2) whether, consistent with the provisions of applicable statutes, the responsibilities assigned to it should be revised;

(3) whether it should be merged with other advisory committees; or

(4) whether it should be abolished.

The Director may from time to time request such information as he deems necessary to carry out his functions under this subsection. Upon the completion of the Director's review he shall make recommendations to the President and to either the agency head or the Congress with respect to action he believes should be taken. Thereafter, the Director shall carry out a similar review annually. Agency heads shall cooperate with the Director in making the reviews required by this subsection.

(c) The Director shall prescribe administrative guidelines and management controls applicable to advisory committees, and, to the maximum extent feasible, provide advise, assistance, and guidance to advisory committees to improve their performance. In carrying out his functions under this subsection, the Director shall consider the recommendations of each agency head with respect to means of improving the performance of advisory committees whose duties are related to such agency.

(d)(1) The Director, after study and consultation with the Civil Service Commission, shall establish guidelines with respect to uniform fair rates of pay for comparable services of members, staffs, and consultants of advisory committees in a manner which gives appropriate recognition to the responsibilities and qualifications required and other relevant factors. Such regulations shall provide that—

(A) no member of any advisory committee or of the staff of any advisory committee shall receive compensation at a rate in excess of the rate specified for GS–18 of the General Schedule under section 5332 of title 5, United States Code; and

(B) such members, while engaged in the performance of their duties away from their homes or regular places of business, may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by section 5703 of title 5, United States Code, for persons employed intermittently in the Government service.

(2) Nothing in this subsection shall prevent—

(A) an individual who (without regard to his service with an advisory committee) is a full-time employee of the United States, or

(B) an individual who immediately before his service with an advisory committee was such an employee,

from receiving compensation at the rate at which he otherwise would be compensated (or was compensated) as a full-time employee of the United States.

(e) The Director shall include in budget recommendations a summary of the amounts he deems necessary for the expenses of advisory committees, including the expenses for publication of reports where appropriate.

RESPONSIBILITIES OF AGENCY HEADS

SEC. 8. (a) Each agency head shall establish uniform administrative guidelines and management controls for advisory committees established by that agency, which shall be consistent with directives of the Director under section 7 and section 10. Each agency shall maintain systematic information on the nature, functions, and operations of each advisory committee within its jurisdiction.

(b) The head of each agency which has an advisory committee shall designate an Advisory Committee Management Officer who shall—

(1) exercise control and supervision over the establishment, procedures, and accomplishments of advisory committees established by that agency;

(2) assemble and maintain the reports, records, and other papers of any such committee during its existence; and

(3) carry out, on behalf of that agency, the provisions of section 552 of title 5, United States Code, with respect to such reports, records, and other papers.

ESTABLISHMENT AND PURPOSE OF ADVISORY COMMITTEES

SEC. 9. (a) No advisory committee shall be established unless such establishment is—

(1) specifically authorized by statute or by the President; or

(2) determined as a matter of formal record, by the head of the agency involved after consultation with the Director, with timely notice published in the Federal Register, to be in the public interest in connection with the performance of duties imposed on that agency by law.

(b) Unless otherwise specifically provided by statute or Presidential directive, advisory committees shall be utilized solely for advisory functions. Determinations of action to be taken and policy to be expressed with respect to matters upon which an advisory committee reports or makes recommendations shall be made solely by the President or an officer of the Federal Government.

(c) No advisory committee shall meet or take any action until an advisory committee charter has been filed with (1) the Director, in the case of Presidential advisory committees, or (2) with the head of the agency to whom any advisory committee reports and with the standing committees of the Senate and of the House of Representatives having legislative jurisdiction of such agency. Such charter shall contain the following information:

(A) the committee's official designation;

(B) the committee's objectives and the scope of its activity;

(C) the period of time necessary for the committee to carry out its purposes;

(D) the agency or official to whom the committee reports;

(E) the agency responsible for providing the necessary support for the committee;

(F) a description of the duties for which the committee is responsible, and, if such duties are not solely advisory, a specification of the authority for such functions;

(G) the estimated annual operating costs in dollars and man-years for such committee;

(H) the estimated number and frequency of committee meetings;

(I) the committee's termination date, if less than two years from the date of the committee's establishment; and

(J) the date the charter is filed.

A copy of any such charter shall also be furnished to the Library of Congress.

ADVISORY COMMITTEE PROCEDURES

SEC. 10. (a) (1) Each advisory committee meeting shall be open to the public.

(2) Except when the President determines otherwise for reasons of national security, timely notice of each such meeting shall be published in the Federal Register, and the Director shall prescribe regulations to provide for other types of public notice to insure that all interested persons are notified of such meeting prior thereto.

(3) Interested persons shall be permitted to attend, appear before, or file statements with any advisory committee, subject to such reasonable rules or regulations as the Director may prescribe.

(b) Subject to section 552 of title 5, United States Code, the records, reports, transcripts, minutes, appendixes, working papers, drafts, studies, agenda, or other documents which were made available to or prepared for or by each advisory committee shall be available for public inspection and copying at a single location in the offices of the advisory committee or the agency to which the advisory committee reports until the advisory committee ceases to exist.

(c) Detailed minutes of each meeting of each advisory committee shall be kept and shall contain a record of the persons present, a complete and accurate description of matters discussed and conclusions reached, and copies of all reports received, issued, or approved by the advisory committee. The accuracy of all minutes shall be certified to by the chairman of the advisory committee.

(d) Subsections (a)(1) and (a)(3) of this section shall not apply to any advisory committee meeting which the President, or the head of the agency to which the advisory committee reports, determines is concerned with matters listed in section 552(b) of title 5, United States Code. Any such determination shall be in writing and shall contain the reasons for such determination. If such a determination is made, the advisory committee shall issue a report at least annually setting forth a summary of its activities and such related matters as would be informative to the public consistent with the policy of section 552(b) of title 5, United States Code.

(e) There shall be designated an officer or employee of the Federal Government to chair or attend each meeting of each advisory committee. The officer or employee so designated is authorized, whenever he determines it to be in the public interest, to adjourn any such meeting. No

advisory committee shall conduct any meeting in the absence of that officer or employee.

(f) Advisory committees shall not hold any meetings except at the call of, or with the advance approval of, a designated officer or employee of the Federal Government, and in the case of advisory committees (other than Presidential advisory committees), with an agenda approved by such officer or employee.

AVAILABILITY OF TRANSCRIPTS

SEC. 11. (a) Except where prohibited by contractual agreements entered into prior to the effective date of this Act, agencies and advisory committees shall make available to any person, at actual cost of duplication, copies of transcripts of agency proceedings or advisory committee meetings.

(b) As used in this section "agency proceeding" means any proceeding as defined in section 551(12) of title 5, United States Code.

FISCAL AND ADMINISTRATIVE PROVISIONS

SEC. 12. (a) Each agency shall keep records as will fully disclose the disposition of any funds which may be at the disposal of its advisory committees and the nature and extent of their activities. The General Services Administration, or such other agency as the President may designate, shall maintain financial records with respect to Presidential advisory committees. The Comptroller General of the United States, or any of his authorized representatives, shall have access, for the purpose of audit and examination, to any such records.

(b) Each agency shall be responsible for providing support services for each advisory committee established by or reporting to it unless the establishing authority provides otherwise. Where any such advisory committee reports to more than one agency, only one agency shall be responsible for support services at any one time. In the case of Presidential advisory committees, such services may be provided by the General Services Administration.

RESPONSIBILITIES OF LIBRARY OF CONGRESS

SEC. 13. Subject to section 552 of title 5, United States Code, the Director shall provide for the filing with the Library of Congress of at least eight copies of each report made by every advisory committee and, where appropriate, background papers prepared by consultants. The Librarian of Congress shall establish a depository for such reports and papers where they shall be available to public inspection and use.

TERMINATION OF ADVISORY COMMITTEES

SEC. 14. (a)(1) Each advisory committee which is in existence on the effective date of this Act shall terminate not later than the expiration of the two-year period following such effective date unless—

(A) in the case of an advisory committee established by the President or an officer of the Federal Government, such advisory committee is renewed by the President or that officer by appropriate action prior to the expiration of such two-year period; or

(B) in the case of an advisory committee established by an Act of Congress, its duration is otherwise provided for by law.

(2) Each advisory committee established after such effective date shall

terminate not later than the expiration of the two-year period beginning on the date of its establishment unless—

(A) in the case of an advisory committee established by the President or an officer of the Federal Government such advisory committee is renewed by the President or such officer by appropriate action prior to the end of such period; or

(B) in the case of an advisory committee established by an Act of Congress, its duration is otherwise provided for by law.

(b)(1) Upon the renewal of any advisory committee, such advisory committee shall file a charter in accordance with section 9(c).

(2) Any advisory committee established by an Act of Congress shall file a charter in accordance with such section upon the expiration of each successive two-year period following the date of enactment of the Act establishing such advisory committee.

(3) No advisory committee required under this subsection to file a charter shall take any action (other than preparation and filing of such charter) prior to the date on which such charter is filed.

(c) Any advisory committee which is renewed by the President or any officer of the Federal Government may be continued only for successive two-year periods by appropriate action taken by the President or such officer prior to the date on which such advisory committee would otherwise terminate.

EFFECTIVE DATE

SEC. 15. Except as provided in section 7(b), this Act shall become effective upon the expiration of ninety days following the date of enactment.

And the Senate agree to the same.

CHET HOLIFIELD,
JOHN S. MONAGAN,
DANTE B. FASCELL,
SAM STEIGER,
GARRY BROWN,
Managers on the Part of the House.

EDMUND S. MUSKIE,
HUBERT H. HUMPHREY,
LAWTON CHILES,
LEE METCALF,
CHARLES PERCY,
W. V. ROTH, Jr.,
BILL BROCK,
Managers on the Part of the Senate.

JOINT EXPLANATORY STATEMENT OF THE COMMITTEE OF CONFERENCE

The managers on the part of the House and the Senate at the conference on the disagreeing votes of the two Houses on the amendment of the Senate to the bill (H.R. 4383) to authorize the establishment of a system governing the creation and operation of advisory committees in the executive branch of the Federal Government, and for other purposes, submit the following joint statement to the House and the Senate in explanation of the effect of the action agreed upon by the managers and recommended in the accompanying conference report:

1. SHORT TITLE

The Senate amendment changed the short title of the House bill to the "Federal Advisory Committee Act". The conference substitute conforms to the Senate amendment.

2. FINDINGS AND PURPOSES

The Senate amendment contained a more lengthy statement of of findings and purposes than did the House bill, but did not differ substantially from the House bill. The conference substitute adopts a compromise between the two provisions.

3. DEFINITIONS

The Senate amendment contained definitions of "agency advisory committee", "Presidential advisory committee", and "advisory committee", while the House bill contained definitions of "advisory committee" and "Presidential advisory committee".

The conference substitute adopts the House definition of "Presidential advisory committee" without any change and adopts the House definition of "advisory committee" with modification.

The conference substitute definition of "advisory committee" includes committees which are established or utilized by the President or by one or more agencies or officers of the Federal Government. The conference substitute excludes from the definition of "advisory committee" the Advisory Commission on Intergovernmental Relations, the Commission on Government Procurement, and any committee which is composed wholly of full-time officers or employees of the Federal Government.

The conference substitute deletes the Senate amendment definitions of "officer" and "employee".

4. APPLICABILITY OF THE PROVISIONS OF THE ACT

The Senate amendment contained a provision setting forth the applicability of provisions of the Act, while the House bill contained

no comparable provision. The conference substitute adopts the language of the Senate amendment with modifications. The conference substitute specifically exempts from the applicability of the provisions of the Act any advisory committee established or utilized by the Central Intelligence Agency or by the Federal Reserve System.

The Act does not apply to persons or organizations which have contractual relationships with Federal agencies nor to advisory committees not directly established by or for such agencies.

5. RESPONSIBILITIES OF CONGRESSIONAL COMMITTEES

The Senate amendment and the House bill contained minor differences regarding the legislative review functions of the standing committees of Congress. The conference substitute adopts the language of the Senate amendment.

The Senate amendment and the House bill differed regarding the duties of the standing committees of Congress when considering legislation establishing advisory committees. The conference substitute adopts the House bill with minor modifications.

The House bill provides that when the President, any agency head, or any other Federal official establishes an advisory committee, he shall follow the guidelines which are set forth in the House bill for standing committees of the Congress when they are considering legislation establishing advisory committees. The Senate amendment contained no comparable provision. The conference substitute adopts the House bill.

6. RESPONSIBILITIES OF THE PRESIDENT

The Senate amendment and the House bill differed with respect to the responsibilities of the President. The conference substitute adopts a compromise provision which provides that the President may delegate responsibility for evaluating and taking action with respect to the public recommendations of Presidential advisory committees. The conference substitute further provides that the President or his delegate shall submit a report to Congress stating his proposals for action or his reasons for inaction with respect to such public recommendations.

The House bill required the President to make an annual report to Congress regarding advisory committees. The Senate amendment required the Director of the Office of Management and Budget to make a similar annual report. The conference substitute adopts the House bill with modifications. The modifications include the adoption of a provision similar to a provision contained in the Senate amendment excluding from such annual report information which should be withheld for reasons of national security.

7. RESPONSIBILITIES OF THE DIRECTOR OF THE OFFICE OF MANAGEMENT AND BUDGET

The Senate amendment contained several differences from the House bill with respect to the responsibilities of the Director of the Office of Management and Budget.

As noted above, the Senate amendment required the Director to make an annual report to Congress on advisory committees. The conference substitute provides that the President shall make such annual reports, as did the House bill.

With respect to the other duties of the Director, the conference substitute adopts the language of the Senate amendment with slight modification.

The conference substitute requires the Director to include in budget recommendations a summary of amounts necessary for the expenses of advisory committees.

8. RESPONSIBILITIES OF AGENCY HEADS

The Senate amendment differed from the House bill in that it provided that each agency head should designate an Advisory Committee Management Officer with specified duties, and the House bill contained no comparable provision. The conference substitute adopts the Senate amendment with slight modifications.

9. ESTABLISHMENT AND PURPOSE OF ADVISORY COMMITTEES

The Senate amendment set forth a procedure to be followed when advisory committees are established and provided that advisory committees be utilized solely for advisory functions. The House bill had no comparable provision. The conference substitute adopts the Senate amendment with modifications.

10. ADVISORY COMMITTEE PROCEDURES

With regard to the availability of the records and other papers of advisory committees and public access to their meetings, the Senate amendment differed from the House bill. The conference substitute provides for publication in the Federal Register of timely notice of advisory committee meetings, except where the President determines otherwise for reasons of national security. The conference substitute further provides for public access to advisory committee meetings subject to restrictions which may be imposed by the President or the head of any agency to which an advisory committee reports. Such restrictions may be imposed after it is determined that an advisory committee meeting is concerned with matters listed in section 552(b) of title 5, United States Code. The conference substitute also provides that subject to section 552 of title 5, United States Code, the records and other papers of advisory committees shall be available for public inspection and copying.

The conference substitute requires that each advisory committee keep detailed minutes of its meetings.

The conference substitute requires that a designated officer or employee of the Government attend each advisory committee meeting. No such meeting may be conducted in his absence or without his approval. Except in the case of Presidential advisory committees the agenda of such meeting must be approved by him.

11. AVAILABILITY OF TRANSCRIPTS

The Senate amendment provided that agencies and advisory committees should make any transcripts of their proceedings or meetings available to the public at actual cost of duplication. The House bill contained no comparable provision. The conference substitute adopts the Senate amendment with modification.

12. COLLECTION OF INFORMATION

The Senate amendment contained a provision relating to procedures followed by the Office of Management and Budget in carrying out its duties under the Federal Reports Act. The House bill contained no such provision.

The conference substitute contains no provision on this subject.

13. FISCAL AND ADMINISTRATIVE PROVISIONS

The Senate amendment and the House bill differ slightly regarding the requirement that records be kept concerning the disposition of funds and the nature and extent of activities of advisory committees. The conference substitute provides that each agency shall keep financial and other records regarding the advisory committees under its jurisdiction and that either the General Services Administration or such agency as the President may designate shall maintain financial records of Presidential advisory committees.

The conference substitute adopts the provision of the Senate amendment concerning support services for advisory committees.

14. RESPONSIBILITIES OF THE LIBRARY OF CONGRESS

The Senate amendment and the House bill differed with respect to the responsibilities of the Library of Congress as a depository of the reports and other materials of advisory committees. The conference substitute adopts the House bill with modifications.

15. TERMINATION OF ADVISORY COMMITTEES

The Senate amendment differed from the House bill in that it provided for the termination of advisory committees created by Act of Congress before the effective date of the bill and further differed in that it provided for the termination of all advisory committees not later than December 31, 1973. The House bill provided for the termination of all advisory committees, other than those created by Act of Congress before the date of enactment of the bill, within two years after the effective date of the bill.

The conference substitute adopts the Senate amendment with modifications. An important modification to the Senate amendment is the substitution of a termination date which occurs two years after the effective date of the bill.

16. EFFECTIVE DATE

The Senate amendment and the House bill differed slightly with respect to effective date. The conference substitute adopts the Senate amendment with modifications.

CHET HOLIFIELD,
JOHN S. MONAGAN,
DANTE B. FASCELL,
SAM STEIGER,
GARRY BROWN,
Managers on the Part of the House.

EDMUND S. MUSKIE,
HUBERT H. HUMPHREY,
LAWTON CHILES,
LEE METCALF,
CHARLES PERCY,
W. V. ROTH, Jr.,
BILL BROCK,
Managers on the Part of the Senate.

○

92D CONGRESS } HOUSE OF REPRESENTATIVES { REPORT
2d Session } { No. 92-1436

TECHNOLOGY ASSESSMENT ACT OF 1972

SEPTEMBER 25, 1972.—Ordered to be printed

Mr. MILLER of California, from the committee of conference, submitted the following

CONFERENCE REPORT

[To accompany H.R. 10243]

The committee of conference on the disagreeing votes of the two Houses on the amendment of the Senate to the bill (H.R. 10243) to establish an Office of Technology Assessment for the Congress as an aid in the identification and consideration of existing and probable impacts of technological application; to amend the National Science Foundation Act of 1950, and for other purposes, having met, after full and free conference, have agreed to recommend and do recommend to their respective Houses as follows:

That the House recede from its disagreement to the amendment of the Senate and agree to the same with an amendment as follows:

In lieu of the matter proposed to be inserted by the Senate amendment insert the following:

That this Act may be cited as the "Technology Assessment Act of 1972".

FINDINGS AND DECLARATION OF PURPOSE

SEC. 2. The Congress hereby finds and declares that:

(a) As technology continues to change and expand rapidly, its applications are—

(1) large and growing in scale; and

(2) increasingly extensive, pervasive, and critical in their impact, beneficial and adverse, on the natural and social environment.

(b) Therefore, it is essential that, to the fullest extent possible, the consequences of technological applications be anticipated, understood, and considered in determination of public policy on existing and emerging national problems.

(c) The Congress further finds that:

(1) the Federal agencies presently responsible directly to the Congress are not designed to provide the legislative branch with adequate and timely information, independently developed, relating to the potential impact of technological applications, and

(2) the present mechanisms of the Congress do not and are not designed to provide the legislative branch with such information.

(d) Accordingly, it is necessary for the Congress to—

(1) equip itself with new and effective means for securing competent, unbiased information concerning the physical, biological, economic, social, and political effects of such applications; and

(2) utilize this information, whenever appropriate, as one factor in the legislative assessment of matters pending before the Congress, particularly in those instances where the Federal Government may be called upon to consider support for, or management or regulation of, technological applications.

ESTABLISHMENT OF THE OFFICE OF TECHNOLOGY ASSESSMENT

SEC. 3. (a) In accordance with the findings and declaration of purpose in section 2, there is hereby created the Office of Technology Assessment (hereinafter referred to as the "Office") which shall be within and responsible to the legislative branch of the Government.

(b) The Office shall consist of a Technology Assessment Board (hereinafter referred to as the "Board") which shall formulate and promulgate the policies of the Office, and a Director who shall carry out such policies and administer the operations of the Office.

(c) The basic function of the Office shall be to provide early indications of the probable beneficial and adverse impacts of the applications of technology and to develop other coordinate information which may assist the Congress. In carrying out such function, the Office shall:

(1) identify existing or probable impacts of technology or technological programs;

(2) where possible, ascertain cause-and-effect relationships;

(3) identify alternative technological methods of implementing specific programs;

(4) identify alternative programs for achieving requisite goals;

(5) make estimates and comparisons of the impacts of alternative methods and programs;

(6) present findings of completed analyses to the appropriate legislative authorities;

(7) identify areas where additional research or data collection is required to provide adequate support for the assessments and estimates described in paragraphs (1) through (5) of this subsection; and

(8) undertake such additional associated activities as the appropriate authorities specified under subsection (d) may direct.

(d) Assessment activities undertaken by the Office may be initiated upon the request of:

(1) the chairman of any standing, special, or select committee of either House of the Congress, or of any joint committee of the Congress, acting for himself or at the request of the ranking minority member or a majority of the committee members;

(2) the Board; or

(3) the Director, in consultation with the Board.

(e) Assessments made by the Office, including information, surveys, studies, reports, and findings related thereto, shall be made avail-

able to the initiating committee or other appropriate committees of the Congress. In addition, any such information, surveys, studies, reports, and findings produced by the Office may be made available to the public except where—

(1) to do so would violate security statutes; or

(2) the Board considers it necessary or advisable to withhold such information in accordance with one or more of the numbered paragraphs in section 552(b) of title 5, United States Code.

TECHNOLOGY ASSESSMENT BOARD

SEC. 4 (a) The Board shall consist of thirteen members as follows:

(1) six Members of the Senate, appointed by the President pro tempore of the Senate, three from the majority party and three from the minority party;

(2) six Members of the House of Representatives appointed by the Speaker of the House of Representatives, three from the majority party and three from the minority party; and

(3) the Director, who shall not be a voting member.

(b) Vacancies in the membership of the Board shall not affect the power of the remaining members to execute the functions of the Board and shall be filled in the same manner as in the case of the original appointment.

(c) The Board shall select a chairman and a vice chairman from among its members at the beginning of each Congress. The vice chairman shall act in the place and stead of the chairman in the absence of the chairman. The chairmanship and the vice chairmanship shall alternate between the Senate and the House of Representatives with each Congress. The chairman during each even-numbered Congress shall be selected by the Members of the House of Representatives on the Board from among their number. The vice chairman during each Congress shall be chosen in the same manner from that House of Congress other than the House of Congress of which the chairman is a Member.

(d) The Board is authorized to sit and act at such places and times during the sessions, recesses, and adjourned periods of Congress, and upon a vote of a majority of its members, to require by subpena or otherwise the attendance of such witnesses and the production of such books, papers, and documents, to administer such oaths and affirmations, to take such testimony, to procure such printing and binding, and to make such expenditures, as it deems advisable. The Board may make such rules respecting its organization and pocedures as it deems necessary, except that no recommendation shall be reported from the Board unless a majority of the Board assent. Subpenas may be issued over the signature of the chairman of the Board or of any voting member designated by him or by the Board, and may be served by such person or persons as may be designated by such chairman or member. The chairman of the Board or any voting member thereof may administer oaths or affirmations to witnesses.

DIRECTOR AND DEPUTY DIRECTOR

SEC. 5. (a) The Director of the Office of Technology Assessment shall be appointed by the Board and shall serve for a term of six years

unless sooner removed by the Board. He shall receive basic pay at the rate provided for level III of the Executive Schedule under section 5314 of title 5, United States Code.

(b) In addition to the powers and duties vested in him by this Act, the Director shall exercise such powers and duties as may be delegated to him by the Board.

(c) The Director may appoint with the approval of the Board, a Deputy Director who shall perform such functions as the Director may prescribe and who shall be Acting Director during the absence or incapacity of the Director or in the event of a vacancy in the office of Director. The Deputy Director shall receive basic pay at the rate provided for level IV of the Executive Schedule under section 5315 of title 5, United States Code.

(d) Neither the Director nor the Deputy Director shall engage in any other business, vocation, or employment than that of serving as such Director or Deputy Director, as the case may be; nor shall the Director or Deputy Director, except with the approval of the Board, hold any office in, or act in any capacity for, any organization, agency, or institution with which the Office makes any contract or other arrangement under this Act.

AUTHORITY OF THE OFFICE

SEC. 6. (a) The Office shall have the authority, within the limits of available appropriations, to do all things necessary to carry out the provisions of this Act, including, but without being limited to, the authority to—

(1) make full use of competent personnel and organizations outside the Office, public or private, and form special ad hoc task forces or make other arrangements when appropriate;

(2) enter into contracts or other arrangements as may be necessary for the conduct of the work of the Office with any agency or instrumentality of the United States, with any State, territory, or possession or any political subdivision thereof, or with any person, firm, association, corporation, or educational institution, with or without reimbursement, without performance or other bonds, and without regard to section 3709 of the Revised Statutes (41 U.S.C. 5);

(3) make advance, progress, and other payments which relate to technology assessment without regard to the provisions of section 3648 of the Revised Statutes (31 U.S.C. 529);

(4) accept and utilize the services of voluntary and uncompensated personnel necessary for the conduct of the work of the Office and provide transportation and subsistence as authorized by section 5703 of title 5, United States Code, for persons serving without compensation;

(5) acquire by purchase, lease, loan, or gift, and hold and dispose of by sale, lease, or loan, real and personal property of all kinds necessary for or resulting from the exercise of authority granted by this Act; and

(6) prescribe such rules and regulations as it deems necessary governing the operation and organization of the Office.

(b) Contractors and other parties entering into contracts and other arrangements under this section which involve costs to the Govern-

ment shall maintain such books and related records as will facilitate an effective audit in such detail and in such manner as shall be prescribed by the Office, and such books and records (and related documents and papers) shall be available to the Office and the Comptroller General of the United States, or any of their duly authorized representatives, for the purpose of audit and examination.

(c) The Office, in carrying out the provisions of this Act, shall not, itself, operate any laboratories, pilot plants, or test facilities.

(d) The Office is authorized to secure directly from any executive department or agency information, suggestions, estimates, statistics, and technical assistance for the purpose of carrying out its functions under this Act. Each such executive department or agency shall furnish the information, suggestions, estimates, statistics, and technical assistance directly to the Office upon its request.

(e) On request of the Office, the head of any executive department or agency may detail, with or without reimbursement, any of its personnel to assist the Office in carrying out its functions under this Act.

(f) The Director shall, in accordance with such policies as the Board shall prescribe, appoint and fix the compensation of such personnel as may be necessary to carry out the provisions of this Act.

ESTABLISHMENT OF THE TECHNOLOGY ASSESSMENT ADVISORY COUNCIL

SEC. 7. (a) The Office shall establish a Technology Assessment Advisory Council (hereinafter referred to as the "Council"). The Council shall be composed of the following twelve members:

(1) ten members from the public, to be appointed by the Board, who shall be persons eminent in one or more fields of the physical, biological, or social sciences or engineering or experienced in the administration of technological activities, or who may be judged qualified on the basis of contributions made to educational or public activities;

(2) the Comptroller General; and

(3) the Director of the Congressional Research Service of the Library of Congress.

(b) The Council, upon request by the Board, shall—

(1) review and make recommendations to the Board on activities undertaken by the Office or on the initiation thereof in accordance with section 3(d);

(2) review and make recommendations to the Board on the findings of any assessment made by or for the Office; and

(3) undertake such additional related tasks as the Board may direct.

(c) The Council, by majority vote, shall elect from its members appointed under subsection (a)(1) of this section a Chairman and a Vice Chairman, who shall serve for such time and under such conditions as the Council may prescribe. In the absence of the Chairman, or in the event of his incapacity, the Vice Chairman shall act as Chairman.

(d) The term of office of each member of the Council appointed under subsection (a)(1) shall be four years except that any such member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed for the remainder of such term. No person shall be appointed a member of

the Council under subsection (a)(1) more than twice. Terms of the members appointed under subsection (a)(1) shall be staggered so as to establish a rotating membership according to such method as the Board may devise.

(e)(1) The members of the Council other than those appointed under subsection (a)(1) shall receive no pay for their services as members of the Council, but shall be allowed necessary travel expenses (or, in the alternative, mileage for use of privately owned vehicles and a per diem in lieu of subsistence at not to exceed the rate prescribed in sections 5702 and 5704 of title 5, United States Code), and other necessary expenses incurred by them in the performance of duties vested in the Council, without regard to the provisions of subchapter 1 of chapter 57 and section 5731 of title 5, United States Code, and regulations promulgated thereunder.

(2) The members of the Council appointed under subsection (a)(1) shall receive compensation for each day engaged in the actual performance of duties vested in the Council at rates of pay not in excess of the daily equivalent of the highest rate of basic pay set forth in the General Schedule of section 5332(a) of title 5, United States Code, and in addition shall be reimbursed for travel, subsistence, and other necessary expenses in the manner provided for other members of the Council under paragraph (1) of this subsection.

UTILIZATION OF THE LIBRARY OF CONGRESS

SEC. 8. (a) To carry out the objectives of this Act, the Librarian of Congress is authorized to make available to the Office such services and assistance of the Congressional Research Service as may be appropriate and feasible.

(b) Such services and assistance made available to the Office shall include, but not be limited to, all of the services and assistance which the Congressional Research Service is otherwise authorized to provide to the Congress.

(c) Nothing in this section shall alter or modify any services or responsibilities, other than those performed for the Office, which the Congressional Research Service under law performs for or on behalf of the Congress. The Librarian is, however, authorized to establish within the Congressional Research Service such additional divisions, groups, or other organizational entities as may be necessary to carry out the purpose of this Act.

(d) Services and assistance made available to the Office by the Congressional Research Service in accordance with this section may be provided with or without reimbursement from funds of the Office, as agreed upon by the Board and the Librarian of Congress.

UTILIZATION OF THE GENERAL ACCOUNTING OFFICE

SEC. 9. (a) Financial and administrative services (including those related to budgeting, accounting, financial reporting, personnel, and procurement) and such other services as may be appropriate shall be provided the Office by the General Accounting Office.

(b) Such services and assistance to the Office shall include, but not limited to, all of the services and assistance which the General Accounting Office is otherwise authorized to provide to the Congress.

(c) Nothing in this section shall alter or modify any services or responsibilities, other than those performed for the Office, which the General Accounting Office under law performs for or on behalf of the Congress.

(d) Services and assistance made available to the Office by the General Accounting Office in accordance with this section may be provided with or without reimbursement from funds of the Office, as agreed upon by the Board and the Comptroller General.

COORDINATION WITH THE NATIONAL SCIENCE FOUNDATION

SEC. 10. (a) The Office shall maintain a continuing liaison with the National Science Foundation with respect to—

(1) grants and contracts formulated or activated by the Foundation which are for purposes of technology assessment; and

(2) the promotion of coordination in areas of technology assessment, and the avoidance of unnecessary duplication or overlapping of research activities in the development of technology assessment techniques and programs.

(b) Section 3(b) of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1862(b)), is amended to read as follows:

"(b) The Foundation is authorized to initiate and support specific activities in connection with matters relating to international cooperation, national security, and the effects of scientific applications upon society by making contracts or other arrangements (including grants, loans, and other forms of assistance) for the conduct of such activities. When initiated or supported pursuant to requests made by any other Federal department or agency, including the Office of Technology Assessment, such activities shall be financed whenever feasible from funds transferred to the Fundation by the requesting official as provided in section 14(g), and any such activities shall be unclassified and shall be identified by the Foundation as being undertaken at the request of the appropriate official."

ANNUAL REPORT

SEC. 11. The Office shall submit to the Congress an annual report which shall include, but not be limited to, an evaluation of technology assessment techniques and identification, insofar as may be feasible, of technological areas and programs requiring future analysis. Such report shall be submitted not later than March 15 of each year.

APPROPRIATIONS

SEC. 12. (a) To enable the Office to carry out its powers and duties, there is hereby authorized to be appropriated to the Office, out of any money in the Treasury not otherwise appropriated, not to exceed $5,000,000 in the aggregate for the two fiscal years ending June 30, 1973, and June 30, 1974, and thereafter such sums as may be necessary.

(b) *Appropriations made pursuant to the authority provided in subsection (a) shall remain available for obligation, for expenditure, or for obligation and expenditure for such period or periods as may be specified in the Act making such appropriations.*

And the Senate agree to the same.

GEORGE P. MILLER,
JOHN W. DAVIS,
EARLE CABELL,
CHARLES A. MOSHER,
MARVIN L. ESCH,
Managers on the Part of the House.

HOWARD W. CANNON,
ROBERT C. BYRD,
Managers on the Part of the Senate.

JOINT EXPLANATORY STATEMENT OF THE COMMITTEE OF CONFERENCE

The managers on the part of the House and the Senate at the conference on the disagreeing votes of the two Houses on the amendment of the Senate to the bill (H.R. 10243) to establish an Office of Technology Assessment for the Congress as an aid in the identification and consideration of existing and probable impacts of technological application; to amend the National Science Foundation Act of 1950, and for other purposes, submit the following joint statement to the House and the Senate in explanation of the effect of the action agreed upon by the managers and recommended in the accompanying conference report:

The amendment of the Senate struck out all after the enacting clause in the House bill and substituted new language. The Committee of Conference agreed to accept the Senate amendment with certain amendments and stipulations proposed by the conferees.

The substantive changes made by the Senate amendment, together with further amendments and modifications by the Committee of Conference, are as follows:

Section 2

Language in the Declaration of Purpose was altered slightly for clarification. No substantive changes were made.

Section 3

With regard to the initation of assessment activities by the Office of Technology Assessment (OTA), the House bill authorized such initiation (1) by the chairmen of Congressional committees acting for themselves, the ranking minority member, or upon the request of a majority of the committee, or (2) by the Technology Assessment Board (The Board). The Senate amendment authorized the Director of the Office to take similar action, but only in consultation with the Board. In this, the Managers on the part of the House concurred, believing that the Director will be in a particularly favorable position to ascertain the need for certain assessments well in advance of the time when they become critical issues the Congress must face. This factor of timing was considered by the conferees to be of marked importance.

The House bill stipulated that all assessments and findings of the Office should eventually be made available to the public except where national security or the Freedom of Information Act might be violated. The Senate amendment placed this decision at the discretion of the Board on the grounds that the Congressional committees for whom the assessments were made conceivably would need the option of whether or not to publish. The House conferees concurred.

Section 4

The make-up of the Technology Assessment Board in the House bill consisted of 10 members of Congress, 5 from each House, to be appointed by the Speaker of the House of Representatives and the President Pro Tempore of the Senate, 3 from the majority party and 2 from the minority party. The Senate amendment provided that the Board consist of 13 members, 6 from each House appointed as previously described, 3 from the majority party and 3 from the minority party. The Senate amendment also added the Director of the Office as a non-voting member of the Board. The House conferees agreed. Since the OTA is intended to be an independent office within the Legislative Branch designed to serve all committees and all members, the make-up of the policy-making board should be bipartisan. The addition of the Director will guarantee that he is privy to all Board actions without permitting him to share in the making of policy for the OTA.

The Senate amendment added a routine provision empowering the Board to sit and act at such places and times as are ordinarily authorized the various committees of the Congress. It also authorized the Board, but only the Board, to subpena witnesses and materials upon the approval of a majority of the Board members. House conferees recommended that subpenas should not be issued over the signature of anyone who is not a voting member of the Board. This action was designed to assure that the subpena power could not be transferred to the Director or any person not an elected member of Congress. The Senate conferees concurred in the House position.

Section 5

The House bill authorized the pay level for the Director of the Office at Level II of the Executive Schedule and the pay level of the Deputy Director at Level III of the Executive Schedule. The Senate amendment lowered these scales for the Director to Level III ($40,000) and for the Deputy Director to Level IV ($38,000). The Managers on the part of the House concurred with this amendment since the original levels would have placed the Director on the same pay scale as members of Congress, who are the employers of the Director and his staff.

Section 6

In the House bill, provisions concerning audit of parties entering into contracts with the Office and the securing of information from executive departments were described as functions of the Director. The Senate amendment placed these functions under the Office as a whole. The House conferees concurred in this change.

The Senate amendment added a clause authorizing the head of any executive department or agency to provide personnel assistance to the OTA in the event of such need. The House conferees concurred in this addition.

The House bill provided that OTA employees be subject to the provisions of Title 5 of the United States Code governing appointments in the competitive service, classification, and pay rates. The Senate amendment deleted this section on the grounds that these provisions of the Code do not apply to employees of the Congress. The

House conferees concurred in this view. The intent of the conference is to have OTA staff considered as Congressional Staff.

Section 7

The Senate amendment established a new Technology Assessment Advisory Council in order to assist the Board. It was considered that such a Council, composed largely of members of the public, was essential since the bill as passed by the House had eliminated any public members from the Board itself. The Council, which is composed of 10 members from the public who are selected by the Board, plus the Comptroller General and the Director of the Congressional Research Service of the Library of Congress, would undertake reviews and recommendations concerning OTA activities, under the Senate amendment.

The Managers on the part of the House concurred in the need for the Council, but recommended that the Council should also be empowered to undertake such additional related tasks as the Board might direct. In this, the Managers on the part of the Senate agreed.

Section 8

The Senate amendment eliminated a number of specific services to be provided by the Congressional Research Service of the Library of Congress which the House bill had included. The Managers on the part of the House concurred in this change, since the language deleted imposed detailed functions on the Congressional Research Service which should be left to the discretion of the Board.

Section 9

The House Act specified that certain supporting services be provided to the OTA by the General Accounting Office upon agreement between the Comptroller General and the Board. The Senate amendment added a clause authorizing the Comptroller General to establish within GAO such additional administrative and organizational entities as might be considered necessary in carrying out this function.

Managers on the part of the House recommended the deletion of this clause. While similar language had been approved by the House in regard to services to be provided by the Congressional Research Service, House conferees pointed out that the Congressional Research Service provides services exclusively to the Congress while the functions of the General Accounting Office are much broader. Therefore, the inclusion of the additional authority with regard to the General Accounting Office might go beyond the intent of the Act. The Managers on the part of the Senate concurred with the House view.

Section 10

No change was made in this section. However, the conferees emphasize that the language in this Act amending the National Science Foundation Act of 1950, as amended, which is designed to stimulate liaison between the OTA and the National Science Foundation, is not intended to restrict the discretion of the National Science Foundation in deciding whether or not to support programs requested by either the OTA or other agencies.

Section 11

No change other than minor rephrasing aimed at clarification.

Section 12

The House bill provided authorization for the OTA not to exceed $5 million in the aggregate for fiscal years 1973 and 1974. The Senate amendment followed this provision but provided for continuing authorization after that time. The Managers on the part of the House concurred in the Senate Amendment.

House conferees considered that it would be unwise to require authorization each year for any entity within the Legislative Branch. To do so could mean a considerable delay in moving the annual Legislative Appropriation Act through the Congress. The imposition of such a burden, which does not presently exist, on the appropriation process for the Legislative Branch, has therefore been avoided.

Section 13

The House bill contained no specific provision for an effective date. The Senate amendment added a new section which would have made the Act effective and the appointment of members of the Board mandatory within 60 days of the final approval of the Act.

Managers on the part of the House disagreed with this section. Since it is anticipated that the passage of this Act will occur near the end of the 92nd Congress, deletion of this section provides for flexibility of timing in the appointment of Members to the Board by the Speaker of the House of Representatives and the President Pro Tempore of the Senate as provided in Section 4 of the Act. Managers on the part of the Senate concurred with the House position and this section was deleted.

GEORGE P. MILLER,
JOHN W. DAVIS,
EARLE CABELL,
CHARLES A. MOSHER,
MARVIN L. ESCH,
Managers on the Part of the House.

HOWARD W. CANNON,
ROBERT C. BYRD,
Managers on the Part of the Senate.

○

Calendar No. 977

92D CONGRESS
2d Session

SENATE

REPORT
No. 92-1028

NATIONAL SCIENCE POLICY AND PRIORITIES ACT OF 1972

AUGUST 9, 1972.—Ordered to be printed

Mr. KENNEDY, from the Committee on Labor and Public Welfare, submitted the following

REPORT

together with

SUPPLEMENTAL VIEWS

[To accompany S. 32]

The Committee on Labor and Public Welfare, to which was referred the bill (S. 32) to authorize the National Science Foundation to conduct research, education, and assistance programs to prepare the country for conversion from defense to civilian, socially oriented research and development activities, and for other purposes, having considered the same, reports favorably thereon, with an amendment in the nature of a substitute and a title amendment, and recommends that the bill, as amended, do pass.

COMMITTEE AMENDMENTS

The amendments are as follows:

That this Act may be cited as the "National Science Policy and Priorities Act of 1972".

DECLARATION OF POLICY

SEC. 2. (a) The Congress hereby finds that—

(1) Federal funding for science and technology represents an investment in the future, which is indispensable to sustained national progress;

(2) the manpower pool of scientists and engineers constitutes an invaluable national resource which should be utilized to the maximum extent possible at all times;

83-010—72——1

(3) the Nation's scientific resources can contribute significantly to meeting America's human needs in such priority problem areas as health care, poverty, public safety, pollution, unemployment, productivity, housing, education, transportation, nutrition, communications, and energy resources; and

(4) at this time of maximum need, much of the Nation's technical talent is being wasted or misapplied because of inadequate programs of civilian science and technology.

(b) The Congress declares that it is the continuing policy and responsibility of the Federal Government to take appropriate measures directed toward achieving the following goals—

(1) the total Federal investment in science and technology must be raised to an expenditure level which is adequate to the needs of the Nation, and then continue to increase annually in proportion to the growth in the gross national product, or at a rate which is greater than such growth;

(2) scientists, engineers, and technicians must have continuing opportunities for socially useful employment in positions commensurate with their professional, technical capabilities;

(3) Federal obligations for civilian research and engineering activities must be increased so as to reach a level of parity with Federal obligations for defense research and engineering activities, whereupon the level of parity must be maintained or exceeded, except when inconsistent with overriding considerations of national security; and

(4) Federal programs for civilian research and engineering must be focused on meeting the human needs of the Nation in such priority problem areas as health care, poverty, public safety, pollution, unemployment, productivity, housing, education, transportation, nutrition, communications, and energy resources.

TITLE I—SCIENCE POLICY AND PRIORITIES FOR CIVILIAN RESEARCH AND ENGINEERING

SHORT TITLE

SEC. 101. This title may be cited as the "Science Policy Act".

AUTHORITY OF THE NATIONAL SCIENCE FOUNDATION

SEC. 102. Section 3 of the National Science Foundation Act of 1950 is amended by striking out subsection (d) and inserting in lieu thereof the following:

"(d) The Foundation shall recommend and encourage the pursuit of national policies designed to foster research and education in science and engineering, and the application of scientific and technical knowledge to the solution of national problems."

RESEARCH AND ENGINEERING PRIORITIES

SEC. 103. (a) The Foundation shall identify priority areas of civilian research and engineering likely to contribute to the resolution of national problems in areas such as health care, poverty, public safety, pollution, unemployment, housing, education, transportation, nutrition, communications, and energy resources. In making such identifications, the Foundation shall—

(1) take account of the results of its programs conducted or assisted under section 207;

(2) consult with appropriate scientific and technical organizations such as the National Academy of Sciences, the National Academy of Engineering, and the National Institute of Medicine; and

(3) coordinate and correlate its activities with respect to such identification with other agencies of the Federal Government undertaking programs relevant to these problems.

(b) From funds available pursuant to section 107, the Foundation may employ by grant or contract such consulting services as it deems necessary to carry out the functions assigned to the Foundation under this section.

RESEARCH PROGAM

SEC. 104. From funds available pursuant to section 107, the Foundation is authorized to make grants to, or enter into contracts with, appropriate organizations for the conduct of basic and applied research and engineering designed to advance the scientific and technical state-of-the-art in such priority areas as are identified under section 103.

NATIONAL SCIENCE BOARD

SEC. 105. Section 4 of the National Science Foundation Act of 1950 is amended—

(1) by inserting before the period at the end of subsection (a) a comma and the following: "within the framework of applicable national policies as set forth by the President and the Congress" and

(2) by striking out subsection (c) and inserting in lieu thereof the following:

"(c) The persons nominated for appointment as members of the Board (1) shall be eminent in the fields of science, social science, engineering, agriculture, industry, education, or public affairs; (2) shall be selected solely on the basis of established records of distinguished service, and (3) shall be so selected as to provide representation of the views of leaders from a diversity of fields from all areas of the Nation. The President is requested, in the making of nominations of persons for appointment as members, to give due consideration to any recommendations for nomination which may be submitted to him by the National Academy of Sciences, the National Academy of Engineering, the National Association of State Universities and Land-Grant Colleges, the Association of American Universities, the Association of American Colleges, the Association of State Colleges and Universities, or by other scientific, technical, or educational associations."

POLICY APPRAISAL AND REPORTING

SEC. 106. In order to carry out the purposes of this Act, the National Science Foundation shall—

(1) analyze information regarding Federal expenditures for research and engineering activities, and the employment and availability of scientific, engineering, and technical manpower, which the Foundation has assembled pursuant to paragraphs (1), (5), (6), and (7) of section 3(a) of the National Science Foundation Act of 1950 in order to appraise the implementation of the policies set forth in section 2 of this Act:

(2) develop and recommend to the President and the Congress programs and activities which will contribute to carrying out the policies set forth in section 2 of this Act; and

(3) prepare and submit to the President for transmittal to the Congress not later than January 31 of each calendar year, a report on its activities under this Act and an appraisal of the extent to which the policies set forth in section 2 are being successfully implemented, together with such recommendations, including recommendations for additional legislation, as it deems appropriate.

AUTHORIZATION OF APPROPRIATIONS

SEC. 107. (a) To carry out the provisions of sections 103 and 104 of this title, there are authorized to be appropriated $10,000,000 for the fiscal year ending June 30, 1973, $15,000,000 for the fiscal year ending June 30, 1974, and $25,000,000 for the fiscal year ending June 30, 1975.

(b) Funds appropriated pursuant to subsection (a) of this section shall remain available for obligation, for expenditure, or for obligation and expenditure, for such period or periods as may be specified in Acts making such appropriations.

TITLE II—DESIGN AND DEMONSTRATION OF CIVIL SCIENCE SYSTEMS

SHORT TITLE

SEC. 201. This title may be cited as the "Civil Science Systems Act".

AUTHORITY OF THE NATIONAL SCIENCE FOUNDATION

SEC. 202. (a)(1) The Foundation is authorized to initiate and support programs which use science, technology, and advanced analytical techniques, such as systems analysis, to design civil science systems which are capable of providing improved public services in such areas as health care delivery, public safety, public sanitation, pollution control, housing, transportation, public utilities, communications, and education.

(2) The Foundation, insofar as is practicable, is authorized and directed to develop alternative civil science systems in order to promote a wider range of choice for the application of such systems.

(b) The Foundation is authorized to initiate and support the public demonstration of civil science systems which have been designed under this title.

(c) Section 5(e) of the National Science Foundation Act of 1950 is amended by adding at the end thereof the following new sentence: "The provisions of this subsection shall not apply to the authority granted to the Director under title II of the National Science Policy and Priorities Act of 1972."

PROGRAMS AUTHORIZED

SEC. 203. In order to carry out the purposes of this title, the Foundation is authorized and directed to—

(a) initiate and support programs of applied research and experimentation, in order to design civil science systems capable of providing improved public services;

(b) test and evaluate the alternative civil science systems designed under this title, and appraise the results of such tests in terms of

applicable technical, environmental, economic, social, and esthetic factors;

(c) disseminate and demonstrate the results of programs conducted or assisted under this title so that such civil science systems may be effectively utilized in the development of new communities, and in the improvement of living conditions in existing communities; and

(d) assure that the programs conducted or assisted under this title make maximum effective use of the Nation's scientists, engineers, and technicians, including those who are unemployed.

ESTABLISHMENT OF THE CIVIL SCIENCE SYSTEMS ADMINISTRATION

SEC. 204. There is hereby established within the National Science Foundation, the Civil Science Systems Administration to administer Federal programs carried out under this title.

ADMINISTRATION OFFICERS

SEC. 205. (a) The Administration shall be headed by an Associate Director for Civil Science Systems who shall be appointed by the President by and with the advice and consent of the Senate.

(b) The functions of the Director under this title and any other functions of the Civil Science Systems Administration shall be carried out through the Administration by the Associate Director, who shall be responsible to and report to the Director.

(c) There shall be a Deputy Associate Director for Civil Science Systems who shall be appointed by the President, by and with the advice and consent of the Senate, and shall perform such duties and exercise such powers as the Associate Director may prescribe. The Deputy Associate Director shall act for, and exercise the powers of, the Associate Director during the absence or disability of the Associate Director or in the event of a vacancy in the office of Associate Director.

(d) There shall be two Assistant Directors for Civil Science Systems who shall be appointed by the President, by and with the advice and consent of the Senate, and shall perform such duties and exercise such powers as the Associate Director shall prescribe, with the stipulation that one Assistant Director shall be responsible for advising and assisting the Associate Director with respect to the engineering and technical aspects of the Administration's programs, and the other Assistant Director shall be responsible for advising and assisting the Associate Director with respect to the behavioral and social science aspects of the Administration's programs.

(e)(1) Section 5314 of title 5, United States Code, is amended by adding at the end thereof the following new paragraph:

"(58) The Associate Director for Civil Science Systems of the National Science Foundation."

(2) Section 5315 of title 5, United States Code, is amended by adding at the end thereof the following new paragraph:

"(95) The Deputy Associate Director for Civil Science Systems of the National Science Foundation."

(3) Section 5316 of title 5, United States Code, is amended by adding at the end thereof the following new paragraph:

"(131) Assistant Directors for Civil Science Systems of the National Science Foundation."

(f) Section 14 of the National Science Foundation Act of 1950 is amended by striking out subsection (b) and inserting in lieu thereof the following:

"(b) Neither the Director, the Deputy Director, the Associate Director, the Deputy Associate Director, nor any Assistant Director shall engage in any other business, vocation, or employment while serving in such position; nor shall the Director, the Deputy Director, the Associate Director, the Deputy Associate Director, or any Assistant Director, except with the approval of the Board, hold any office in, or act in any capacity for, any organization, agency, or institution with which the Foundation makes any grant, contract, or other arrangement under this Act."

CIVIL SCIENCE SYSTEMS ADVISORY COUNCIL

SEC. 206. (a) There is hereby established a Civil Science Systems Advisory Council to be composed of thirty-one members, of whom eighteen members shall be appointed by the Director for terms of three years, and thirteen shall be ex officio members designated in subsection (c) of this section. Appointed members shall be chosen from among persons who have, by reason of experience or accomplishments, demonstrated their qualifications to serve on the Council, in equal numbers from among the following categories—

1. business;
2. labor;
3. engineers, design professionals, and natural scientists;
4. social and behavioral scientists;
5. environmental and other community groups; and
6. consumers.

(b)(1) Of the members first appointed, six shall be appointed for a term of one year, six shall be appointed for a term of two years, and six shall be appointed for a term of three years, as designated by the Director at the time of appointment.

(2) Any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed only for the remainder of such term. Members shall be eligible for reappointment and may serve after the expiration of their terms until their successors have taken office.

(3) Any vacancy on the Council shall not affect its powers, but shall be filled in the same manner by which the original appointment was made.

(4) Each appointed member of the Council shall, while serving on business of the Council, be entitled to receive compensation at a rate not to exceed the daily rate prescribed for GS–18 of the General Schedule under section 5332 of title 5, United States Code, including traveltime, and while so serving away from their homes or regular places of business, they may be allowed travel expenses, including per diem in lieu of subsistence, in the same manner as the expenses authorized by section 5703(b) of title 5, United States Code, for person in the Government service employed intermittently.

(5) The Council shall annually elect one of its members to serve as Chairman until the next election. The Council shall meet at the call of the Chairman, but not less often than four times a year.

(6) Eleven of the voting members of the Council shall constitute a quorum necessary for the transaction of official business.

(c) *The Associate Director for Civil Science Systems; the Assistant Secretary of Commerce for Science and Technology; the Assistant Secretary of Health, Education, and Welfare for Health and Scientific Affairs; the Assistant Secretary of Housing and Urban Development for Research and Technology; the Administrator of the National Aeronautics and Space Administration; the Chairman of the Atomic Energy Commission; the Assistant Secretary of Transportation for Systems Development and Technology; the Administrator of the Environmental Protection Agency; the Director of the Office of Economic Opportunity; and the Chairman of the Council on Environmental Quality shall be nonvoting ex officio members of the Council.*

(d) *A representative designated by the National Governors Conference; a representative designated by the National Association of Counties; and a representative jointly designated by the National League of Cities and the United States Conference of Mayors shall be voting ex officio members of the Council.*

(e) *The Council shall—*

(1) advise the Director with respect to the discharge of his responsibilities under this title;

(2) review and evaluate the effectiveness of Federal programs under this title;

(3) prepare and submit to the Director and the National Science Board such interim reports as it deems advisable, and an annual report of its findings and recommendations, together with any recommendations for changes in the provisions of this title; and

(4) disseminate its findings and recommendations to such extent and in such manner as it deems effective and advisable.

(f) *The Director shall make available to the Council such staff, information, and other assistance as it may require to carry out its activities.*

PLANNING FOR CIVIL SCIENCE SYSTEMS

SEC. 207. (a) *From funds available pursuant to section 214, the Director is authorized to conduct planning studies, to transfer funds to other departments and agencies of the Federal Government, and make grants to, or to enter into contracts with, academic institutions, nonprofit institutes and organizations, State, regional, and local governmental agencies, and private business firms, for the conduct of planning studies for the design and demonstration of civil science systems capable of providing improved public services. Such studies will—*

(1) be directed toward the objective of designing, testing, evaluating, and demonstrating civil science systems for subsequent incorporations in new communities, and for subsequent use, with appropriate adaptations, in existing communities;

(2) include long-range planning studies as well as intermediate and short-range studies;

(3) make maximum use of the results of activities undertaken under sections 103 and 104 and the scientific and technical information provided under section 211;

(4) encompass studies of a wide range of public service areas, including but not limited to health care, public safety, public sanitation pollution control, housing, transportation, public utilities, communications, and education;

(5) include specific studies of the economic, sociological, psychological, legal, administrative, and political factors which affect the

design, development, and implementation of civil science systems to provide public services;

(6) include total civil systems studies which integrate the specific studies carried out under paragraphs (4) and (5) of this subsection.

(b) In delineating the goals and establishing the priorities for such planning studies as are conducted under subsection (a) of this section, the Director shall consult with the Civil Science Systems Advisory Council.

APPLIED SOCIAL RESEARCH

SEC. 208. (a) From funds available pursuant to section 214, the Director is authorized to transfer funds to other departments and agencies of the Federal Government, and to make grants to, and to enter into contracts with academic institutions, nonprofit institutes and organizations, public agencies, and private business firms, for the conduct of applied social research into the economic, sociological, political, legal, administrative, and psychological aspects of the design, development, and implementation of civil science systems capable of providing improved public services.

(b) The scientific information which is currently available in these areas and which is generated as a result of the research undertaken under this section shall be fully taken into account by the Foundation in the development of programs and the design and evaluation of civil science systems under this title.

(c) In making grants or entering into contracts under this section, the Director shall take appropriate account of the results of the planning studies conducted or assisted under section 207.

CIVIL SCIENCE SYSTEM RESEARCH AND DESIGN

SEC. 209. (a) From funds available pursuant to section 214, the Director is authorized to transfer funds to other departments and agencies of the Federal Government, and to make grants to, and to enter into contracts with, academic institutions, nonprofit institutes and organizations, public agencies, and private business firms, for research with respect to, and design of, civil science systems capable of providing improved public services in areas such as health care, public safety, public sanitation, pollution control, housing, transportation, public utilities, communication, and education.

(b) In making grants or entering into contracts under this section, the Director shall take appropriate account of the results of the planning studies conducted or assisted under section 207, and the applied social research studies conducted or assisted under section 208.

(c) Each contract awarded under this section shall contain provisions which assure that specific performance objectives, and any applicable physicial, environmental, economic, social, and esthetic constraints are specified with particularity for each project conducted under said contract.

(d) To assure that civil science systems designed under this section are responsive to public needs and desires, the Director shall obtain community and public views in his determination of the performance objectives and priorities to be met by such systems.

TESTING AND EVALUATION

SEC. 210. (a)(1) From funds available pursuant to section 214, the Director is authorized to transfer funds to other departments and agencies

of the Federal Government, and to make grants to, and to enter into contracts with, academic institutions, nonprofit institutes and organizations, State, regional, and local governmental agencies, and private business firms for testing and evaluating civil science systems which make use of advanced science and technology.

(2) Such testing and evaluation shall utilize all available, applicable analytical techniques, such as computer simulation, systems analysis, and technology assessment, to test and appraise such systems in terms of their conformance to performance objectives; adherence to stipulated constraints; costs and ancillary consequences; impact on the environment; impact on esthetic values; responsiveness to public needs and desires; and their comparison with alternative civil science systems which may provide similar public services.

(b) From funds available pursuant to section 214, the Director is authorized and directed to carry out final evaluations of civil science systems which make use of advanced science and technology, taking appropriate account of the results of the tests conducted or assisted under subsection (a) of this section, and the results of the applied social research conducted or assisted under section 208.

(c) In making grants or entering into contracts under this section, the Director shall take account of the results of the planning studies conducted or assisted under section 207.

INFORMATION DISSEMINATION

SEC. 211. From funds available pursuant to section 214, the Director is authorized to establish a computerized Civil Science Systems Information Service, which shall collect and integrate the scientific, technical, and social information pertaining to civil science systems resulting from programs under this title, and shall provide such information to interested organizations in Federal, State, and local government, industry, academic institutions, and the nonprofit sector, upon request from such organizations, in accordance with such administrative procedures as are established by the Director.

SYSTEMS DEMONSTRATION

SEC. 212. (a) From funds available pursuant to section 214, the Director is authorized to transfer funds to other departments and agencies of the Federal Government, and to make grants to, and to enter into contracts with, academic institutions, nonprofit institutes and organizations, State, regional, and local governmental agencies, and private business firms, for the construction and public exhibition of civil science systems demonstration projects, which illustrate the functioning and associated benefits of alternative, effective civil science systems resulting from research and design activities conducted or assisted under this title.

(b) Such grants or contracts shall contain provisions which assure that such demonstration projects include—

(1) accurate and complete representations of the civil science systems involved in the demonstration, indicating the improved public services which they are capable of providing; and

(2) public exhibitions which are announced in advance and are open for inspection by any interested organization or individual in accordance with such administrative procedures as are prescribed by the Foundation.

(c) Prior to entering into any demonstration project grant or contract, the Director will consult with all State and local governments in whose jurisdictions such demonstration may occur, and will take account of the views of such governments in determining to award such a grant or contract.

COORDINATION WITH OTHER GOVERNMENT AGENCIES

SEC. 213. In planning and conducting or assisting programs under this title, the Director shall maintain continuing consultation and coordination with appropriate Federal, State, regional, and local governmental agencies, including, but not limited to, the Departments of Commerce; Health, Education, and Welfare; Housing and Urban Development; and Transportation; the Council on Environmental Quality; the National Aeronautics and Space Administration; the Atomic Energy Commission; the Office of Economic Opportunity; the Environmental Protection Agency; the National Governors Conference; the National Association of Counties; the United States Conference of Mayors; and the National League of Cities. Such consultation and coordination shall be carried out through the Council established under section 206, and through appropriate staff contacts at other levels of the agencies involved.

AUTHORIZATION OF APPROPRIATIONS

SEC. 214. (a) To carry out the provisions of this title, there are authorized to be appropriated $200,000,000 for the fiscal year ending June 30, 1973, of which $25,000,000 shall be available to carry out the provisions of section 207, $30,000,000 shall be available to carry out the provisions of section 208, $120,000,000 shall be available to carry out the provisions of section 209, $15,000,000 shall be available to carry out the provisions of section 210, $5,000,000 shall be available to carry out the provisions of section 211, and $5,000,000 shall be available to carry out the provisions of section 212; $400,000,000 for the fiscal year ending June 30, 1974, of which $20,000,000 shall be available to carry out the provisions of section 207, $50,000,000 shall be available to carry out the provisions of section 208, $270,000,000 shall be available to carry out the provisions of section 209, $30,000,000 shall be available to carry out the provisions of section 210, $10,000,000 shall be available to carry out the provisions of section 211, and $20,000,000 shall be available to carry out the provisions of section 212; and $600,000,000 for the fiscal year ending June 30, 1975, of which $10,000,000 shall be available to carry out the provisions of section 207, $60,000,000 shall be available to carry out the provisions of section 208, $400,000,000 shall be available to carry out the provisions of section 209, $60,000,000 shall be available to carry out the provisions of section 210, $15,000,000 shall be available to carry out the provisions of section 211, and $55,000,000 shall be available to carry out the provisions of section 212.

(b) Funds appropriated pursuant to subsection (a) of this section shall remain available for obligation, for expenditure, or for obligation and expenditure, for such period or periods as may be specified in Acts making such appropriations.

TITLE III—TRANSITION OF TECHNICAL MANPOWER TO CIVILIAN PROGRAMS

SHORT TITLE

SEC. 301. This title may be cited as the "Technical Manpower Transition Act".

AUTHORITY OF THE NATIONAL SCIENCE FOUNDATION

SEC. 302. The Foundation is authorized to plan and assist in the transition of scientific and technical manpower from research and engineering programs which have been terminated or significantly reduced to other civilian-oriented research and engineering activities.

ADVISORY PANEL ON TRANSITION OF SCIENTIFIC AND TECHNICAL MANPOWER TO CIVILIAN PROGRAMS

SEC. 303. (a) There is hereby established an Advisory Panel on Transition of Scientific and Technical Manpower to Civilian Programs to be composed of thirty-one members, of whom eighteen members shall be appointed by the Director for terms of three years, and of thirteen ex officio members designated in subsection (c) of this section. Appointed members shall be chosen from among persons who have, by reason of experience or accomplishments, demonstrated their qualifications to serve on the Panel, in equal numbers from the following categories:

(1) Engineering and natural sciences, including the environmental sciences;

(2) Economics and social sciences;

(3) Industry;

(4) Labor;

(5) Public affairs, education, and manpower training; and

(6) Unemployed or underemployed scientists, engineers, and technicians.

(b) (1) Of the members first appointed, six shall be appointed for a term of one year, six shall be appointed for a term of two years, and six shall be appointed for a term of three years, as designated by the Director at the time of appointment.

(2) Any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed only for the remainder of such term. Members shall be eligible for reappointment and may serve after the expiration of their terms until their successors have taken office.

(3) Any vacancy on the Panel shall not affect its powers, but shall be filled in the same manner by which the original appointment was made.

(4) Each appointed member of the Panel shall, while serving on business of the Panel, be entitled to receive compensation at a rate not to exceed the daily rate prescribed for GS–18 of the General Schedule under section 5332 of title 5, United States Code, including traveltime, and while so serving away from their homes or regular places of business, they may be allowed travel expenses, including per diem in lieu of subsistence, in the same manner as the expenses authorized by section 5703(b) of title 5, United States Code, for persons in the Government service employed intermittently.

(5) Eleven of the voting members of the Panel shall constitute a quorum necessary for the transaction of official business.

(c) The Panel shall annually elect one of its appointed members to serve as chairman until the next election. The Panel shall meet at the call of the chairman, but not less often than four times a year. The Associate Director for Civil Science Systems; the Chairman of the Council of Economic Advisers; the Assistant Secretary of Commerce for Science and Technology; the Assistant Secretary of Labor for Manpower; the Assistant Director for Economic Affairs of the United States Arms Control and Disarmament Agency; the Administrator of the National Aeronautics and Space Administration; the Director of Defense Research and Engineering; the Chairman of the Atomic Energy Commission; the Commissioner of Education; and the Assistant Secretary of Health, Education, and Welfare for Health and Scientific Affairs shall be ex officio nonvoting members of the Panel.

(d) A representative designated by the National Governors Conference; a representative designated by the National Association of Counties; and a representative jointly designated by the National League of Cities and the United States Conference of Mayors shall be voting ex officio members of the Panel.

(e) The Panel shall—

(1) advise the Director, with respect to the discharge of his responsibilities under this title;

(2) review and evaluate the effectiveness of Federal programs under this title;

(3) prepare and submit such interim reports as it deems advisable, and an annual report of its findings and recommendations, together with any recommendation for changes in the provisions of this title; and

(4) disseminate its findings and recommendations to such extent and in such manner as it deems effective and advisable.

(f) The Director shall make available to the Panel such staff, information, and other assistance as it may require to carry out its activities.

RESEARCH ON TRANSITION TO CIVILIAN PROGRAMS

SEC. 304. From funds available pursuant to section 313, the Foundation is authorized to—

(1) make grants to, or to enter into contracts with, academic institutions, nonprofit institutes and organizations, public agencies, and private business firms, for the conduct of research designed to study and appraise the social, economic, and managerial aspects of transition from defense research and engineering activities to civilian-oriented research and engineering activities; and

(2) disseminate publicly, or enter into contracts with academic institutions, nonprofit institutes and organizations, public agencies, and private business firms for the public dissemination of, the significant results of such research conducted under subsection (1) of this section, as appear likely to aid in the transition from defense research and engineering activities to civilian-oriented research and engineering activities, particularly those directed toward the resolution of priority national problems, as identified under section 103.

ASSISTANCE TO STATE AND LOCAL GOVERNMENTS

SEC. 305. (a) From funds available pursuant to section 313, the Foundation is authorized to make grants to State and local governments and regional governmental agencies for—

(1) the conduct of programs at the State, local, or regional level, which are designed to facilitate the transition of scientific and technical activities to civilian programs within the particular State, local, or regional areas; and

(2) the hiring of currently unemployed or underemployed scientists engineers, and technicians to work within State, local, or regional governmental agencies in positions which utilize their technical skills.

(b) The Director shall prescribe applicable salary rates for different types of technical positions in different areas of the country, none of which shall exceed the rate paid a person occupying grade GS–13, step 1.

(c) No one hired by a State, local, or regional governmental agency under this section may—

(1) receive compensation from Federal funds at a rate which exceeds the applicable rate as set by the Director; or

(2) remain in a position compensated under this section for a period in excess of two years.

TRAINING GOVERNMENT OFFICIALS

SEC. 306. (a) From funds available pursuant to section 313, the Foundation is authorized to make grants to, and to enter into contracts with, academic institutions, nonprofit institutes and organizations, and private business firms, for the purpose of their planning, developing, strengthening, or operating training programs for officers and employees of Federal, State, and local government who will be responsible for, or participate in, determining or administering government-assisted or conducted programs for civilian, socially oriented research and engineering activities.

(b) Such training programs will be directed at (1) acquainting the program participants with the potential contributions of science and technology to the resolution of public problems in such priority areas as are identified pursuant to this Act; and (2) teaching such participants how to utilize scientific and technical talent in an effective and economical manner.

(c) Organizations conducting such training programs may not charge any fee to a participant or participant's agency, which is not permitted by such regulations as the Foundation may prescribe.

(d) Participants in such training programs will be selected by the grantee or contractor from nominations made by interested government agencies, in accordance with such criteria and regulations as the Foundation may prescribe.

GOVERNMENT EMPLOYEE PARTICIPATION

SEC. 307. (a) From funds available pursuant to section 313, the Foundation is authorized to transfer funds to other departments and agencies of the Federal Government, and to make grants to, and to enter into contracts with, State, regional, and local government agencies for the purpose of paying the travel and subsistence expenses of government

employees incurred in connection with their participation in training programs carried out under section 306.

(b) Executive agencies of Federal, State, and local government are encouraged, to the extent consistent with efficient administration, to provide opportunities for appropriate officers and employees of such agencies to participate in training programs carried out under section 306.

COMMUNITY CONVERSION CORPORATIONS

SEC. 308. (a) From funds available pursuant to section 313, the Foundation is authorized to make grants to, or enter into contracts with, local governments or nonprofit corporations for the establishment and operation of community conversion corporations, which—

(1) function as nonprofit corporations;

(2) operate under the direction of a Board of Directors which is representative of a wide range of community interests, including citizen group and consumer participation, selected in accordance with such criteria as may be prescribed by the Foundation;

(3) conduct, contract for, or stimulate the conduct of civilian-oriented research and development activities which focus on the particular problems, or draw on the particular resources, of the community within which the corporation is located; and

(4) give preference in personnel recruitment to unemployed or underemployed scientists, engineers, and technicians, provided that they meet necessary qualifications for effective job performance.

(b) Existing nonprofit corporations are eligible to apply as community conversion corporations for financial assistance under this section, if such corporations meet the qualifications set forth under subsection (a) of this section.

(c) Each community conversion corporation receiving a grant or contract from the National Science Foundation is encouraged to seek additional financial support and payment for services from other agencies of Federal, State, or local government, private foundations, community organizations, and private business firms; and the National Science Foundation will give preference in awarding such community conversion grants or contracts to those corporations which show a likelihood of being able to obtain such additional financial support.

(d) The receipt by a community conversion corporation of a grant or contract from the National Science Foundation under this section does not make said corporation ineligible to receive other categories of grants and contracts from the Foundation.

(e) In awarding grants or contracts to community conversion corporations for specific research and development projects, the Foundation will give preference to those projects which offer the most promise of aiding in the resolution of national problems in priority areas as identified under section 103.

JOB TRANSITION PROGRAMS

SEC. 309. (a) From funds available pursuant to section 313, the Foundation is authorized, upon application, to make job transition grants to nonprofit institutes and organizations and to private business firms in order to enable them to hire scientists, engineers, and technicians for work on projects for which they are not yet fully qualified. Each such application shall contain provision to assure that—

(1) such projects shall consist of civilian-oriented research and engineering activities;

(2) the personnel participating in such job transition programs shall be selected from unemployed or underemployed applicants by the grantees, in accordance with such criteria and regulations as shall be prescribed by the Foundation, including the requirement that the participants shall have a reasonable prospect of achieving full job qualification within a stipulated period of time;

(3) the personnel participating in such programs shall be afforded a reasonable opportunity to attend specialized training courses when such courses are deemed by the grantee to be necessary to supplement the on-the-job training of the participant; and

(4) no one may continue, or be selected, to participate in a job transition program under this section after such time that he receives a career transition fellowship under section 310.

(b) All significant scientific and technical information which is generated by the personnel participating in such programs shall be made available for public use, in accordance with such procedures as shall be prescribed by the Foundation.

CAREER TRANSITION FELLOWSHIPS

SEC. 310. (a) From funds available pursuant to section 313, the Foundation is authorized to award career transition fellowships to unemployed or underemployed scientists, engineers, and technicians to enable them to pursue a course of study through which they can acquire specialized technical knowledge and skills in fields other than the ones in which they are already proficient.

(b) The Foundation shall allocate fellowships under this section in such manner, insofar as practicable, as will—

(1) attract highly qualified applicants; and

(2) provide an equitable distribution of such fellowships throughout those areas of the United States which are experiencing a higher than average level of technical unemployment.

For the purpose of this section, the Foundation shall consult with the Secretary of Labor to establish for each region in the United States the average level of technical unemployment.

(c) The Foundation shall award at least 10 per centum but not to exceed 20 per centum of the fellowships awarded under this section to scientists, engineers, and technicians who have completed their formal academic education within a five-year period prior to award of the fellowship, as certified in accordance with such regulations as the Foundation may prescribe.

(d) The Foundation shall pay to persons awarded fellowships under this section such stipends (including such allowances for subsistence, health insurance, relocation expenses, job placement expenses, and other expenses for such persons and their dependents) as it may prescribe by regulation.

(e) Fellowships shall be awarded under this section upon application made at such times and containing such information as the Foundation shall by regulation require.

PLACEMENT ASSISTANCE

SEC. 311. (a) From funds available pursuant to section 313, the Foundation is authorized to transfer funds to other departments and agencies of the Federal Government, and to make grants to, and to enter into contracts with scientific, professional, technical, and business associations, and labor unions in order to establish and operate placement programs for unemployed or underemployed scientists, engineers, and technicians.

(b) Such grants and contracts may include provision for relocation expenses of the individual participant and his family when necessary, in accordance with such regulationas as the Foundation shall prescribe.

(c) Grantees and contractors shall select applicants for such placement assistance in accordance with such criteria and regulations as the Foundation shall prescribe.

(d) No one shall be eligible for placement assistance under this section when he is—

(1) a participant in a job transitwn program under section 309;

or

(2) a recipient of a career transition fellowship under section 310.

EDUCATION PROGRAM

SEC. 312. From funds available pursuant to section 313, the Foundation is authorized to make grants to, and to enter into contracts with, academic institutions, nonprofit institutes and organizations, and private business firms, for the purpose of their planning, developing, strengthening, or carrying out education programs which design courses and curriculums intended to prepare students for careers in civilian, socially oriented research and engineering activities, in areas such as pollution control, mass transit, solid waste disposal systems, public utilities, public safety systems, and health care technology.

AUTHORIZATION OF APPROPRIATIONS

SEC. 313. (a) There are authorized to be appropriated $152,000,000 for the fiscal year ending June 30, 1973, of which $5,000,000 shall be available to carry out the provisions of section 304, $15,000,000 shall be available to carry out the provisions of section 305, $4,500,000 shall be available to carry out the provisions of section 306, $500,000 shall be available to carry out the provisions of section 307, $30,000,000 shall be available to carry out the provisions of section 308, $75,000,000 shall be available to carry out the provisions of section 309, $15,000,000 shall be available to carry out the provisions of section 310, $5,000,000 shall be available to carry out the provisions of section 311, and $2,000,000 shall be available to carry out the provisions of section 312; $203,000,000 for the fiscal year ending June 30, 1974, of which $5,000,000 shall be available to carry out the provisions of section 304, $25,000,000 shall be available to carry out the provisions of section 305, $9,000,000 shall be available to carry out the provisions of section 306, $1,000,000 shall be available to carry out the provisions of section 307, $30,000,000 shall be available to carry out the provisions of section 308, $100,000,000 shall be available to carry out the provisions of section 309, $20,000,000 shall be available to carry out the provisions of section 310, $10,000,000 shall be available to carry out the provisions of section 311, and $3,000,000 shall be available to carry out the provisions of section 312,

$205,000,000 for the fiscal year ending June 30, 1975, of which $5,000,000 shall be available to carry out the provisions of section 304, $35,000,000 shall be available to carry out the provisions of section 305, $4,500,000 shall be available to carry out the provisions of section 306, $500,000 shall be available to carry out the provisions of section 307, $30,000,000 shall be available to carry out the provisions of section 308, $100,000,000 shall be available to carry out the provisions of section 309, $20,000,000 shall be available to carry out the provisions of section 310, $5,000,000 shall be available to carry out the provisions of section 311, and $5,000,000 shall be available to carry out the provisions of section 312.

(b) Funds appropriated pursuant to subsection (a) of this section shall remain available for obligation, for expenditure, or for obligation and expenditure, for such period or periods as may be specified in Acts making such appropriations.

TITLE IV—PROTECTION OF PENSION RIGHTS OF SCIENTISTS AND ENGINEERS

SEC. 401. The Congress finds that because of rapid and frequent changes in Federal procurement objectives and policies, engineering and scientific personnel suffer a uniquely high rate of forfeiture of pension benefits under private pension plans, as such employees tend to change employment more frequently than other workers. The Congress declares that it is the policy of the United States to seek to protect scientists and engineers from such forfeitures by making protection against forfeiture of pension credits, otherwise provided, a condition of compliance with Federal procurement regulations.

SEC. 402. The Director shall develop, in consultation with appropriate professional societies and heads of interested Federal departments and procurement agencies, recommendations for modifications of Federal procurement regulations to insure that scientists, engineers, and others working in associated occupations employed under Federal procurement, construction, or research contracts or grants shall, to the extent feasible, be protected against forfeitures of pension or retirement rights or benefits, otherwise provided, as a consequence of job transfers or loss of employment resulting from terminations or modifications of Federal contracts or procurement policies.

SEC. 403. Recommended changes in procurement regulations shall be developed by the Director, as required by section 402, within six months after enactment of this Act, and shall be published in the Federal Register within fifteen days thereafter as proposed regulations subject to comment by interested parties.

SEC. 404. After publication under section 403, receipt of comments, and such modification of the published proposals as the Director deems appropriate, the recommended changes in procurement regulations developed under this title shall be adopted by each Federal department and procurement agency within sixty days thereafter unless the head of such department or agency determines that such changes would not be in the national interest or would not be consistent with the primary objectives of such department or agency.

TITLE V—GENERAL PROVISIONS

DEFINITIONS

SEC. 501. As used in this Act:

(1) The term "academic institution" means any United States institution of higher education as defined in sections 491 and 1201 of the Higher Education Act of 1965.

(2) The term "Administration" means the Civil Science Systems Administration.

(3) The term "Assistant Director" means an Assistant Director of the National Science Foundation.

(4) The term "Associate Director" means the Associate Director for Civil Science Systems of the National Science Foundation.

(5) The term "civil science system" means any set of interrelated technological applications which are designed to perform certain public services, as defined in subsection (11) of this section.

(6) The term "civilian research and engineering activities" means all nondefense research and engineering activities as determined pursuant to regulations of the Director of the Foundation after consultation with the Directors of the Office of Management and Budget and the Office of Science and Technology.

(7) The term "Council" means the Civil Science Systems Advisory Council.

(8) The term "defense research and engineering activities" means any activity which involves—

(i) research, development, or engineering, including necessary supporting services, performed under grant from, or contract with, the Department of Defense or under subcontract to such a grant or contract, or

(ii) the construction, reconstruction, repair, or installation of any building, plant, structure, facility, or equipment connected or necessary to such research, development, engineering, or supporting services.

(9) The term "Deputy Associate Director" means the Deputy Associate Director for Civil Science Systems of the National Science Foundation.

(10) The term "Director" means the Director of the National Science Foundation.

(11) The term "Federal executive agency" means any department, agency, or independent establishment in the executive branch of the Government, including any wholly owned Government corporation.

(12) The term "Foundation" means the National Science Foundation.

(13) The term "Panel" means the Advisory Panel on Transition of Scientific and Technical Manpower to Civilian Programs.

(14) The term "public service" means any set of interrelated organizations and activities which collectively perform certain related functions normally associated with life in our society, including but not limited to such public services as health care, public safety, public sanitation, pollution control, housing, transportation, public utilities, communications, and education.

(15) The term "State" includes each of the several States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Trust Territory of the Pacific Islands.

ADMINISTRATIVE PROVISIONS

SEC. 502. (a) The Director of the Foundation is authorized, in furtherance of the purposes and provisions of this Act, to—

(1) appoint such additional personnel as he deems necessary to carry out this Act;

(2) appoint such advisory committees as he deems advisable;

(3) procure the services of experts and consultants in accordance with section 3109 of title 5, United States Code; and

(4) use the services, personnel, facilities, and information of any other Federal department or agency, any agency of a State, or political subdivision thereof, or any private research agency with the consent of such agencies, with or without reimbursement therefor.

(b) Upon request by the Director, each Federal department or agency is authorized to make its services, personnel, facilities, and information, including suggestions, estimates, and statistics, available to the greatest practicable extent to the Director, or his designee, in the performance of his functions under this Act.

(c) The Director shall establish such additional divisions or offices within the Foundation as he deems necessary to carry out his functions under this Act.

PAYMENTS AND WITHHOLDING

SEC. 503. (a) Payments under this Act may be made in installments, in advance, or by way of reimbursement, with necessary adjustments on account of underpayment or overpayment.

(b) Whenever the Director, after giving reasonable notice and opportunity for hearing to a grantee or contractor under this Act, finds—

(1) that the program or project for which such grant or contract was made has been so changed that it no longer complies with the provisions of this Act; or

(2) that, in the operation of the program or project, there is failure to comply substantially with any such provision—

the Director shall notify such grantee or contractor of his findings and no further payments may be made to such grantee or contractor by him until he is satisfied that such noncompliance has been or will promptly be, corrected. The Director may authorize the continuance of payments with respect to any projects pursuant to this Act which are being carried out by such grantee or contractor and which are not involved in the noncompliance.

RECORDS AND AUDIT

SEC. 504. (a) Each recipient of assistance under this Act pursuant to grants received, agreements entered into, or contracts entered into under other than competitive bidding procedures shall keep such records as the Director shall prescribe, including records which fully disclose the amount and disposition of the proceeds of such assistance, the total cost of the project or undertaking in connection with which such assistance is given or used, and the amount of that portion of the cost of the project or undertaking supplied by other sources, and such other records as will facilitate an effective audit.

(b) The Director and the Comptroller General of the United States, or any of their duly authorized representatives, shall have access for the purpose of audit and examination to any books, documents, papers, and

records of the recipients that are pertinent to the assistance received under this Act.

PATENT RIGHTS

SEC. 505. (a) Each grant, contract, or other arrangement executed pursuant to this Act which relates to scientific research or engineering shall contain provisions governing the disposition of inventions produced thereunder in a manner calculated to protect the public interest and the equities of the individual or organization with which the grant, contract, or other arrangement is executed. Nothing in this Act shall be construed to authorize the Foundation to enter into any contractual or other arrangement inconsistent with any provision of law affecting the issuance or use of patents.

(b) No officer or employee of the Foundation shall acquire, retain, or transfer any rights, under the patent laws of the United States or otherwise, in any invention which he may make or produce in connection with performing his assigned activities and which is directly related to the subject matter thereof. This subsection shall not be construed to prevent any officer or employee of the Foundation from executing any application for patent on any such invention for the purpose of assigning the same to the Government or its nominee in accordance with such rules and regulations as the Director may establish.

Amend the title so as to read:

A bill to amend the National Science Foundation Act of 1950 in order to establish a framework of national science policy and to focus the Nation's scientific talent and resources on its priority problems, and for other purposes.

SUMMARY

GENERAL

This bill establishes national science policy and programs to focus the Nation's scientific talent and resources on its civilian priority problems. It authorizes $1.81 billion over a three-year period—$50 million to advance the state-of-the-art in priority research areas; $1.2 billion to design and demonstrate civil science systems which can provide improved public services; and $560 million to aid States, communities, companies, and individual scientists, engineers, and technicians in making the transition to civilian research and engineering programs. In addition, the bill creates a mechanism to establish Federal procurement policies and regulations which would foster portable pensions for scientists and engineers to protect their pension credits as they shift from one job to another.

NATIONAL POLICY PROVISIONS

The bill declares as national policy that: (1) Federal funds for science will grow in proportion to the Gross National Product; (2) scientific and technical manpower must have continuing employment opportunities at their professional skill levels; (3) Federal funds for civilian research and development (R & D) must be maintained at parity with military R & D; and (4) Federal programs for civilian R & D must be focused on meeting national needs in priority areas.

TITLE I—SCIENCE POLICY

This title gives explicit authority to the National Science Foundation to develop national policies for applying science to national problems. The bill also broadens the composition of the National Science Board (the Foundation's governing board) to include more technical and industrial representation. The $50 million is authorized to the Foundation in order to advance the state-of-art in those areas.

TITLE II—DESIGN AND DEMONSTRATION OF CIVIL SCIENCE SYSTEMS

This title establishes a Civil Science Systems Administration within the National Science Foundation and authorizes $1.2 billion to do research, design, testing and evaluation, and demonstration of civil science systems capable of providing improved public services in areas such as: health care, public safety, public sanitation, pollution control, housing, transportation, public utilities, communications, and education.

Programs would be carried out through contract with industry, universities, nonprofit organizations and public agencies, and would include provision for transfer of funds to other government agencies. Over FY '73, '74, and '75, the Administration would be authorized—$55 million for planning civil science systems; $140 million for applied social research necessary to design such systems; $790 million for research and design of civil science systems; $105 million for testing and evaluation of such systems; $30 million for dissemination of technical information on such systems; and $80 million for public demonstration of civil science systems.

Title III—Transition of Technical Manpower to Civilian Programs

This title authorizes the National Science Foundation to plan and assist in the transition of scientific and technical manpower from research and engineering programs which have been terminated or significantly reduced, to other civilian-oriented research and engineering activities. Thus $560 million over FY '73, '74, and '75 is authorized to aid States, communities, companies, and individual scientists, engineers, and technicians in making the transition. Programs include: $15 million for research on economic conversion; $95 million to State, regional and local governments for training of government officials, operating conversion programs, and for hiring unemployed technical personnel to work in government positions; $90 million for Community Conversion Corporations to channel research and engineering programs in hard-hit communities; $275 million for Job Transition Programs to enable companies to hire technical personnel to work on civilian projects for which they are not yet fully qualified (on-the-job training subsidies); $55 million for Career Transition Fellowships to unemployed or underemployed technical personnel to acquire skills in other fields; $20 million for placement assistance to technical personnel who are unemployed or underemployed; and $10 million for developing university courses and curricula oriented toward civilian engineering projects.

Title IV—Protection of Pension Rights of Scientists and Engineers

This title declares as national policy that scientists and engineers be protected, to the extent feasible, against forfeiture of pension rights or benefits as a consequence of job transfers or loss of employment resulting from terminations or modifications of Federal contracts or procurement policies. The bill provides for the development and implementation of Federal procurement regulations designed to achieve that policy.

Title V—General Provisions

This title contains definitions of terms used in this Act, administrative provisions which are necessary to implement this Act, and provisions to protect the public interest and the equities of grantees and contractors in disposition of patent rights.

Section-by-Section Analysis

Section 1.—This section states that this Act may be cited as the "National Science Policy and Priorities Act of 1972".

DECLARATION OF POLICY

Section 2. This section declares as national policy that: (1) Federal funds for science and technology must be raised to an adequate level and then continue to grow in proportion to the growth in the GNP; (2) there must be continuing employment opportunities for scientists, engineers, and technicians in positions commensurate with their capabilities; (3) Federal funds for civilian research and engineering must be maintained at least at a level of parity with Federal funds for defense research and engineering; and (4) Federal funds for civilian research and engineering must be focused on meeting human needs in national priority problem areas.

TITLE I—SCIENCE POLICY AND PRIORITIES FOR CIVILIAN RESEARCH AND ENGINEERING

SHORT TITLE

Section 101. This section states that this title may be cited as the "Science Policy Act."

AUTHORITY OF THE NATIONAL SCIENCE FOUNDATION

Section 102. This section amends section 3 of the National Science Foundation Act of 1950 to require that the Foundation develop national policies to foster the application of scientific and technical knowledge to the solution of national problems.

RESEARCH AND ENGINEERING PRIORITIES

Section 103. This section requires that the Foundation identify priority areas of civilian research and engineering likely to contribute to the resolution of national problems.

RESEARCH PROGRAM

Section 104. This section authorizes the Foundation to contract for basic and applied research to advance the state-of-the-art in priority research areas.

NATIONAL SCIENCE BOARD

Section 105. This section clarifies the policy-making role of the National Science Board and broadens the membership of the National Science Board to emphasize more industrial and technical representation.

POLICY APPRAISAL AND REPORTING

Section 106. This section requires that the Foundation report to the President and the Congress with respect to the implementation of policies set forth in section 2 of this Act.

AUTHORIZATION OF APPROPRIATIONS

Section 107. This section authorizes $50 million to the National Science Foundation over fiscal years 1973, 1974, and 1975 to carry out the provisions of sections 103 and 104.

TITLE II—DESIGN AND DEMONSTRATION OF CIVIL SCIENCE SYSTEMS

SHORT TITLE

Section 201. This section states that this title may be cited as the "Civil Science Systems Act."

AUTHORITY OF THE NATIONAL SCIENCE FOUNDATION

Section 202. This section authorizes the Foundation to design and demonstrate civil science systems which are capable of providing improved public services in areas such as health care delivery, public safety, public sanitation, pollution control, and public utilities. This section also exempts the Director of the National Science Foundation from having to obtain the approval of the National Science Board in all contracts of $2 million or more, with respect to the programs authorized under this title.

PROGRAMS AUTHORIZED

Section 203. This section authorizes the Foundation to support programs of applied research and experimentation to design civil science systems, to test and evaluate such systems, and to disseminate and demonstrate the results of such programs; and to assure that these programs make maximum effective use of the Nation's technical manpower, including those who are unemployed.

ESTABLISHMENT OF THE CIVIL SCIENCE SYSTEMS ADMINISTRATION

Section 204. This section establishes a Civil Science Systems Administration within the National Science Foundation to carry out the programs under this title.

ADMINISTRATION OFFICERS

Section 205. This section establishes the positions of Associate Director for Civil Science Systems, Deputy Associate Director for Civil Science Systems, and two Assistant Directors for Civil Science Systems to administer the programs of the Civil Science Systems Administration.

CIVIL SCIENCE SYSTEMS ADVISORY COUNCIL

Section 206. This section establishes a Civil Science Systems Advisory Council to advise the Director of the National Science Foundation with respect to his responsibilities under this title.

PLANNING FOR CIVIL SCIENCE SYSTEMS

Section 207. This section authorizes the Foundation to support a program of planning studies for the design and demonstration of civil science systems capable of providing improved public services.

APPLIED SOCIAL RESEARCH

Section 208. This section authorizes the Foundation to support a program of applied social research into the economic, sociological, political, legal, administrative, and psychological aspects of the design, development, and implementation of civil science systems capable of providing improved public services.

CIVIL SCIENCE SYSTEM RESEARCH AND DESIGN

Section 209. This section provides the Foundation with specific authorization to support a program of research and design of civil science systems capable of providing improved public services; requires that performance objectives and applicable physical, environmental, economic, social, and esthetic constraints are included in each contract awarded under this section; and requires that the Foundation obtain community and public views in its determination of the performance objectives and priorities to be met by such systems.

TESTING AND EVALUATION

Section 210. This section provides the Foundation with specific authorization to support programs of testing and evaluation of civil science systems.

INFORMATION DISSEMINATION

Section 211. This section authorizes the Foundation to establish and operate a computerized Civil Science Systems Information Service for the benefit of Federal, State, and local governmental agencies, industry, academic institutions, and nonprofit organizations.

SYSTEMS DEMONSTRATION

Section 212. This section provides specific authorization to the Foundation for the support of systems demonstration projects which publicly demonstrate the benefits of alternative civil science systems; and assures that the Foundation will consult with all State and local governments in whose jurisdictions such demonstrations may occur, prior to awarding contracts for such demonstrations.

COORDINATION WITH OTHER GOVERNMENT AGENCIES

Section 213. This section requires that the Foundation maintain continuing consultation and coordination with appropriate Federal, State, regional, and local government agencies in planning and conducting or assisting programs under this title.

AUTHORIZATION OF APPROPRIATIONS

Section 214. This section authorizes $1.2 billion to the National Science Foundation over fiscal years 1973, 1974, and 1975 to carry out the provisions of this title.

TITLE III—TRANSITION OF TECHNICAL MANPOWER TO CIVILIAN PROGRAMS

SHORT TITLE

Section 301. This section states that this title may be cited as the "Technical Manpower Transition Act".

AUTHORITY OF THE NATIONAL SCIENCE FOUNDATION

Section 302. This section authorizes the Foundation to assist in the transition of scientific and technical manpower from programs which have been terminated or significantly reduced to other civilian-oriented research and engineering activities.

ADVISORY PANEL ON TRANSITION OF SCIENTIFIC AND TECHNICAL MANPOWER TO CIVILIAN PROGRAMS

Section 303. This section establishes an Advisory Panel on Transition of Scientific and Technical Manpower to Civilian Programs to advise the Director of the National Science Foundation with respect to his responsibilities under this title.

RESEARCH ON TRANSITION TO CIVILIAN PROGRAMS

Section 304. This section authorizes the Foundation to support research on the social, economic, and managerial aspects of transition from defense research and engineering activities to civilian-oriented research and engineering activities; and to disseminate the significant results of such research.

ASSISTANCE TO STATE AND LOCAL GOVERNMENTS

Section 305. This section authorizes the Foundation to make grants to State and local governments and regional governmental agencies for programs to facilitate the transition of scientific and technical activities to civilian programs within the particular area; and for the hiring of currently unemployed scientists, engineers, and technicians to use their technical skills in government positions.

TRAINING GOVERNMENT OFFICIALS

Section 306. This section authorizes the Foundation to support training programs for Federal, State, and local government employees who will determine or administer programs for civilian research and engineering activities.

GOVERNMENT EMPLOYEE PARTICIPATION

Section 307. This section authorizes the Foundation to transfer funds to other government agencies to pay for the travel and subsistence expense of government employees incurred in connection with their participation in training programs carried out under section 306.

COMMUNITY CONVERSION CORPORATIONS

Section 308. This section authorizes the Foundation to contract with local governments or nonprofit corporations for the establishment and operation of Community Conversion Corporations which would stimulate civilian-oriented research and development activities which focus on the particular problems, or draw on the particular resources, of the community within which the corporation is located.

JOB TRANSITION PROGRAMS

Section 309. This section authorizes the Foundation to make job transition grants to industry and nonprofit organizations to enable them to hire unemployed technical personnel for work on civilain research and engineering projects for which they are not yet fully qualified; i.e., to subsidize their on-the-job learning process as they make the transition to civilian research and engineering work.

CAREER TRANSITION FELLOWSHIPS

Section 310. This section authorizes the Foundation to award career transition fellowships to unemployed or underemployed technical personnel to enable them to pursue a course of study through which they can acquire specialized technical skills in new fields.

PLACEMENT ASSISTANCE

Section 311. This section authorizes the Foundation to support placement programs for unemployed or underemployed technical personnel.

EDUCATION PROGRAM

Section 312. This section authorizes the Foundation to support the design of courses and curriculums intended to prepare students for careers in civilian research and engineering activities.

AUTHORIZATION OF APPROPRIATIONS

Section 313. This section authorizes $560 million to the National Science Foundation over fiscal years 1973, 1974, and 1975 to carry out the provisions of this title.

Title IV—Protection of Pension Rights of Scientists and Engineers

Section 401. This section declares as the policy of the United States to seek to protect scientists and engineers from undue forfeiture of pension benefits under private pension plans.

Section 402. This section requires the Foundation, in consultation with other agencies and appropriate outside groups, to develop recommendations for changes in Federal procurement regulations to insure (to the extent feasible) protection against forfeitures of pension or retirement rights or benefits, as a consequence of job transfers or loss of employment resulting from terminations or modifications of Federal contracts or procurement policies.

Section 403. This section requires that the Foundation develop such recommendations within six months after enactment of this Act and publish such proposed changes in the Federal Register within fifteen days thereafter, for comment by interested parties.

Section 404. This section provides that, after incorporation of additional changes based on the comments received, the recommended changes in procurement regulations shall be adopted by each Federal agency within sixty days, unless the head of such agency vetoes the application of such regulations for his agency.

Title V—General Provisions

DEFINITIONS

Section 501. This section defines terms used in this Act.

ADMINISTRATIVE PROVISIONS

Section 502. This section sets forth certain administrative provisions necessary to enable the Director of the National Science Foundation to carry out his responsibilities under this Act.

PAYMENTS AND WITHHOLDING

Section 503. This section provides for payments and withholding under this Act.

RECORDS AND AUDIT

Section 504. This section requires the maintenance of appropriate records by grantees or contractors under this Act; and authorizes the Director of the Foundation and the Comptroller General of the United States, or their duly authorized representatives, to have access to such records for the purpose of audit and examination.

PATENT RIGHTS

Section 505. This section provides for the protection of the public interest and the equities of contractors and grantees in the disposition of inventions produced under the programs carried out under this Act.

Explanation of Need

Science and technology have become central to our civilization. Throughout history science and technology have had occasional but significant impacts on military capabilities and economic development. But only since World War II have the effects of science and technology become pervasive in our society. Our military security depends on scientific research and development. Our economic development and productivity, along with our international competitive position, depend on increasing technical innovation to provide new products and services which meet changing needs. And the quality of life in our society—the adequacy of health care, the preservation of the environment, the adequacy of educational programs, the provision of transportation and communication services, and the very sources of energy which make other services possible—all are interwoven with, and depend in part on, the efficacy of scientific and technical progress.

Since the Second World War the principal focus of the Nation's scientific programs has been on defense, and since Sputnik on space. The achievements of the Nation's scientists and engineers in these areas have been sweeping in scope, and staggering in their impact. The development of an overwhelming arsenal of nuclear weapons, ballistic missiles, travel to the Moon and probes to other planets are now commonplace facts to our children.

These developments have had some spin-off effect on the civilian area of our economy and society. Computers, the vast expansion in electronics, and passenger jet aircraft are all derived from military and space programs. But most areas of civilian industry have not yet been significantly affected by scientific research. Textiles, shoes, and furniture are three examples of civilian industries which are still dependent on traditional methods and which have not reaped the benefits which scientific advance can provide.

And in the public service sector of the economy, the situation is even worse. Trash in our city streets is still collected in the same inefficient manner, and still disposed of in vast rubbish heaps that mar our countryside and pollute our air. Transportation in our metropolitan areas becomes more snarled and inconvenient all the time. And adequate health care for all our citizens continues to become more costly, even when it is available.

In the civilian sector of our economy and in the social area, the vast promise of science has been nowhere near matched by its performance. The reason for this is simple. We have not made the investment of scientific talent and resources which the situation demands. The bulk of our technical effort has been focused on defense and space with only marginal attention given to other problem areas.

The Committee's favorable recommendation with respect to this bill in no way implies any criticism of that past allocation of effort; nor does the bill in any way aim at limiting that effort in the future. (As a matter of fact, Section 2(a)(1) of the bill would assure continuing growth for all areas of research and development.) But the bill is aimed at assuring that our civilian science programs are adequate to meet our needs over the coming years.

It is important to note that for the first time in our history we have a large surplus of scientific and technical manpower which is not engaged in productive technical employment. This has resulted from Federal cutbacks, over recent years, in defense and space research and development, without corresponding increases in civilian science and technology.

So at the very time that the Nation's problems with the environment, with health, with economic productivity, and the quality of life in our society need to be tackled with all the talent we can get from our technical workforce, we find technical unemployment higher than it has ever been in history.

The exact figures on technical unemployment are shrouded in obscurity. The data on unemployment gathered by the Labor Department are not collected in such a way as to lend themselves to analysis for technical unemployment. The National Science Foundation attempted to shed additional light on the situation by conducting surveys of technical unemployment in the Spring of 1971.

But in the words of the Director of the National Science Foundation (in a letter addressed to the subcommittee chairman, dated June 20, 1972): "Our special 1971 surveys were designed to measure the changes which had taken place during a twelve-month period for a selected group of scientists and engineers. We knew that these 1971 results were not totally representative of the complete U.S. scientific and engineering manpower pool . . . We had been considering the advisability of an additional special survey of the employment status of scientists and engineers in 1972. However, a number of factors convinced us that it would be preferable not to proceed at this time. These include: the currently changing conditions of the job market, the limitations of the available sample (we were planning to use the same population that was used in the 1971 surveys), and the fact that some information concerning the unemployment situation for scientists and engineers will become available later in 1972 from the Foundation sponsored Postcensal Survey of Professional, Technical, and Scientific Personnel."

Thus the National Science Foundation surveys in 1971 "were not totally representative of the complete U.S. scientific and engineering manpower pool", and in 1972 the National Science Foundation has not conducted any follow-up survey. Whatever the precise extent of technical unemployment, it is prudent to assume that it lies somewhere between the admittedly incomplete NSF estimates and the much higher estimates emanating from the scientific and technical community. When one takes into account the large number of technical personnel who are working at jobs which do not draw on their professional skills, it is reasonable to assume that several hundred thousand scientists, engineers, and technicians are either unemployed or are underemployed (by working at jobs well below their skill levels). In terms of the total technical workforce, it is reasonable to assume that from five to ten percent of the Nation's approximately three million scientists, engineers, and technicians are either unemployed or seriously underemployed.

This obviously represents a serious human hardship to the individuals involved and to their families. It also represents a substantial economic loss to the communities in which they live; for this group

was among the highest income producing groups in their communities, and their reduction in income depresses their communities' economic activity in greater measure than their numbers would indicate.

But apart from the human hardship involved, this situation represents a tragic waste of one of our most valuable national resources. For the Nation's scientists and engineers must be viewed as a national resource. An enormous national investment has gone into their education and on-the-job training, through Federal fellowships, scholarships, institutional aid to education, and Federal funding of research and development. As long as this group stands idle or applies its talents to tasks well beneath its skill levels, this national investment is going to waste.

It should be used to reap a vast return in economic and social benefit to the nation. In this connection it is worth pointing out that the noted economist, Dr. Leonard Lecht of the National Planning Association has estimated that for every scientist or engineer put to work through Federal funds, jobs are created throughout the economy for six to ten other workers.

Yet at this time of maximum need, when the Nation's domestic economy is still lagging, when our international competitive position needs strengthening, when the problems of our cities, our environment, and our public services are so insistent in their pressure—at this very time we have permitted a sizable segment of our technical workforce to waste its enormous talent.

It is time to reformulate our national science policies and to redirect our priorities for civilian research and engineering. The statute establishing the National Science Foundation was enacted in 1950. Although a significant strengthening of that statute was enacted in the Daddario-Kennedy NSF Act Amendments of 1968, and although the Foundation has made efforts in recent years to apply scientific knowledge more effectively to the problems of society, the problems have far outstripped the institutions we have for dealing with them.

It is for these reasons that the National Science Policy and Priorities Act has been developed by the Committee on Labor and Public Welfare and favorably recommended to the Senate.

Background

The Committee on Labor and Public Welfare began serious consideration of these issues in the Ninety-First Congress. On December 1 and 2, 1969, the Committee held hearings on Postwar Economic Conversion. The Committee heard testimony from Professor Warren L. Smith, Department of Economics, University of Michigan and former member of the Council of Economic Advisers; Dr. Seymour Melman, economist and professor of industrial engineering at Columbia University; the late Walter P. Reuther, President of the United Auto Workers; Dr. Wilfred Lewis, Jr. of the National Planning Association; the Honorable Archibald S. Alexander, former Assistant Director for Economics of the U.S. Arms Control and Disarmament Agency; and Nathanial Goldfinger, Director of Research, AFL–CIO.

Additional hearings on Postwar Economic Conversion were held before the Committee in Lexington, Massachusetts on March 23, 1970, and in Framingham, Massachusetts on April 3, 1970. At those hearings the Committee heard testimony from General James Gavin, Chairman

of the Board, Arthur D. Little, Inc.; Dr. George Gols of Arthur D. Little; Carroll Sheehan, Commissioner of the Massachusetts Department of Commerce and Development; Bernard O'Keefe, President of E.G. & G. Corporation; D. Justin McCarthy, President of Framingham State College; Joseph Hyman, President of Hycor Corporation; Dr. Arthur S. Obermayer, President of Moleculon Corporation; Dr. Duncan MacDonald, business consultant; and William Alexander, President of the Research, Development, and Technical Employees Association, MIT Laboratories.

The testimony and statements for the record submitted at these hearings provided the Committee with a comprehensive background on the problems of economic conversion and a realization that national legislation was required to enable the country to build a strong base of civilian science and technology.

As Chairman of the Special Subcommittee on the National Science Foundation, Senator Edward M. Kennedy, began developing legislation aimed at meeting needs in this area. On August 14, 1970, he introduced S. 4241, the Conversion Research and Education Act. Although it was not possible to hold hearings on the bill before the end of the Ninety-first Congress, the bill was subjected to close scrutiny by leading authorities in this field throughout the Nation.

After careful consideration of their comments and suggestions, the bill was revised and re-introduced by Senator Kennedy in the Ninety-second Congress on January 25, 1971, as S. 32, the Conversion, Research, Education, and Assistance Act. The bill was referred to the Committee on Labor and Public Welfare and assigned to the Subcommittee on the National Science Foundation.

The bill was circulated among leading authorities throughout the Nation who were expert in various of its aspects, and their comments and suggestions were carefully studied by the Subcommittee. At the same time a companion bill to S. 32 had been introduced in the House of Representatives as H.R. 34, by Congressmen John W. Davis and Robert N. Giaimo and one hundred and eleven cosponsors in January 1971. H.R. 34 was virtually identical to S. 32. Consequently the eight days of comprehensive hearings which the House Committee on Science and Astronautics held on H.R. 34 on June 22, 23, 24, July 13, 14, 15, and August 5 and 6, 1971 proved extremely helpful in the National Science Foundation Subcommittee's consideration of S. 32.

Based on the extensive comments and suggestions which were received over these months, from various experts and organizations throughout the country and through the House hearings, Senator Kennedy filed Amendment 469, a major amendment to S. 32 on October 13, 1971. This amendment was designed to take account of many of the suggestions which the Subcommittee had received.

On October 26 and 27, 1971, the Subcommittee on the National Science Foundation held hearings on S. 32, including consideration of Amendment 469. (The hearings also considered S. 1261, the Economic Conversion Loan Authorization Act, which is still under study by the Subcommittee on the National Science Foundation.) Testimony was heard from the Administration spokesman, Dr. William D. McElroy, Director of the National Science Foundation; Paul Robbins, Executive Director of the National Society of Professional Engineers; Jack

Golodner, Executive Secretary of the Council of AFL–CIO Unions for Scientific, Professional, and Cultural Employees; Sanford V. Lenz, Chairman, Professional, Technical, and Salaried Conference Board, IUE, AFL–CIO: Mrs. Betty Vetter, Executive Director, Scientific Manpower Commission; Professor Paul H. Thompson, Graduate School of Business Administration, Harvard University; and four unemployed engineers—Robert Fraser from Lincoln, Massachusetts, S. Robert Salow from Newton, Massachusetts, Charles Laible from Cherry Hill, New Jersey, and Nathan N. Budish from Seattle, Washington.

In addition to the testimony received at the hearings, the hearings record also included statements on the legislation from the Comptroller General and the Administration and from twenty-seven organizations and individuals with special competence in this area. Since the hearings record was published, scores of other statements have been received from interested organizations and individuals with respect to S. 32.

Based on all of the information and the views which were received, the bill was further revised and considered by the Special Subcommittee on the National Science Foundation in an Executive Meeting on April 5, 1972. At that meeting, upon the suggestion of Senator Dominick, the Subcommittee agreed to submit the bill (in its revised form) to the Executive Agencies and the General Accounting Office for further comment. Letters were received from sixteen agencies and the GAO, and the specific comments were taken into careful account by the Subcommittee.

Based on those comments, the bill was further revised and considered again by the Subcommittee in Executive Meeting on May 30, 1972. At that meeting, the Subcommittee, without opposition, favorably reported the bill to the full Committee with an amendment in the nature of a substitute and with a title amendment.

The bill was considered by the full Committee on Labor and Public Welfare in Executive Meetings on June 21 and June 28, 1972. At the June 28 meeting, the Committee on Labor and Public Welfare ordered the bill, with a modified amendment in the nature of a substitute and with a title amendment, reported favorably to the Senate. On the roll call vote to report, all seventeen members of the Committee were recorded as voting to report the bill favorably.

Committee Views

NATIONAL SCIENCE POLICY

The policy statement in section 2 is perhaps the most significant section of the bill. This section recognizes that Federal funding for science and technology represents an investment in the future, and declares that that investment must be raised to an expenditure level which is adequate to the needs of the Nation.

Federal funds for research and development as a percentage of the gross national product have been dropping steadily over the past decade. In 1963 Federal funds for research and development were 2.6% of the gross national product (GNP). By 1971, they had dropped to 1.6% of the gross national product. This decline of one percent represents about $10 billion on the base of the present gross national product. This means that if Federal funds for research and develop-

ment in 1971 had been the same percentage of the GNP as they had been in 1963, they would total about $10 billion more than they now do. When one takes into account the fact that there has been a considerable inflation in R & D costs during that period, one realizes that the decline in relative resources allocated to R & D has been even more substantial during that time.

But just as each major industrial corporation tends to allocate a portion of its funds each year as a long-term investment in the future development of the firm, so must the Nation make an annual investment in its future through research and development. This is especially true because there are certain types of R & D of great potential benefit to the Nation, which are too extensive for any individual firm to undertake; and other types of R & D which are not likely to prove profitable to a particular firm, but which nevertheless can provide great benefits for the Nation as a whole.

So Federal funds for R & D must be seen as a continuing investment in the Nation's future. Their precipitous decline over the past eight years, as a percentage of the GNP, which parallels a period of low productivity in the economy, indicates that they should be restored to a higher level, and that the Nation would benefit from such a restoration.

Once they have been increased to an appropriate level, they should grow from year to year in proportion to the growth in the GNP. In this way the Nation can assure to the generations to come the benefits which can only flow from research which we are farsighted enough to undertake today.

This section also establishes as national policy that there should be continuing employment opportunities for scientists and engineers in positions commensurate with their capabilities. This emphasizes the recognition that our technical manpower pool is a national resource which must be utilized to the fullest.

This section also stipulates that Federal funds for civilian research and engineering should be maintained at or above a level of parity with Federal funds for military research and engineering, except when inconsistent with overriding considerations of national security.

Finally this section establishes as national policy that Federal funds for civilian research and engineering should be focused on meeting human needs in priority problem areas such as health care, public safety, pollution, productivity, education, transportation, and energy resources.

Title I—Science Policy and Priorities for Civilian Research and Engineering

This title is intended to provide the National Science Foundation with the broad authority needed for it to exercise a leadership role in determining national science priorities and in developing national policies which foster the application of scientific and technical knowledge to the solution of national problems. In addition, this title clarifies the policy-making role of the National Science Board and broadens the composition of the Board which has been traditionally oriented toward academic, basic science, to include increased representation of people with an industrial or technical background. In this connection, the Committee notes that it considers the last phrase of section 105 ("by other scientific, technical, or educational associations.") to include unions of scientists, engineers, and technicians.

Over a three year period, $50 million is authorized for the programs carried out under sections 103 and 104. These would involve approximately 100 research projects at an average cost of about $500,000 each; and would provide jobs in the peak third year directly for about 1600 scientists, engineers, technicians, and research assistants.

Title II, Sec. 204—Establishment of Civil Science Systems Administration

The Civil Science Systems Administration (for which $1.2 billion is authorized over a three year period) is intended to be a NASA-like organization which would channel technical talent and resources toward the problems of our society in much the same way the National Aeronautics and Space Administration has focused such efforts on the problems of outer space. The Civil Science Systems Administration would function primarily through the award of contracts to industry, universities, and other research organizations. It would also be empowered to transfer some funds to other agencies when it was more appropriate for particular program components to be carried out by some other agency. The contracting approach would be simi ar to the NASA model in that there would be considerable reliance on systems contracts, with the prime contractors in turn subcontracting specific portions of the task to other contractors. Federal Procurement Regulations would, of course, prevail for these contracts, so that most contracts would be awarded on a competitive basis.

Sec. 207—Planning for Civil Science Systems

It is expected that the $55 million authorized over a three year period for this program would provide for about 110 planning projects at an average cost of about $500,000 per project. In its peak first year, this program would provide jobs directly for about 2,000 scientists, engineers, technicians, and research assistants.

Sec. 208—Applied Social Research

It is expected that the $140 million authorized for this program over a three year period would provide for about 233 applied social research projects at an average cost of about $600,000 per project. In its peak third year this program would provide jobs directly for about 2,500 scientists and research assistants.

Sec. 209—Civil Science Systems Research and Design

Over a three year period $790 million is authorized for this program, which is the major component of the overall Civil Science Systems Program. It is expected that this authorization would permit funding for research and design in about twelve major areas, such as: routine health care services; emergency health care services; public safety (crime control); public safety (fire prevention and control); power supply (gas and electric utilities); innovative mass transit; innovative construction technology; educational systems; water pollution control; air pollution control; solid waste disposal systems; communication systems; etc. It is expected that over the three year period, the program could mount in each such area (in very rough terms) about forty research projects at about $1 million each and about five major design projects at about $5 million each. Thus, for all areas of activity over the three year period, it is roughly estimated that there might be about 480 research projects and about sixty design projects. It is expected that in the peak third year, this program would directly employ about 15,000 scientists, engineers, and technicians.

Subsection (c) of section 209 states that "Each contract awarded under this section shall contain provisions which assure that specific performance objectives, and any applicable physical, environmental, economic, social, and esthetic constraints are specified with particularity for each project conducted under said contract." The Committee requires that the National Science Foundation, in implementing the provisions of this subsection, take special account of the particular problems of persons with physical handicaps and take steps to assure that any architects working on contracts awarded under this section develop their architectural plans with full attention to the needs of such persons.

Sec. 210—Testing and Evaluation

It is estimated that the $105 million authorized for this program over the three year period would provide for about sixty testing and evaluation projects at about $1.75 million each. And it is expected that this program would employ about 2,000 scientists, engineers, and technicians in the peak third year.

Sec. 211 and 212—Information Dissemination and Systems Demonstration

Over the three year period, $110 million is allocated for the Information Dissemination and Systems Demonstration programs, which are essential to the overall success of the Civil Science Systems Administration. For it is essential that the results of the Civil Science Systems programs be widely disseminated and demonstrated so that they can be put into practical use throughout the Nation. Only through a concerted program of information dissemination and demonstration of the systems which have been developed will it be possible to assure maximum benefit to society from these programs. The information dissemination program is similar to the NASA technology utilization program, but is of more critical importance to the Civil Science Systems activity. For technology utilization of the innovations resulting from the Space Program is a byproduct of the main effort to explore outer space; it is an added benefit, not a central output. But in the Civil Science Systems Program, the major purpose is to develop technical knowledge which can be of direct benefit to society. Through the information dissemination and systems demonstration programs, the new knowledge developed through this effort will be made widely available throughout our economy and its benefits will accrue to society at large.

It is estimated that the $80 million authorized for the systems demonstration program over the three year period would permit the initiation of about forty systems demonstration projects at about $2 million each. It is expected that the information dissemination program would directly provide about 500 jobs for technical information specialists; and that the systems demonstration program would directly provide about 2,000 jobs for engineers and technicians.

Title III—Transition of Technical Manpower to Civilian Programs (Sec. 302)

The scientific and technical community has experienced significant dislocations over the past few years as major Government programs have been terminated or significantly reduced, and programs of comparable magnitude have not emerged to absorb the manpower resources which have been released. Because of different patterns of

operation in civilian markets and in meeting needs in the public sector of our economy, as opposed to the patterns which prevail in defense and aerospace programs, it is important that the Government aid in planning and assisting in the transition of technical manpower from one mode of operation to the other.

The U.S. Arms Control and Disarmament Agency has sponsored some research in the past to consider the problems of such transition. And the Labor Department has mounted some programs to aid in the actual transition. But these have been modest efforts relative to the need. And moreover, the problems of technical manpower are unique in their characteristics. The National Science Foundation has unique capabilities and experience in dealing with scientific and technical manpower, and the Committee deems it appropriate that the Foundation be the lead agency for coordinating the Government's program for dealing with the transition of technical manpower.

Sec. 304—Research on Transition to Civilian Programs

It is estimated that the $15 million authorized for this program over the three year period would provide for about thirty research projects at about $500,000 each; and would directly provide jobs for about 200 scientists and research assistants.

Sec. 305, 306, and 307—Assistance to State and Local Governments

In arranging for the orderly transition of technical manpower into civilian research and engineering programs, it is imperative that State and local governments and regional governmental agencies play a key role in the planning and implementation of programs which will impinge on their jurisdictions. It is for this reason that the Civil Science Systems Advisory Council and the Advisory Panel on Transition of Scientific and Technical Manpower to Civilian Programs include representatives of the National Governors Conference, the National Association of Counties, and the National League of Cities and the United States Conference of Mayors. In addition the bill includes a three year authorization of $95 million which would go to State and local governments and regional governmental agencies. These funds would enable such governments to hire unemployed technical personnel on their staff and to conduct programs designed to facilitate the transition of scientific and technical activities to civilian programs within their particular jurisdiction. In addition, these funds would permit government officials at the State, local, and regional level to receive specialized training which would acquaint them with the potential contributions of science and technology to the resolution of public problems in priority areas, and teach them how to utilize scientific and technical talent in an effective and economical manner. For the most part, officials at these levels of government have not had the experience in dealing with research and engineering programs which officials of the Defense Department or Space Agency have had. Since planning, contracting for, and monitoring such programs take specialized understanding and skills, it is desirable that officials at the State, local, and regional levels have the opportunity for such training, in order to maximize the results which society will receive from these programs. It is estimated that the $75 million authorized for section 305 over a three year

period would provide directly for about 2,000 jobs per year for technical professionals; and that sections 306 and 307 would provide training for about 6,000 state, regional, and local governmental officials throughout the Nation, or about an average of 120 per State.

Sec. 308—Community Conversion Corporations

The purpose of the Community Conversion Corporation Program is to provide a mechanism for enabling communities which have been substantially affected by cutbacks in research and engineering programs to help themselves. Under this program (for which $90 million is authorized over a three year period) such communities could charter a community conversion corporation, which meets the criteria of subsection (a) of section 308. This corporation could be an existing non-profit corporation which meets those criteria; a subsidiary of an existing corporation specially designed to meet those criteria; a non-profit corporation set up under the auspices of a local or regional governmental agency; or an entirely new non-profit entity with no ties to any existing organizations.

The community conversion corporation would, if it qualified, be eligible to receive a grant from the National Science Foundation to fund its overall operations, while it sought specific grants and contracts from other government agencies, private foundations, community organizations, and private business firms. Since "the National Science Foundation will give preference in awarding such community conversion grants or contracts to those corporations which show a likelihood of being able to obtain such additional financial support," existing organizations which qualified as community conversion corporations would have a certain competitive advantage over entirely new organizations established for this purpose. On the other hand, a newly established community conversion corporation of high caliber, with imaginative leadership, would still be able to compete effectively with community conversion corporations which were tied to existing organizations.

The community conversion corporation would "conduct, contract for, or stimulate the conduct of civilian-oriented research and development activities which focus on the particular problems, or draw on the particular resources, of the community within which the corporation is located." Thus it would have a catalyzing effect in generating research and engineering activity throughout the community and stimulating other economic activity as a consequence.

It is estimated that the $90 million authorized for Community Conversion Corporations over the three year period would provide for the launching and three year funding of about twenty community conversion corporations throughout the country, at about $1.5 million each per year. It is expected that this program would directly provide about 1,000 jobs per year for scientists, engineers, and technicians.

Sec. 309—Job Transition Program

The job transition program (for which $275 million is authorized over a three year period) is the major program in Title III. The $275 million provided under this section would be awarded as job transition grants to industrial firms and research organizations "to enable them to hire scientists, engineers, and technicians for work on projects for which they are not yet fully qualified." In other

words, firms undertaking civilian research and engineering projects could hire unemployed or underemployed technical personnel whose experience had been in defense and aerospace programs and who were not yet fully qualified for the particular civilian research or engineering project on which they would work. The job transition grants would subsidize all or a portion of their salary, within stipulated limits, while they, in effect, received on-the-job training (i.e., learned by doing).

The same kind of subsidization process occurred in the early years of the Space Program and in the research and development of various defense systems; only in those instances it occurred in the form of cost over-runs. In this situation it would be clearly recognized that there is an on-the-job learning process which must occur in new kinds of research and engineering activity, and that the country should openly and honestly budget for it.

This program would, of course, be of great benefit to industrial firms seeking to enter new civilian research and engineering markets. But it would also be of considerable benefit to the unemployed scientists and engineers who would be able to find jobs because of it.

It is estimated that the $275 million authorized for this program over the three year period would directly involve about one hundred firms and provide partial employment subsidies for about 10,000 scientists and engineers in each of the peak (second and third) years

Sec. 310—Career Transition Fellowships

Although the testimony and views received on this bill indicated that the vast bulk of displaced technical personnel did not need extensive academic re-training, it was the consensus that some smaller segment of that group would require or strongly desire academic re-training to prepare them for more substantial shifts in their special fields of expertise. The Career Transition Fellowship Program has been developed with this group in mind. It is estimated that the $55 million authorized for this program over the three year period would provide for about 2,000 fellowships in each of the second and third years. In determining the amount of stipends to be paid to fellows under subsection (d) of this section, the Committee expects that the National Science Foundation will establish criteria to assure that such stipends that it pays are in keeping with other stipends that are paid by the Foundation and other Government agencies for comparable programs.

Title IV—Protection of Pension Rights of Scientists and Engineers

Because of rapid and frequent changes in Federal procurement objectives and policies, engineering and scientific personnel suffer a uniquely high rate of forfeiture of pension benefits under private pension plans. In its Executive Meeting on June 28, 1972, the Committee unanimously adopted, as a new Title IV, an amendment offered by Senator Javits to help protect the pension rights of scientists and engineers working under government contracts, by providing for the development of amendments to the procurement regulations of government procurement agencies to require such protection, to the extent feasible.

The Labor Subcommittee of this Committee has under consideration several bills designed to establish minimum Federal standards for private pension plans; but the evidence in hearings on these bills

demonstrates that the high labor mobility of scientific and engineering personnel makes it unlikely that they will benefit directly from such legislation. For example, the primary bill under consideration in the Labor Subcommittee would require, as a minimum, that pension plans provide vesting of a thirty percent non-forfeitable interest after eight years of work for an employer with a pension plan. But most engineers and scientists working under government procurement contracts never work that long for a single employer, shifting instead, from job to job as Federal procurement contracts expire and procurement objectives change from year to year.

Accordingly, the Committee concluded that it would be desirable for the Federal Government to investigate the matter and attempt to develop new procurement standards which would provide adequate protection of the pension rights of these mobile professionals, particularly since, under the Federal procurement regulations pension cost is normally treated as a reimbursable cost even though very few scientists and engineers receive benefits from the plans, the costs of which are reimbursed by the Government.

Section 402 of the bill states that the NSF Director shall develop his recommendations for changes in Federal Procurement Regulations "in consultation with appropriate professional societies." The Committee considers this phrase to include unions of scientists, engineers, and technicians.

IMPACT ON ECONOMY

As indicated in the foregoing discussion of specific programs contained in S. 32, enactment of this measure would directly provide positions for about 41,000 scientists, engineers, and other technical personnel in its peak year. And as has been pointed out above, each professionally active scientist or engineer creates jobs for six to ten other workers throughout the economy. Thus enactment of this measure and subsequent appropriation of the full amount authorized would create a total of about 290,000 to 450,000 jobs throughout the economy.

But creating jobs would only be one aspect, albeit it a very important one, of its economic impact. The bill would also create a host of new products, services, industries, and markets; it would help increase productivity; and it would have a strong revitalizing effect on the entire civilian economy. Moreover, it would greatly assist the Nation in strengthening its international economic competitive position: through technical innovations which could be used to advantage in international trade and in U.S. business operations abroad.

IMPACT ON SOCIETY

In addition to its direct impact on the economy, enactment of S. 32 would have a powerful impact on the shape of our society for years to come. For it could bring to our domestic problems and social issues the same reservoir of talent, the same dedication of purpose, the same dramatic imagination which have characterized our Space Program over the past decade. And in strengthening our economy and helping to solve our social problems, S. 32 could also serve as a catalyst for recapturing the commitment of the Nation's youth.

In the words of one of the authorities who submitted a statement on S. 32 (John P. Eberhard, Dean of the School of Architecture and

Environmental Design, State University of New York at Buffalo): "I think that your proposed legislation could open the door to a new period of scientific and engineering exploration that was as exciting as any we have engaged in during the past twenty years. It could make it possible for us to do something substantial about the quality of life in our urban centers. It could give many of our young people who are disenchanted with previous value systems . . . a new kind of hope and enthusiasm to do something about our environment. It could give us all an opportunity to make an investment in the future cities which our children and our children's children will inherit from us."

Or in the words of former Senator Joseph S. Clark, Chairman of the Coalition on National Priorities: "S. 32, the National Science Policy and Priorities Act is a noble beginning. It will help get our most able brains about the real needs of the global village. By setting our thinking people on an enlightened course, our civilization will prosper."

Agency Comments

At the April Executive Meeting of the Subcommittee on the National Science Foundation it was decided to send a committee print of S. 32, as revised, to all Government agencies that might conceivably have an interest in the bill for futher comment on the revised version. Responses were received from the General Accounting Office, the Office of Management and Budget, and fifteen other Government agencies whose responses were coordinated by the Office of Management and Budget. The fifteen Executive agencies were: the Departments of Commerce; Labor, Health, Education, and Welfare; Defense; Transportation; and Housing and Urban Development; National Science Foundation; National Aeronautics and Space Administration; Atomic Energy Commission; Environmental Protection Agency; Arms Control and Disarmament Agency; Office of Economic Opportunity; Council on Environmental Quality; Council of Economic Advisers; and the Office of Science and Technology.

The comments received included a number of suggestions for changes in the bill, all of which were carefully considered, and many of which served as the basis for further revision of the bill. With the exception of the General Accounting Office whose comments were entirely technical and a few agencies that deferred substantive comment to the judgment of the National Science Foundation, all of the comments which were received were in opposition to enactment of S. 32.

Since the agency comments, which were coordinated by the Office of Management and Budget, overlap considerably, their various arguments against enactment of S. 32 are summarized and discussed in turn below:

Need for S. 32

The Administration's first point is that there is no need for such legislation. In asserting this argument, the Administration assumes that the problem to which the legislation is addressed is solely that of technical unemployment. With respect to that problem, the letters made the following points: (1) the extent of technical unemployment is not so bad as has been claimed by the scientific and technical

associations; (2) the anticipated general upturn in the economy will provide jobs for a large portion of the technical unemployed; (3) the budget request for a fiscal year 1973 increase in military and civilian R&D programs will provide still other jobs for technical personnel; and (4) existing programs in the Department of Labor and Housing and Urban Development and in the National Science Foundation (for job search, placement, and retraining) are adequate to provide for the remainder of the unemployed technical personnel.

The Committee believes that the extent of technical unemployment in the Nation is greater than that admitted by the Administration. The fact that the National Science Foundation admits its 1971 surveys of technical unemployment were inadequate, and that the Foundation has failed to conduct any further surveys this year indicates that the Administration estimates are out of date and not entirely accurate. In addition, the fact that the scientific and technical associations are convinced that technical unemployment is much higher leads the Committee to conclude that technical unemployment is substantially higher than is recognized by the Administration. Moreover, the fact that a large number of other technical personnel are seriously underemployed significantly adds to the problem.

A general upturn in the economy, even if it proves as substantial as the Administration predicts, will not directly create the kind of jobs which draw upon the skills of the technical unemployed. An increase in automobile production will not of itself create jobs that draw on the untapped skills of the aerospace engineers. The kinds of jobs these people have held in the past have been created by direct Government funding of research and engineering in defense and space; only through Federal funding of civilian research and engineering can jobs which really use these professional skills be created over the next few years. Over the longer run it is highly desirable for industry to generate research and engineering jobs directly for these professionals; but that can only be stimulated through Federal funding of civilian research and engineering in the next few years.

It is true that the Administration's budget request for a $1.4 billion increase in research and development, to the extent the money is appropriated and subsequently expended, would create a substantial number of technical jobs. However, $800 million of the $1.4 billion additional requested was in Defense Department research and engineering, and the figure authorized by Congress for that category is likely to be about $400 million less than the Administration request. Thus, if the amounts appropriated for all other programs did in fact net out to the amount of the Administration request, the total increase would be only $1 billion. Using the most recent National Science Foundation figures, one can calculate that the $1 billion in additional Federal funding for R&D would produce about 18,900 jobs for scientists and engineers. This falls far short of the current need for technical jobs. And the Labor Department, HUD, and NSF programs for unemployed technical personnel have at the most optimistic estimates found positions for no more than 13,000 persons; and there is no indication of how many of those were placed in positions in which they could utilize their technical skills.

In short, it is the Committee's view that the extent of technical unemployment is much greater than the Administration admits; and that the Administration predictions, proposals, and programs for

dealing with technical unemployment will fall far short of the actual need for technical jobs.

The most important point to be made with respect to the need for S. 32, is that this bill is not primarily directed at solving the technical unemployment problem. It is directed at focusing the Nation's technical talent on the solution of our pressing social problems.

The need for S. 32—the need for a reshaping of our national science policies and priorities—does not arise from technical unemployment. It arises because the Nation has pressing problems which must be solved, because the economy needs new sources of innovation and new means of increasing productivity, because the quality of our environment and the quality of our lives are not up to the standards all Americans deserve. And because the Nation's scientists and engineers have the talent and the imagination to help move the Nation toward those goals. That is why the Committee believes enactment of S. 32 is in the national interest.

National Capability to Carry Out S. 32

The second Administration argument against enactment of S. 32 is that we do not have the necessary knowledge and experience to carry out such a program successfully. For example, how do we know it is desirable for Federal funds for research and engineering to grow in proportion to the GNP? How do we know it is desirable for civilian research and engineering to be maintained at a level of at least parity with military R&D?

The answer is that these are policy determinations based on the recognition that Federal funding for research and engineering is an investment in the Nation's future and that, while military R&D must be maintained at an adequate level, so too must civilian R&D be maintained at a level adequate to the needs of our society.

It is true that the Nation does not have much experience for dealing with the program set forth in S. 32; but neither did the Nation have much experience with a space program before NASA was formed. The way to gain the experience is to tackle these problems with the best thought and talent we can bring to bear on them; not to wait for them to go away of their own accord.

A variation on this argument in the agency letters is the assertion that the civilian economy is not structurally adapted for undertaking science and technology programs of this magnitude. In this connection the Committee points out that the first year funding authorized by S. 32 is $362 million, which is only twenty percent of the total three year authorization, that the aerospace industry did not exist in its present form two decades ago, and that the way to adapt civilian industry to these problems and needs is to initiate a program such as S. 32.

Potential Overlap and Duplication with R&D Programs of Other Agencies

A number of the agency letters pointed out the potential problems of overlap and possible duplication between the programs of S. 32 and the R&D programs of various other Government agencies. This is a real problem which has been taken into careful account in the drafting of the legislation. The bill provides for the establishment of the Civil Science Systems Advisory Council and the Advisory

Panel on Transition of Scientific and Technical Manpower to Civilian Programs. These bodies are given the responsibility of advising the NSF Director with respect to his responsibilities under Title II and Title III of the bill respectively. Both bodies include ex officio representatives of all other Government agencies with whose programs there might be any overlap or duplication, so that these representatives would participate in the shaping of policy for S. 32 programs to avoid such overlap and duplication. In addition, the bill explicitly requires continuing consultation and coordination with other Government agencies through the Advisory Council and also through appropriate staff contacts at other levels of the agencies involved. The bill also permits the transfer of funds from NSF to other Government agencies when a portion of a particular program could more appropriately be carried out by another agency. Finally, it should be pointed out that the Federal Council on Science and Technology is an existing interagency committee with continuing responsibility for coordinating the Government's science and technology programs. The new programs of S. 32 would fall under the jurisdiction of this interagency group, which is chaired by a representative of the White House Office of Science and Technology; and any disputes which could not be resolved through other forms of coordination could be resolved by the Federal Council on Science and Technology.

A more basic point that should be made in this connection is that science cuts across all fields and all problem areas, so that the existing programs of the National Science Foundation themselves cut across many other agencies' jurisdictions and have potential overlap and duplication with agency R&D programs. These potential problems have never proved insurmountable in the past with existing NSF programs, and there is no reason to assume that S. 32 programs could not be similarly handled. It is the Committee view that each Government agency needs a research and development program of its own, which can focus on its particular needs. The R&D programs contained in S. 32 are in no way intended to supplant, but merely to supplement and, indeed, stimulate the R&D programs of other agencies.

But while there will always be a need for agency R&D programs which can focus on their particular needs, there is also a major, presently unfilled need, for a concerted civilian R&D program as set forth in S. 32. For only through such a single, coordinated effort can the major problems be tackled and mastered; since most of these problems cut across the limited scope and resources of particular agencies.

To understand this point clearly, it is worth examining a particular example in detail. Consider the systems design for a new community, in which the prime contract called for the design of a comprehensive underground network that would provide central heating and air conditioning; electric, gas, and telephone lines; cable TV; an integrated computer network for schools, hospitals, business firms, and home study on computer consoles; an integrated automatic alarm system for police and fire fighting; underground systems for the movement of mail and bulk transport (boxes and crates); water supplies; solid waste disposal systems; etc. Such systems would, of course, be designed in such a way to provide access for maintenance and change in the systems so that they could be routinely accomplished without ripping up the streets. If designed in an integrated way as outlined here, the

waste heat which individual air conditioners, toasters, etc. put out could be conserved and recycled to aid in the central heating system. This would not only greatly reduce the cost and consumption of energy in the community; it would also greatly reduce pollution due to the use of energy.

The Civil Science Systems Administration could contract for the design and demonstration of such a system, and could coordinate the various prime contractors and subcontractors involved, in much the same way as NASA has handled its moon program. The advantages of such an approach are obvious, in the opportunity for innovative technology and in the ability to take an overall systems approach to the problems involved. Yet the case outlined above cuts across the jurisdictions of many Government agencies. It overlaps with the Departments of Commerce, Interior, Transportation, Housing and Urban Development, and Health, Education, and Welfare, the Environmental Protection Agency, the Federal Power Commission, and other agencies.

No one of these agencies has the mandate or resources to treat the problems in their total systems context; yet only through such an approach can the full power and potential of modern science be brought to bear on these problems, with resulting benefits for all our citizens. Accordingly, the Committee feels it is essential that the programs, set forth in S. 32 be administered by a single agency.

The Role of the National Science Foundation

A major theme in many of the agency letters, including the comments of the National Science Foundation itself, is that NSF is not the agency to carry out the programs contained in S. 32.

An argument can be made for setting up the Civil Science Systems Administration as an independent agency. But this would add to the proliferation of Federal agencies without offering any significant advantages in turn. While the head of an independent agency would report directly to the President, the head of the Civil Science Systems Administration reports to the Director of NSF who in turn reports directly to the President. Moreover by locating the new Administration within the National Science Foundation, the new program can draw on all the accumulated expertise of the Foundation relating to research in all fields of science and engineering.

Many of the letters state that NSF does not have the experience for these kind of programs and could not carry them out effectively. The Committee recognizes the Foundation's lack of experience with certain aspects of this program. But the Committee believes that the new management and operating personnel who would be brought in to administer these programs would bring the necessary experience with them. In addition, the bill broadens the composition of the National Science Board to include more of an industrial and technical orientation, and clarifies the scope of NSF responsibilities to include policy development for the application of scientific knowledge to the solution of social problems. While NSF may not now have the capacity to mount the programs set forth in S. 32, the changes in agency structure and authority contained in the bill and the new personnel who would be brought in to administer the program would enable the agency to cope with this problem.

Criticism was also made of the degree of autonomy accorded to the Civil Science Systems Administration within the National Science Foundation. In this connection particular criticism was expressed of subsection (c) of section 202. This subsection exempts Title II from the provisions of the NSF Act, which requires that all contracts in excess of $2,000,000 be specifically approved by the National Science Board, which meets almost every month. The National Science Board is the policy-making body for the National Science Foundation, and also approves specific grants and contracts which exceed $2,000,000.

This approach is fine for the traditional academic programs of the National Science Foundation. But the experience of DOD, NASA, and AEC with management of systems procurement programs makes it abundantly clear that a high technology systems procurement program involving industry cannot be managed by a committee of twenty-four distinguished scholars which meets almost every month. In the Civil Science Systems Program there will be deadlines to be met, subcontractor projects to be coordinated, and costs and performance goals to be watched. Such a program requires tight project management which can make the procurement decisions on a day-to-day basis, not a committee of scholars which meets intermittently.

The Committee feels that the inclusion in the bill of subsection (c) of section 202 is essential to the successful management of the program. It should be noted, however, that while this subsection would enable the Civil Science Systems Administration to award contracts (on competitive bidding) without specific Board approval for each contract, the new Administration would still be under Board control with respect to overall policies. The head of the new Administration would "report and be responsible to the Director" of NSF. And the existing NSF Act provides: in Sec. 4(a) that "the Board shall establish the policies of the Foundation" and in Sec. 5(d) that "the formulation of programs in conformance with the policies of the Foundation shall be carried out by the Director in consultation with the Board."

Finally some of the letters expressed the fear that the introduction of such new programs into the National Science Foundation might in some intangible way impair the Foundation's traditional programs in basic science and education. It is the view of the Committee that the safeguards which have been built into the bill would prevent any damage to existing programs. Indeed, the new program might help NSF's traditional programs by enlisting greater public support for them, by showing what science can do to aid society.

A Special Program for Scientists and Engineers

Some of the agency letters criticized the notion of having a special program which was directed at scientists and engineers. They viewed it as being designed for the benefit of the scientists and engineers who would participate in it. But while S. 32 would provide many thousands of jobs for scientists and engineers, its primary purpose is not to aid them as a special group, but rather to aid the Nation. Each scientist or engineer who is put to work generates jobs for six to ten other workers throughout the economy. The research and engineering projects on which they work generate technical innovations which can lead to new products, increased productivity, services, and industries, thereby revitalizing the economy and strengthening

our international competitive position. Moreover, the efforts not only benefit the economy, but they also can have a major impact on enhancing the quality of life in our society: through solving many of the problems which are currently despoiling our Nation. Finally, an enormous national investment has gone into the education and on-the-job training of our scientists and engineers. The country is entitled to receive a major return on that investment in economic and social benefit. But that return can only be realized when they are engaged in work which utilizes their high talent and skills. The Nation's scientists and engineers are one of our most valuable resources. S. 32 is not aimed at aiding them as individuals, but at utilizing that resource for the benefit of all our citizens.

Administration Budget Ceiling

A final argument made in the agency commentary on S. 32 is that enactment of the bill would violate the Administration's budget ceiling. In this connection the Committee notes that the first year authorization is for $362 million, which is only twenty percent of the total three year authorization. Based on the consensus of the experts consulted in the development of this legislation, the Committee believes that this is the minimum amount for effective initiation of such a program. More importantly, the Committee believes that the authorization for S. 32 must be viewed as an investment in the Nation's future—an investment which will bring great economic and social returns to the Nation for years to come, including increased Federal tax receipts flowing from the new economic activity generated by these programs.

Rollcall Votes

The committee cast two rollcall votes on this bill. In accordance with section 133(b) of the Legislative Reorganization Act of 1946 as amended, the votes were as follows:

(1) On a motion by Senator Dominick to amend the bill by deleting subsection (c) of section 202, Senators Beall, Dominick, Javits, Packwood, Schweiker, Stafford, and Taft voted aye; Senators Cranston, Eagleton, Hughes, Kennedy, Mondale, Nelson, Pell, Randolph, Stevenson, and Williams voted nay. The motion was defeated by a vote of ten to seven.

(2) On the motion to report the bill favorably to the Senate, Senators Cranston, Eagleton, Hughes, Kennedy, Mondale, Nelson, Pell, Randolph, Stevenson, Williams, Beall, Dominick, Javits, Packwood, Schweiker, Stafford, and Taft voted aye. The committee voted to report the bill favorably to the Senate by a unanimous vote of seventeen to nothing.

Cost Estimates

In accordance with section 252(a) of the Legislative Reorganization Act of 1970, the committee estimates that costs which would be incurred in carrying out this bill for fiscal years 1973, 1974, and 1975 would be as follows:

fiscal year 1973—$362 million (Title I–$10 million; Title II–$200 million; Title III–$152 million)

fiscal year 1974—$618 million (Title I–$15 million; Title II–$400 million; Title III–$203 million)

fiscal year 1975—$830 million (Title I–$25 million; Title II–$600 million; Title III–$205 million)

No estimated expenditures were provided by the executive branch.

A detailed funding chart of the programs authorized by S. 32 is given below:

S. 32, NATIONAL SCIENCE POLICY AND PRIORITIES ACT

TABLE OF AUTHORIZATIONS OF APPROPRIATIONS

	1973	1974	1975	Section total	Title total
Title I: Science policy and priorities for civilian research and engineering	$10,000,000	$15,000,000	$25,000,000		$50,000,000
Title II	200,000,000	400,000,000	600,000,000		1,200,000,000
Sec. 207: Planning for civil service systems	25,000,000	20,000,000	10,000,000	$55,000,000	
Sec. 208: Applied social research	30,000,000	50,000,000	60,000,000	140,000,000	
Sec. 209: Civil science system and research design	120,000,000	270,000,000	400,000,000	790,000,000	
Sec. 210: Testing and evaluation	15,000,000	30,000,000	60,000,000	105,000,000	
Sec. 211: Information dissemination	5,000,000	10,000,000	15,000,000	30,000,000	
Sec. 212: Systems demonstration	5,000,000	20,000,000	55,000,000	80,000,000	
Title III	152,000,000	203,000,000	205,000,000		560,000,000
Sec. 304: Research on transition to civilian programs	5,000,000	5,000,000	5,000,000	15,000,000	
Sec. 305: Assistance to State and local governments	15,000,000	25,000,000	35,000,000	75,000,000	
Sec. 306: Training government officials	4,500,000	9,000,000	4,500,000	18,000,000	
Sec. 307: Government employee participation	500,000	1,000,000	500,000	2,000,000	
Sec. 308: Community conversion corporations	30,000,000	30,000,000	30,000,000	90,000,000	
Sec. 309: Job transition programs	75,000,000	100,000,000	100,000,000	275,000,000	
Sec. 310: Career transition fellowships	15,000,000	20,000,000	20,000,000	55,000,000	
Sec. 311: Placement assistance	5,000,000	10,000,000	5,000,000	20,000,000	
Sec. 312: Education program	2,000,000	3,000,000	5,000,000	10,000,000	
Total	362,000,000	618,000,000	830,000,000		[1] 1,810,000,000

[1] Bill total.

Changes in Existing Law

In compliance with subsection (4) of rule XXIX of the Standing Rules of the Senate, changes in existing law made by the bill, as reported, are shown as follows (existing law proposed to be omitted is enclosed in black brackets, new matter is printed in italic, existing law in which no change is proposed is shown in roman):

Functions of the Foundation (42 U.S.C. § 1862)

Sec. 3.

* * * * * * *

[(d) The Board and the Director shall recommend and encourage the pursuit of national policies for the promotion of basic research and education in the sciences.]

(d) The Foundation shall recommend and encourage the pursuit of national policies designed to foster research and education in science and engineering, and the application of scientific and technical knowledge to the solution of national problems.

National Science Board (42 U.S.C. § 1863)

Sec. 4. (a) The Board shall consist of twenty-four members to be appointed by the President, by and with the advice and consent of the Senate, and of the Director ex officio. In addition to any powers and functions otherwise granted to it by this Act, the Board shall establish the policies of the Foundation, *within the framework of applicable national policies as set forth by the President and the Congress.*

(b) The Board shall have an Executive Committee as provided in section 7, and may delegate to it or to the Director or both such of the powers and functions granted to the Board by this Act as it deems appropriate.

[(c) The persons nominated for appointment as members of the Board (1) shall be eminent in the fields of the basic, medical, or social sciences, engineering, agriculture, education, research management or public affairs; (2) shall be selected solely on the basis of established records of distinguished service, and (3) shall be so selected as to provide representation of the views of scientific leaders in all areas of the Nation. The President is requested, in the making of nominations of persons for appointment as members, to give due consideration to any recommendations for nomination which may be submitted to him by the National Academy of Sciences, the National Association of State Universities and Land Grant Colleges, the Association of American Universities, the Association of American Colleges, the Association of State Colleges and Universities, or by other scientific or educational organizations.]

(c) The persons nominated for appointment as members of the Board (1) shall be eminent in the fields of science, social science, engineering, agriculture, industry, education, or public affairs; (2) shall be selected

solely on the basis of established records of distinguished service, and (3) shall be so selected as to provide representation of the views of leaders from a diversity of fields from all areas of the Nation. The President is requested, in the making of nominations of persons for appointment as members, to give due consideration to any recommendations for nomination which may be submitted to him by the National Academy of Sciences, the National Academy of Engineering, the National Association of State Universities and Land-Grant Colleges, the Association of American Universities, the Association of American Colleges, the Association of State Colleges and Universities, or by other scientific, technical, or educational associations.

Director of the Foundation (42 U.S.C. § 1864)

Sec. 5.

* * * * * * *

(e) The Director shall not make any contract, grant, or other arrangement pursuant to section 11(c) without the prior approval of the Board, except that a grant, contract, or other arrangement involving a total commitment of less than $2,000,000 or less than $500,000 in any one year, or a commitment of such lesser amount or amounts and subject to such other conditions as the Board in its discretion may from time to time determine to be appropriate and publish in the Federal Register, may be made if such action is taken pursuant to the terms and conditions set forth by the Board, and if each such action is reported to the Board at the Board meeting next following such action. *The provisions of this subsection shall not apply to the authority granted to the Director under title II of the National Science Policy and Priorities Act of 1972.*

Miscellaneous Provisions (42 U.S.C. § 1873)

Sec. 14.

* * * * * * *

[(b) Neither the Director, the Deputy Director, nor any Assistant Director shall engage in any other business, vocation, or employment while serving in such position; nor shall the Director, the Deputy Director, or any Assistant Director, except with the approval of the Board, hold any office in, or act in any capacity for, any organization, agency, or institution with which the Foundation makes any grant, contract, or other arrangement under this Act.]

(b) Neither the Director, the Deputy Director, the Associate Director, the Deputy Associate Director, nor any Assistant Director shall engage in any other business, vocation, or employment while serving in such position; nor shall the Director, the Deputy Director, the Associate Director, the Deputy Associate Director, or any Assistant Director, except with the approval of the Board, hold any office in, or act in any capacity for, any organization, agency, or institution with which the Foundation makes any grant, contract, or other arrangement under this Act.

Section 5314 of Title 5, United States Code

Positions at level III

* * * * * * *

(58) The Associate Director for Civil Science Systems of the National Science Foundation.

Section 5315 of Title 5, United States Code

Positions at level IV

* * * * * * *

(95) The Deputy Associate Director for Civil Science Systems of the National Science Foundation.

Section 5316 of Title 5, United States Code

Positions at level V

* * * * * * *

(131) Assistant Directors for Civil Science Systems of the National Science Foundation.

SUPPLEMENTAL VIEWS OF MESSRS DOMINICK, PACKWOOD, AND TAFT

The stated dual purpose of S. 32 is to apply science to domestic problems and to alleviate underemployment and unemployment among our Nation's scientists and engineers. In justification of this legislation, emphasis has been placed on the numbers of unemployed and numbers of jobs to be provided.

There is, however, a failure to describe how the talents of the unemployed would match, in numbers and skills, the jobs to be done. For example, one professional organization, the American Institute of Aeronautics and Astronautics, stated to the committee that technological projects in such areas as crime control, pollution, mass transit, and health care cannot reach sufficient maturity to employ more than a few thousand unemployed scientists and engineers. The technological component of urban problems is relatively low and as an area of employment offers little promise to specialists in such areas as fluid dynamics, combustion, atmospheric physics, and propulsion, who must be employed in technology-intensive projects.

The declaration of policy of this legislation (sec. 2) ties the investment level in science and technology to the gross national product and calls for a Federal level of investment in civilian research and engineering activities which at least equals our level of investment in defense research and development (R. & D.). Neither the gross national product nor the level of investment in defense R. & D. are a valid indication of the demand for, or the effectiveness of, the R. & D. expenditures authorized by this bill, and could potentially distort and misallocate resources, thereby resulting in a perpetuation of the professional unemployment problem.

It should be emphasized that both the administration and Congress have initiated constructive programs with very similar objectives, and these programs should be given time to demonstrate their value before being superseded. Perhaps the most immediately effective action to alleviate the problem has already been taken with regard to the fiscal year 1973 budget requests for research and development of $17.8 billion, an increase of $1.4 billion over fiscal year 1972. These funds will translate directly into jobs for those associated with the research and development enterprise.

To help alleviate unemployment among scientists and engineers, the Department of Labor has established several programs, the most comprehensive of which is the technology mobilization and reemployment program (TMRP). It includes: Testing and feasibility of employing former aerospace engineers and scientists in professional jobs in State and local governments; improving the methods scientists and engineers use to look for jobs and communicating them to the unemployed; establishing a target list of 14 metropolitan areas most heavily hit by unemployment among scientists and engineers; exploring the use of displaced industrial engineers in health services; establishing a national registry for engineers; relocation grants to those

who get jobs outside their present geographic areas; retraining, where necessary; and finally, support for cooperative activities by related professional societies.

One example of the TMRP effort is the volunteer engineers, scientists and technician program (VEST) conducted by the American Institute of Aeronautics and Astronautics. VEST units in more than 20 States provide job information and counseling services, as well as office facilities and supplies for job hunters.

Under a Department of Labor project conducted by the National Society for Professional Engineers, study teams consisting of unemployed aerospace and defense engineers analyzed the potential for engineering and scientific employment in a variety of industries. The results show that numerous industries have significant job potential, including food and food products, transportation, wood and wood products, power resources, pollution control, health care and health services, security systems and criminal justice, banking and finance, solid waste management, educational technology and occupational safety. The job opportunities discovered through this project alone already number more than 30,000.

The National Science Foundation is administering a TMRP called the Presidential internship program which provides opportunities for 400 unemployed scientists and engineers with advanced degrees to work for 1 year at federally funded research and development laboratories. The projects on which the participants will work are intended to apply scientific knowledge to current social problems, such as pollution, sanitation, and transportation.

The Senate has, through S. 2393, initiated action to alleviate the hardships of unemployment, including scientists and engineers. This measure, which passed the Senate and is presently awaiting House action, would amend the Disaster Relief Act by establishing a new category of economic disasters. Individuals in qualifying areas could then obtain aid normally granted to victims of natural disasters, including emergency housing, mortgage payments, food, extended unemployment compensations, relocation assistance, and medical services. Business and local governments would be eligible for loans and grants.

The Congress has also twice extended unemployment compensation beyond the "normal" 26 weeks and passed the Emergency Employment Act, which provided transitional jobs to help improve State and local public services. The latter specifically focuses on workers affected by technological change or cutbacks in Federal employment.

In addition, to help achieve the goal of applying science to domestic problems, the administration has requested increased funding for this fiscal year alone for new and existing programs in this area by 65 percent from fiscal year 1969—$3.295 billion in fiscal year 1969 to $5.406 billion requested for fiscal year 1973. Some of the more significant examples include:

An increase of $88 million for research and development to help meet the Nation's needs for electrical energy without damage to the environment.

An additional $43 million for research and development on natural hazards to improve capabilities to control, predict, or reduce destruction from fires, earthquakes, floods, hurricanes, and severe storms.

An increase of $90 million in research and development by Transportation and Commerce to provide fast, safe, and pollution-free transportation.

A growth of $73 million in National Aeronautics and Space Administration's research and development programs which have greater direct benefits to society, such as weather prediction, communications, and aeronautics.

A significant expansion of problem-related research programs by the National Science Foundation to permit an increase of more than 40 percent in research on such problems as preventing environmental degredation through better land use, improving municipal services through the application of science and technology, and improving materials and manufacturing processes to advance economic productivity.

An additional $40 million to explore ways of stimulating the overall national investment in, and use of, science and technology.

The Department of Housing and Urban Development administers the urban systems engineering demonstration program, a grant program designed to utilize systems engineering, analysis techniques, and computer technology in establishing economic and efficient public service systems. This significantly overlaps with title II of S. 32.

Congress has considered several programs which apply scientific research to civilian problems, including the National Environmental Data Systems Act, water and air pollution control bills, Toxic Substances Control Act, National Environmental Laboratories Act, and research and technology in rural areas through the Rural Development Act. In short, there are numerous programs, both legislative and administrative, which focus on the same problems as S. 32. The chances for wasteful duplication are substantial.

Title II of S. 32, which has a 3-year authorization of $1.2 billion, provides for grants and contracts to develop "civil science systems," which is defined as any set of interrelated technological applications which are designed to perform certain public services. "Public services" are defined as any set of interrelated organizations and activities which collectively perform certain related functions normally associated with life in our society. Because these definitions are something less than restrictive, and because the chances for duplication and overlap with other programs are so great, fiscal responsibility dictates a reduction in the authorization and gradual implementation of this legislation.

It seems to us that the $1.81 billion authorized by S. 32 could well be reduced without jeopardizing the potential of this legislation to achieve its stated objectives. Such a reduction would also insure that S. 32, as administered by the National Science Foundation, would not overlap with nor detract from the above-mentioned programs administered by other Federal agencies.

Finally, we are concerned about the placement of the Civil Science Systems Administration (CSSA, title II) within the National Science Foundation and exempting the Administration from NSF Board control. Section 202(c) of S. 32 exempts the CSSA from the established requirement in NSF's enabling legislation of Board approval for grants or contracts which exceed $500,000 in 1 year or $2 million in total.

There is agreement that the NSF Board should, at a minimum, have clear responsibility for policy with regard to the CSSA. If not, there is no sound reason for placing the CSSA within NSF. We are concerned about the deleterious effect this provision would have by decreasing the National Science Board's autonomy and impartiality, which have significantly contributed to NSF's success since its inception in 1950. This defect can best be corrected by deleting section 202(c).

In summary, our level of investment in science and technology should not be tied to the GNP or the level of investment in defense R. & D., which could further distort resource allocation. The Board of Directors of NSF should retain their traditional control over programs within their agency, especially in view of the committee's action in strengthening the Board by increasing technical and industrial representation under title I. Because of the requested increases in the administration's proposed budget for research and development, the Department of Labor's technology mobilization and reemployment program, including the volunteer engineers, scientists and technician program and NSF's presidential internship program, and the most promising Department of Labor project conducted by the National Society for Professional Engineers, the recently passed economic disaster amendments to the Disaster Relief Act, the unemployment compensation extensions, HUD's urban systems engineering demonstration program, and the administration's requested increases in the proposed budget to achieve the goal of applying science to domestic problems in such areas as energy, pollution, weather prediction, and control of natural hazards, we are persuaded to the conclusion that the authorization level of S. 32 should be reduced.

PETER H. DOMINICK.
BOB PACKWOOD.
ROBERT TAFT, Jr.

○

Calendar No. 977

92D CONGRESS
2D SESSION

S. 32

[Report No. 92–1028]

IN THE SENATE OF THE UNITED STATES

JANUARY 25, 1971

Mr. KENNEDY (for himself, Mr. ANDERSON, Mr. BAYH, Mr. BENTSEN, Mr. BROOKE, Mr. CANNON, Mr. CASE, Mr. CHILES, Mr. COTTON, Mr. CRANSTON, Mr. EAGLETON, Mr. GAMBRELL, Mr. GRAVEL, Mr. HARRIS, Mr. HART, Mr. HARTKE, Mr. HATFIELD, Mr. HOLLINGS, Mr. HUGHES, Mr. HUMPHREY, Mr. INOUYE, Mr. JACKSON, Mr. JAVITS, Mr. MAGNUSON, Mr. MANSFIELD, Mr. MCGEE, Mr. MCGOVERN, Mr. METCALF, Mr. MONDALE, Mr. MONTOYA, Mr. MOSS, Mr. MUSKIE, Mr. NELSON, Mr. PASTORE, Mr. PEARSON, Mr. PELL, Mr. RANDOLPH, Mr. RIBICOFF, Mr. SCHWEIKER, Mr. SPARKMAN, Mr. STEVENS, Mr. STEVENSON, Mr. TUNNEY, Mr. WEICKER, and Mr. WILLIAMS) introduced the following bill; which was read twice and referred to the Committee on Labor and Public Welfare

AUGUST 9, 1972

Reported by Mr. KENNEDY, with amendments

[Strike out all after the enacting clause and insert the part printed in italic]

A BILL

To authorize the National Science Foundation to conduct research, education, and assistance programs to prepare the country for conversion from defense to civilian, socially oriented research and development activities, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, ~~That this Act may be cited as the "Conversion Research, Education, and Assistance Act of 1971".~~

DECLARATION OF POLICY

SEC. 2. (a) The Congress hereby finds that—

(1) further declines in defense spending are likely because of diminished involvement in Indochina and reductions in other defense programs, resulting from pressing domestic needs and shifting national policies;

(2) to forestall and reduce unemployment and the related waste of national talent and resources, it is essential that the Federal Government take effective steps now to assist in the conversion of defense-related activities to civilian-related activities;

(3) since a substantial segment of the defense effort nology, especially in the education of scientists, engineering, it is imperative that Federal conversion programs not only encompass industrial production, but also place sufficient emphasis on the conversion of scientific and technical resources;

(4) the Federal investment in science and technology, especially in the education of scientists, engineers, and technicians, constitutes one of the Nation's most valuable resources, which is a prerequisite for America's continued progress in the future; and

(5) in these times of deepening concern over our domestic crises, it is essential that this vast potential of United States science and technology be converted not

simply to serve civilian, consumer ends, but that it be specifically aimed at aiding in the resolution of our besetting social ills; science must serve society in coping with problems such as unemployment, poverty, crime, racism, pollution, nutrition, housing, health care, transportation, education, and the alienation of youth.

(b) Accordingly, the Congress declares that it is the continuing policy and responsibility of the Federal Government to take appropriate measures directed toward achieving the following goals:

(1) scientists, engineers, and technicians must have continuing opportunities for socially useful employment in positions commensurate with their professional, technical capabilities;

(2) the total Federal investment in science and technology must be raised to an adequate annual expenditure level, and then continue to grow annually at least proportionally to the growth in the gross national product;

(3) Federal obligations for civilian-oriented research and development activities must be increased so as to reach a level of parity with Federal obligations for defense research and development activities, whereupon the level of parity must be maintained or

exceeded, except when inconsistent with overriding considerations of national security.

TITLE I—RESEARCH AND DEVELOPMEENT CONVERSION COORDINATION POLICY

NATIONAL SCIENCE FOUNDATION AUTHORITY

SEC. 101. It shall be the function of the National Science Foundation to—

(a) analyze data regarding Federal expenditures for research and development activities, and the employment and availability of scientific, engineering, and technical manpower, which the Foundation has assembled pursuant to section 3(a) (1), (5), (6), and (7) of Public Law 81-507, as amended, in order to appraise the implementation of the policies set forth in section 2 of this Act;

(b) develop and recommend to the President programs and activities which will contribute to carrying out the policies set forth in section 2 of this Act;

(c) prepare and submit to the President for transmittal to the Congress not later than March 1 of each calendar year, ending prior to March 1, 1975, a report on its activities under this title and an appraisal of the extent to which the policies set forth in section 2 are being successfully implemented, together with such

recommendations, including recommendations for additional legislation, as it deems appropriate.

CONSULTATION

SEC. 102. The Director of the Foundation, in carrying out the functions of the Foundation under this title, shall consult with the Director of the Office of Management and Budget, the Director of the Office of Science and Technology, the Chairman of the Council of Economic Advisers, and the Advisory Commission on Research and Development Conversion (established under section 402 of this Act).

TITLE II—NATIONAL SCIENCE FOUNDATION CONVERSION PROGRAM

RESEARCH PROGRAM

SEC. 201. (a) From funds available pursuant to section 406, the Foundation is authorized to make grants to, or to enter into contracts with, academic institutions, not-for-profit institutes and organizations, public agencies, and private business firms, for the conduct of basic and applied research designed to—

(1) study and appraise the social, economic, and managerial aspects of conversion from defense-related research and development activities to civilian research and development activities;

(2) identify priority areas of civilian research and development activity likely to contribute to the resolu-

tion of the Nation's pressing domestic problems, including but not limited to, unemployment, poverty, race relations, social alienation, crime, environmental pollution, urban problems, energy sources and natural resources, nutrition, housing, transportation, education, and health care; and

(3) advance the scientific and technical state of the art in priority areas indentified under the preceding paragraph.

(b) From funds available pursuant to section 406, the Foundation is authorized to make grants to State and local governments and regional governmental agencies for the establishment and development of conversion planning and support programs at the State, local, or regional level.

(c) From funds available pursuant to section 406, the Foundation is authorized to disseminate publicly, or enter into contracts with academic institutions, not-for-profit institutes and organizations, public agencies, and private business firms for the public dissemination of, the significant results of such research conducted under section 201(a), as appear likely to aid the Nation in the conversion from defense related research and development activities to civilian research and development activities, especially those aimed at the resolution of the Nation's social problems. Such dissemination may be carried out through publications, scien-

tific symposia, workshops, demonstration projects, or other appropriate means of dissemination.

ASSISTANCE TO STATE AND LOCAL GOVERNMENTS

SEC. 202. From funds available pursuant to section 406, the Foundation is authorized to make grants to State and local governments and regional governmental agencies for—

(a) the establishment and development of conversion planning and support programs at the State, local, or regional level; and

(b) the hiring as Government employees of currently unemployed scientists, engineers, and technicians who, immediately prior to becoming unemployed, had been employed in defense-related research and development activities.

COMMUNITY CONVERSION CORPORATIONS

SEC. 203. (a) From funds available pursuant to section 406, the Foundation is authorized to make grants to, or enter into contracts with, local governments or not-for-profit corporations for the establishment an development of community conversion corporation, provided that each such community conversion corporation:

(1) is established and operates as a not for profit corporation;

(2) engages solely in non-defense-related research and development activities; and

(3) gives preference in personnel recruitment to unemployed scientists, engineers, and technicians who, immediately prior to becoming unemployed, had been employed in defense-related research and development activities.

(b) Each community conversion corporation receiving an establishment or development grant or contract from the National Science Foundation is encouraged to seek additional financial support and payment for services from other agencies of Federal, State, or local government, private foundations, community organizations, and private business firms.

(c) Each community conversion corporation receiving an establishment or development grant or contract from the National Science Foundation is eligible also to receive other grants and contracts from National Science Foundation, including those awarded under section 201 (a) of this Act.

(d) In awarding grants or contracts to community conversion corporations for specific research and development projects, the Foundation will give preference to those projects which offer the most promise of aiding in the resolution of the Nation's social problems in priority areas as identified under section 201 (a) (2) of this Act.

EDUCATION PROGRAM

SEC. 204. From funds available pursuant to section 406, the Foundation is authorized to make grants to, and to enter into contracts with, academic institutions, not-for-profit institutes and organizations, and private business firms, for the purpose of their planning, developing, strengthening, or carrying out education programs designed to—

(a) retain scientists, engineers, and technicians so that they can contribute constructively to civilian research and development activities by working effectively in scientific and technical fields, or problem areas, other than the ones in which they have been working or studying. The specific fields or problem areas for which such retraining programs will be designed will be designated by the National Science Foundation from among the priority areas identified under section 201 (a) (2) of this Act;

(b) train or retrain officers and employees of Federal, State, and local government who will be responsible for, or participate in, determining or administering the government market demand for civilian, socially oriented research and development activities, so that they can recognize the potential contributions of science and technology to the resolution of the Nation's social prob-

lems and direct their utilization in the most effective and economical manner; and

(c) provide courses and curriculums designed to prepare students for careers in civilian, socially oriented research and development activities.

FEES

SEC. 205. Under regulations prescribed by the National Science Foundation, grantees and contractors conducting educational programs under section 204 (a) and (b) may charge minimum fees for each participant scientist, engineer, technician, government officer, or employee. Such fees will be paid to the grantee or contractor by the participant's academic institution, not for profit institute or organization, private firm, or government agency, or by the individual participant. Grants, contracts, and fellowships under this title may not be used for the payment of such fees, except as provided for under sections 206 and 207.

GOVERNMENT EMPLOYEE PARTICIPATION

SEC. 206. (a) From funds available pursuant to section 406, the National Science Foundation is authorized to transfer funds to other departments and agencies of the Federal Government, and to make grants to, and to enter into contracts with, State and local government agencies for the purpose of assisting in paying the fees of government em-

ployees who participate in the educational programs carried out under section 204.

(b) Executive agencies of Federal, State, and local government are encouraged, to the extent consistent with efficient administration, to provide opportunities for appropriate officers and employees of such agencies to participate in educational programs carried out under section 204.

CONVERSION FELLOWSHIPS

SEC. 207. (a) From funds available pursuant to section 406, the Foundation is authorized to award conversion fellowships to highly qualified scientists, engineers, and technicians to enable them to participate in educational programs carried out under section 204.

(b) The Foundation shall allocate fellowships under this section in such manner, insofar as practicable, as will—

(1) attract highly qualified applicants;

(2) provide an equitable distribution of such fellowships throughout the United States; and

(3) meet the requirements of subsection (c).

(c) (1) The Foundation shall accord priority to applicants under this section who are or anticipate being out of work as a direct result of reductions in defense related research and development expenditures.

(2) The Foundation shall reserve at least 10 per centum but not to exceed 20 per centum of the fellowships awarded

under this section to scientists, engineers, and technicians who have completed their academic training within a two-year period prior to award of the fellowship.

(d) The Foundation shall pay to persons awarded fellowships under this part such stipends (including such allowances for subsistence, health insurance, relocation expenses, and other expenses for such persons and their dependents as it may determine to be consistent with prevailing practices under comparable federally supported programs.

(e) Fellowships shall be awarded under this section upon application made at such times and containing such information as the Foundation shall by regulation require.

TITLE III—SMALL BUSINESS CONVERSION PROGRAM

EDUCATION GRANTS

SEC. 301. (a) From funds available pursuant to section 406, the Small Business Administration is authorized to make grants to small business concerns, which have engaged in defense-related research and development activities within the five-year period immediately prior to the date of enactment of this Act, to pay up to 80 per centum of the cost of enrolling eligible personnel of such concerns in any program assisted under title II of this Act.

(b) Grants under this section shall be made only upon applications made at such times and containing such information as the Administration shall require. The Administration is authorized to prepare recommended programs from among programs carried out under title II of this Act which the Administration determines are especially applicable to assisting small businesses in converting to civilian research and development activities.

(c) No small business concern may receive more than $25,000 in any fiscal year pursuant to this section.

(d) No small business concern may utilize funds received pursuant to this section to pay the expenses of any employee to attend any conversion education program for which he has also received a National Science Foundation Conversion Fellowship awarded pursuant to section 207.

LOAN GUARANTEE AND INTEREST PAYMENT PROGRAM

SEC. 302. Title IV of the Small Business Investment Act of 1958 is amended—

(1) by striking out the title heading and inserting in lieu thereof the following:

"TITLE IV—GUARANTEES

"PART A—LEASE GUARANTEES";

(2) by striking out "this title", wherever it appears in sections 402 and 403, and inserting in lieu thereof "this part"; and

(3) by adding at the end thereof the following:

"PART B—CONVERSION PROJECT GUARANTEES

"DEFINITIONS

"SEC. 410. As used in this part—

"(1) The term 'eligible lender' means an eligible institution, an agency, or instrumentality of a State, or a financial or credit institution (including an insurance company) which is subject to examination and supervision by an agency of the United States or of any State, or a pension fund approved by the Administration for this purpose.

"(2) The term 'conversion project' means the planning and carrying out of any project by a business concern which is designed to facilitate that business concern's conversion of its defense related research and development activities to nondefense related research and development activities.

"(3) The term 'defense related research and development activities' means any activity—

"(A) which involves—

"(i) research, development, or engineering, including necessary supporting services, performed under grant from, or contract with, the Department of Defense, the Atomic Energy Commission, or the National Aeronautics and Space Administration, or under subcontract to such a grant or contract; or

"(ii) the construction, reconstruction, repair, or installation of any building, plant, structure, facility, or equipment connected or necessary to such research, development, engineering, or supporting services; and

"(B) which requires at least six months to complete.

"AUTHORIZATION OF THE ADMINISTRATION

"SEC. 411. (a) The Administration may, upon such terms and conditions as it may prescribe, enter into a contract and guarantee any loan for a conversion project made by an eligible lender against loss as a result of the failure of any person to meet the terms of such loan, subject to the following conditions:

"(1) The person to whom the loan is made is a small business concern.

"(2) The loan is required in order for such person to carry out a conversion project.

"(3) Such person is not able to obtain such loan on reasonable terms and conditions without a guarantee under this section.

"(4) The loan bears interest at a rate not in excess of 8 per centum a year.

"(5) The Administration determines that there is reasonable assurance that such person will repay the loan.

"(6) The conversion project for which the loan is made meets requirements established by the Administration for feasibility and reasonableness of costs.

"(b) When entering into a contract to guarantee a loan for a conversion project which meets the six conditions specified in section 411(a) above, the Administration will—

"(1) give preference to small business concerns which have suffered severe financial difficulties resulting from the diminution or termination of Federal contracts for defense-related research and development activities; and

"(2) give preference to conversion projects aimed at aiding in the resolution of the Nation's pressing domestic problems.

"(c) Any contract of guarantee under this section shall obligate the Administration to pay upon default to an eligible lender the unpaid balance of the principal amount of the loan, other than interest added to principal.

"(d) The Administration shall fix a uniform annual fee for any guarantee under this section which shall be payable at such time as may be determined by the Administration. To the extent practicable, having due regard for the purpose of this section, the amount of any such fee shall be determined in accordance with sound actuarial practices and procedures.

Any fee so established shall be subject to periodic review in order that the lowest fee that experience under the program shows to be justified will be placed into effect. The Administration may also fix such uniform fees for the processing of applications for guarantees under this section as it determines are reasonable and necessary to pay administrative expenses incurred in connection therewith.

"(e) The provisions of section 402 shall apply in the administration of this section.

"FUND

"SEC. 412. (a) There is established a revolving fund for use by the Administration in carrying out this part, except section 413 thereof. Initial capital for such fund shall consist of not to exceed $50,000,000 transferred from the fund established under section 4(c)(1)(B) of the Small Business Act, but paragraph (6) of such section shall not apply to any amounts so transferred.

"(b) There shall be deposited into the fund established by this section all receipts from the guarantee program authorized by this part. Money in such fund not needed for the payment of current operating expenses or for the payment of claims arising under such programs shall be invested in bonds or other obligations of, or guaranteed by, the United States; except that money provided as initial

capital for such fund shall be returned to the fund established by section 4(c)(1)(B) of the Small Business Act, in such amounts and at such times as the Administration determines to be appropriate, whenever the level of the fund established by this section permits the return of such money without endangering the solvency of the program under this part.

"INTEREST ASSISTANCE PAYMENTS

"SEC. 413. (a) In addition to any contract of guarantee entered into pursuant to section 411 of this title, the Administration is authorized to make, and to contract to make, interest assistance payments to any eligible lender which has made a loan subject to the provisions of such section 411, on behalf of any person to whom such loan is made. Such payments shall be made at such times and under such conditions as the Administration may by regulation provide. Interest assistance payments to any such lender shall be made only for the period equal to the repayment period as provided in the agreement evidencing such loan, but in no event for a period longer than five years.

"(b) No interest assistance payments made under this section for any loan for any year shall exceed the difference between 3 per centum and the interest such person would be required to pay under the agreement evidencing such loan.

"(c)(1) There are hereby authorized to be appropriated to the Administration such sums as may be necessary for the payment of interest assistance grants to eligible lenders in accordance with this section.

"(2) Contracts for interest assistance grants under this section shall not be entered into in an aggregate amount greater than is authorized in appropriation Acts, and in any event the total amount of interest assistance grants which may be paid to eligible lenders in any year pursuant to contracts entered into under this section shall not exceed $15,000,000."

SEC. 303. From funds available pursuant to section 406, the Small Business Administration is authorized to establish and operate a computerized Conversion Information Service to acquaint small business concerns with—

(a) the conversion education programs and other forms of conversion assistance which are available; and

(b) with market needs and opportunities for civilian research and development activities, especially those directed toward assisting in the resolution of the Nation's besetting social problems, to the extent that such market needs and opportunities are legitimately matters for the public record.

SEC. 304. (a) Section 7(b) of the Small Business Act (15 U.S.C. 636(b)) is amended—

(1) by striking the period at the end of paragraph (5) and inserting "; and"; and

(2) by adding after paragraph (5) a new paragraph as follows:

"(6) to make such loans (either directly or in cooperation with banks or other lending institutions through agreements to participate on an immediate or deferred basis) as the Administration determines to be necessary or appropriate to assist any small business concern in purchasing, leasing, or installing any new facilities or equipment, or in making alterations to existing facilities or equipment, where such purchase, lease, installation, or alteration is necessitated by conversion from defense-related research and development activities to non-defense-related research and development activities and the Administration determines that such concern is likely to suffer substantial economic injury without assistance under this paragraph in making such loans, the Administration shall give preference to small business concerns which are converting to activities aimed at aiding in the resolution of the Nation's domestic problems. The term 'defense-related research and development activities' in this paragraph shall have the same meaning as that set forth in section 410 (3) of the Small Business Investment Act of 1958, as amended above."

(b) The third sentence of section 7 (b) of such Act is amended by striking "or (5)" and inserting ", (5), or (6)".

(c) Section 4 (c) (1) of such Act is amended by inserting "7 (b) (6)," after "7 (b) (5),".

TITLE IV—GENERAL PROVISIONS

DEFINITIONS

SEC. 401. (a) As used in this Act—

(1) The term "Foundation" means the National Science Foundation.

(2) The term "Director" means the Director of the National Science Foundation.

(3) The term "defense-related research and development activities" means any activity—

(A) which involves—

(i) research, development, or engineering, including necessary supporting services, performed under grant from, or contract with, the Department of Defense, the Atomic Energy Commission, or the National Aeronautics and Space Administration, or under subcontract to such a grant or contract; or

(ii) the construction, reconstruction, repair, or installation of any building, plant, structure, facility, or equipment connected or necessary to such research, development, engineering, or supporting services; and

~~(B) which requires at least six months to complete.~~

~~(4) The term "civilian research and development activities" mean all nondefense related research and development activities as determined pursuant to regulations of the Director of the Foundation after consultation with the Directors of the Office of Management and Budget and the Office of Science and Technology, and with the Advisory Commission on Research and Development Conversion.~~

~~(5) The term "academic institution" means any United States university or college, including community colleges, technical institutions, and business schools.~~

~~(6) "Federal executive agency" means any department, agency, or independent establishment in the executive branch of the Government, including any wholly owned Government corporation.~~

~~(7) The term "State" includes each of the several States, the District of Columbia, and the Commonwealth of Puerto Rico.~~

~~ADVISORY COMMISSION ON RESEARCH AND DEVELOPMENT CONVERSION~~

~~SEC. 402. (a) There is hereby established an Advisory Commission on Research and Development Conversion to be composed of fifteen members appointed by the President for terms of three years without regard to the provisions of title 5, United States Code, and of three ex officio members~~

~~as designated in section 402(c) below. Appointed members shall be chosen from among persons who have, by reason of experience or professional accomplishments, demonstrated their special qualifications to serve on the Commission, in equal numbers from the following:~~

~~(1) Representatives of private industry with experience in nondefense related research and development activities;~~

~~(2) Engineers;~~

~~(3) Natural scientists;~~

~~(4) Social scientists; and~~

~~(5) Educators.~~

~~(b)(1) Of the members first appointed, five shall be appointed for a term of one year, five shall be appointed for a term of two years, and five shall be appointed for a term of three years, as designated by the President at the time of appointment.~~

~~(2) In order to enable the Commission to provide timely counsel on the urgent problems of conversion, the President is urged to appoint at least eight members of the Commission (sufficient to constitute a quorum necessary for the transaction of official business) not later than six months after enactment of this Act.~~

~~(3) Any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor~~

was appointed shall be appointed only for the remainder of such term. Members shall be eligible for reappointment and may serve after the expiration of their terms until their successors have taken office.

(4) Any vacancy on the Commission shall not affect its powers, but shall be filled in the same manner by which the original appointment was made.

(5) Appointed members of the Commission shall, while serving on business of the Commission, be entitled to receive compensation at rates not to exceed $125 per diem, including traveltime, and while so serving away from their homes or regular places of business, they may be allowed travel expenses, including per diem in lieu of subsistence, in the same manner as the expenses authorized by section 5703 (b) of title 5, United States Code, for persons in the Government service employed intermittently.

(c) The Commission shall annually elect one of its appointed members to serve as chairman until the next election. The Commission shall meet at the call of the chairman, but not less often than three times a year. The Director, the Assistant Secretary of Commerce for Science and Technology, and the Assistant Secretary of Health, Education, and Welfare for Education shall be ex officio members of the Commission.

(d) The Commission shall—

(1) advise the Director, and the Administrator, with respect to their respective responsibilities under this Act;

(2) review and evaluate the effectiveness of Federal programs under this Act;

(3) prepare and submit such interim reports as it deems advisable, and an annual report of its findings and recommendations, together with any recommendation for changes in the provisions of this Act; and

(4) publicize its findings and recommendations to such extent and in such manner as it deems effective and advisable.

(e) The Director shall make available to the Commission such staff, information, and other assistance as it may require to carry out its activities.

ADMINISTRATIVE PROVISIONS

SEC. 403. (a) Except as otherwise provided in this title, the Foundation shall, in carrying out its functions under this title, have the same powers and authority it has under Public Law 81-507, as amended, to carry out its functions under that law.

(b) In addition to any other authority vested in the head of any Federal executive agency by this Act, the Director, and the Administrator of the Small Business Ad-

ministration are, in order to carry out their respective functions under this Act, authorized to—

(1) promulgate such rules and regulations as may be necessary;

(2) appoint such advisory committees as may be advisable;

(3) procure the services of experts and consultants in accordance with section 3109 of title 5, United States Code; and

(4) use the services, personnel, facilities, and information of any other Federal department or agency, or any agency of any State, or political subdivision thereof, or any private research agency with the consent of such agencies, with or without reimbursement therefor.

(c) Upon request by the Director or the Administrator, each Federal department and agency is authorized and directed to make its services, personnel, facilities, and information, including suggestions, estimates, and statistics, available to the greatest practicable extent to the appropriate officer in the performance of his functions under this Act.

(d) The Director shall establish such additional divisions or offices within the Foundation as he deems necessary to carry out his functions under this Act.

(e) The Administrator shall establish such additional offices within the Small Business Administration as he deems necessary to carry out his functions under this Act.

AUDIT

SEC. 404. The Director and the Administrator of the Small Business Administration for grants and contracts for which each official is responsible, and the Comptroller General of the United States or any of their duly authorized representatives shall have access for the purpose of audit and examination to any books, documents, papers, and records that are pertinent to any grantee or contractor under this Act.

PAYMENTS AND WITHHOLDING

SEC. 405. (a) Payments under this Act may be made in installments, in advance, or by way of reimbursement, with necessary adjustments on account of underpayment or overpayment.

(b) Whenever the Director or the Administrator of the Small Business Administration for grants or contracts for which each officer is responsible under this Act, and after giving reasonable notice and opportunity for hearing to a grantee or contractor under this Act, finds—

(1) that the program or project for which such

grant or contract was made has been so changed that it no longer complies with the provisions of this Act; or

(2) that in the operation of the program or project there is failure to comply substantially with any such provision;

the appropriate officer shall notify such grantee or contractor of his findings and no further payments may be made to such grantee or contractor by him until he is satisfied that such noncompliance has been, or will promptly be, corrected. The appropriate officer may authorize the continuance of payments with respect to any projects pursuant to this Act which are being carried out by such grantee or contractor and which are not involved in the noncompliance.

AUTHORIZATION OF APPROPRIATIONS

SEC. 406. (a) There are authorized to be appropriated $110,000,000 for the fiscal year ending June 30, 1972, of which $8,000,000 shall be available to carry out the provisions of section 201, $10,000,000 shall be available to carry out the provisions of section 202, $10,000,000 shall be available to carry out the provisions of section 203, $15,000,000 shall be available to carry out the provisions of section 204, $5,000,000 shall be available to carry out the provisions of section 206, $50,000,000 shall be available to carry out the provisions of section 207, $11,000,000 shall

be available to carry out the provisions of section 301, and $1,000,000 shall be available to carry out the provisions of section 303; $165,000,000 for the fiscal year ending June 30, 1973, of which $11,000,000 shall be available to carry out the provisions of section 201, $15,000,000 shall be available to carry out the provisions of section 202, $20,000,000 shall be available to carry out the provisions of section 203, $20,000,000 shall be available to carry out the provisions of section 204, $7,000,000 shall be available to carry out the provisions of section 206, $75,000,000 shall be available to carry out the provisions of section 207, $15,000,000 shall be available to carry out the provisions of section 301, and $2,000,000 shall be available to carry out the provisions of section 303; $225,000,000 for the fiscal year ending June 30, 1974, of which $15,000,000 shall be available to carry out the provisions of section 201, $20,000,000 shall be available to carry out the provisions of section 202, $33,000,000 shall be available to carry out the provisions of section 203, $25,000,000 shall be available to carry out the provisions of section 204, $10,000,000 shall be available to carry out the provisions of section 206, $100,000,000 shall be available to carry out the provisions of section 207, $19,000,000 shall be available to carry out

~~the provisions of section 301, and $3,000,000 shall be available to carry out the provisions of section 303.~~

~~(b) Funds appropriated pursuant to this section shall remain available until expended.~~

That this Act may be cited as the "National Science Policy and Priorities Act of 1972".

DECLARATION OF POLICY

SEC. 2. (a) The Congress hereby finds that—

(1) Federal funding for science and technology represents an investment in the future, which is indispensable to sustained national progress;

(2) the manpower pool of scientists and engineers constitutes an invaluable national resource which should be utilized to the maximum extent possible at all times;

(3) the Nation's scientific resources can contribute significantly to meeting America's human needs in such priority problem areas as health care, poverty, public safety, pollution, unemployment, productivity, housing, education, transportation, nutrition, communications, and energy resources; and

(4) at this time of maximum need, much of the Nation's technical talent is being wasted or misapplied because of inadequate programs of civilian science and technology.

(b) The Congress declares that it is the continuing policy and responsibility of the Federal Government to take

appropriate measures directed toward achieving the following goals—

(1) the total Federal investment in science and technology must be raised to an expenditure level which is adequate to the needs of the Nation, and then continue to increase annually in proportion to the growth in the gross national product, or at a rate which is greater than such growth;

(2) scientists, engineers, and technicians must have continuing opportunities for socially useful employment in positions commensurate with their professional, technical capabilities;

(3) Federal obligations for civilian research and engineering activities must be increased so as to reach a level of parity with Federal obligations for defense research and engineering activities, whereupon the level of parity must be maintained or exceeded, except when inconsistent with overriding considerations of national security; and

(4) Federal programs for civilian research and engineering must be focused on meeting the human needs of the Nation in such priority problem areas as health care, poverty, public safety, pollution, unemployment, productivity, housing, education, transportation, nutrition, communications, and energy resources.

TITLE I—SCIENCE POLICY AND PRIORITIES FOR CIVILIAN RESEARCH AND ENGINEERING

SHORT TITLE

SEC. 101. This title may be cited as the "Science Policy Act".

AUTHORITY OF THE NATIONAL SCIENCE FOUNDATION

SEC. 102. Section 3 of the National Science Foundation Act of 1950 is amended by striking out subsection (d) and inserting in lieu thereof the following:

"(d) The Foundation shall recommend and encourage the pursuit of national policies designed to foster research and education in science and engineering, and the application of scientific and technical knowledge to the solution of national problems."

RESEARCH AND ENGINEERING PRIORITIES

SEC. 103. (a) The Foundation shall identify priority areas of civilian research and engineering likely to contribute to the resolution of national problems in areas such as health care, poverty, public safety, pollution, unemployment, housing, education, transportation, nutrition, communications, and energy resources. In making such identifications, the Foundation shall—

(1) take account of the results of its programs conducted or assisted under section 207;

(2) consult with appropriate scientific and technical organizations such as the National Academy of Sciences, the National Academy of Engineering, and the National Institute of Medicine; and

(3) coordinate and correlate its activities with respect to such identification with other agencies of the Federal Government undertaking programs relevant to these problems.

(b) From funds available pursuant to section 107, the Foundation may employ by grant or contract such consulting services as it deems necessary to carry out the functions assigned to the Foundation under this section.

RESEARCH PROGRAM

SEC. 104. From funds available pursuant to section 107, the Foundation is authorized to make grants to, or enter into contracts with, appropriate organizations for the conduct of basic and applied research and engineering designed to advance the scientific and technical state-of-the-art in such priority areas as are identified under section 103.

NATIONAL SCIENCE BOARD

SEC. 105. Section 4 of the National Science Foundation Act of 1950 is amended—

(1) by inserting before the period at the end of subsection (a) a comma and the following: "within the framework of applicable national policies as set forth by the President and the Congress" and

(2) by striking out subsection (c) and inserting in lieu thereof the following:

"(c) The persons nominated for appointment as members of the Board (1) shall be eminent in the fields of science, social science, engineering, agriculture, industry, education, or public affairs; (2) shall be selected solely on the basis of established records of distinguished service, and (3) shall be so selected as to provide representation of the views of leaders from a diversity of fields from all areas of the Nation. The President is requested, in the making of nominations of persons for appointment as members, to give due consideration to any recommendations for nomination which may be submitted to him by the National Academy of Sciences, the National Academy of Engineering, the National Association of State Universities and Land-Grant Colleges, the Association of American Universities, the Association of American Colleges, the Association of State Colleges and Universities, or by other scientific, technical, or educational associations."

POLICY APPRAISAL AND REPORTING

SEC. 106. In order to carry out the purposes of this Act, the National Science Foundation shall—

(1) analyze information regarding Federal expenditures for research and engineering activities, and the employment and availability of scientific, engineering,

and technical manpower, which the Foundation has assembled pursuant to paragraphs (1), (5), (6), and (7) of section 3(a) of the National Science Foundation Act of 1950 in order to appraise the implementation of the policies set forth in section 2 of this Act;

(2) develop and recommend to the President and the Congress programs and activities which will contribute to carrying out the policies set forth in section 2 of this Act; and

(3) prepare and submit to the President for transmittal to the Congress not later than January 31 of each calendar year, a report on its activities under this Act and an appraisal of the extent to which the policies set forth in section 2 are being successfully implemented, together with such recommendations, including recommendations for additional legislation, as it deems appropriate.

AUTHORIZATION OF APPROPRIATIONS

SEC. 107. (a) To carry out the provisions of sections 103 and 104 of this title, there are authorized to be appropriated $10,000,000 for the fiscal year ending June 30, 1973, $15,000,000 for the fiscal year ending June 30, 1974, and $25,000,000 for the fiscal year ending June 30, 1975.

(b) Funds appropriated pursuant to subsection (a)

of this section shall remain available for obligation, for expenditure, or for obligation and expenditure, for such period or periods as may be specified in Acts making such appropriations.

TITLE II—DESIGN AND DEMONSTRATION OF CIVIL SCIENCE SYSTEMS

SHORT TITLE

SEC. 201. This title may be cited as the "Civil Science Systems Act".

AUTHORITY OF THE NATIONAL SCIENCE FOUNDATION

SEC. 202. (a)(1) The Foundation is authorized to initiate and support programs which use science, technology, and advanced analytical techniques, such as systems analysis, to design civil science systems which are capable of providing improved public services in such areas as health care delivery, public safety, public sanitation, pollution control, housing, transportation, public utilities, communications, and education.

(2) The Foundation, insofar as is practicable, is authorized and directed to develop alternative civil science systems in order to promote a wider range of choice for the application of such systems.

(b) The Foundation is authorized to initiate and support the public demonstration of civil science systems which have been designed under this title.

(c) Section 5(e) of the National Science Foundation Act of 1950 is amended by adding at the end thereof the following new sentence: "The provisions of this subsection shall not apply to the authority granted to the Director under title II of the National Science Policy and Priorities Act of 1972."

PROGRAMS AUTHORIZED

SEC. 203. In order to carry out the purposes of this title, the Foundation is authorized and directed to—

(a) initiate and support programs of applied research and experimentation, in order to design civil science systems capable of providing improved public services;

(b) test and evaluate the alternative civil science systems designed under this title, and appraise the results of such tests in terms of applicable technical, environmental, economic, social, and esthetic factors;

(c) disseminate and demonstrate the results of programs conducted or assisted under this title so that such civil science systems may be effectively utilized in the development of new communities, and in the improvement of living conditions in existing communities; and

(d) assure that the programs conducted or assisted under this title make maximum effective use of the Na-

tion's scientists, engineers, and technicians, including those who are unemployed.

ESTABLISHMENT OF THE CIVIL SCIENCE SYSTEMS ADMINISTRATION

SEC. 204. There is hereby established within the National Science Foundation, the Civil Science Systems Administration to administer Federal programs carried out under this title.

ADMINISTRATION OFFICERS

SEC. 205. (a) The Administration shall be headed by an Associate Director for Civil Science Systems who shall be appointed by the President by and with the advice and consent of the Senate.

(b) The functions of the Director under this title and any other functions of the Civil Science Systems Administration shall be carried out through the Administration by the Associate Director, who shall be responsible to and report to the Director.

(c) There shall be a Deputy Associate Director for Civil Science Systems who shall be appointed by the President, by and with the advice and consent of the Senate, and shall perform such duties and exercise such powers as the Associate Director may prescribe. The Deputy Associate Director shall act for, and exercise the powers of, the Associate Director

during the absence or disability of the Associate Director or in the event of a vacancy in the office of Associate Director.

(d) There shall be two Assistant Directors for Civil Science Systems who shall be appointed by the President, by and with the advice and consent of the Senate, and shall perform such duties and exercise such powers as the Associate Director shall prescribe, with the stipulation that one Assistant Director shall be responsible for advising and assisting the Associate Director with respect to the engineering and technical aspects of the Administration's programs, and the other Assistant Director shall be responsible for advising and assisting the Associate Director with respect to the behavioral and social science aspects of the Administration's programs.

(e)(1) Section 5314 of title 5, United States Code, is amended by adding at the end thereof the following new paragraph:

"(58) The Associate Director for Civil Science Systems of the National Science Foundation."

(2) Section 5315 of title 5, United States Code, is amended by adding at the end thereof the following new paragraph:

"(95) The Deputy Associate Director for Civil Science Systems of the National Science Foundation."

(3) Section 5316 of title 5, United States Code, is

amended by adding at the end thereof the following new paragraph:

"(131) Assistant Directors for Civil Science Systems of the National Science Foundation."

(f) Section 14 of the National Science Foundation Act of 1950 is amended by striking out subsection (b) and inserting in lieu thereof the following:

"(b) Neither the Director, the Deputy Director, the Associate Director, the Deputy Associate Director, nor any Assistant Director shall engage in any other business, vocation, or employment while serving in such position; nor shall the Director, the Deputy Director, the Associate Director, the Deputy Associate Director, or any Assistant Director, except with the approval of the Board, hold any office in, or act in any capacity for, any organization, agency, or institution with which the Foundation makes any grant, contract, or other arrangement under this Act."

CIVIL SCIENCE SYSTEMS ADVISORY COUNCIL

SEC. 206. (a) There is hereby established a Civil Science Systems Advisory Council to be composed of thirty-one members, of whom eighteen members shall be appointed by the Director for terms of three years, and thirteen shall be ex officio members designated in subsection (c) of this section. Appointed members shall be chosen from among persons who have, by reason of experience or

accomplishments, demonstrated their qualifications to serve on the Council, in equal numbers from among the following categories—

1. business;

2. labor;

3. engineers, design professionals, and natural scientists;

4. social and behavioral scientists;

5. environmental and other community groups; and

6. consumers.

(b)(1) Of the members first appointed, six shall be appointed for a term of one year, six shall be appointed for a term of two years, and six shall be appointed for a term of three years, as designated by the Director at the time of appointment.

(2) Any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed only for the remainder of such term. Members shall be eligible for reappointment and may serve after the expiration of their terms until their successors have taken office.

(3) Any vacancy on the Council shall not affect its powers, but shall be filled in the same manner by which the original appointment was made.

(4) Each appointed member of the Council shall, while

serving on business of the Council, be entitled to receive compensation at a rate not to exceed the daily rate prescribed for GS–18 of the General Schedule under section 5332 of title 5, United States Code, including traveltime, and while so serving away from their homes or regular places of business, they may be allowed travel expenses, including per diem in lieu of subsistence, in the same manner as the expenses authorized by section 5703(b) of title 5, United States Code, for person in the Government service employed intermittently.

(5) The Council shall annually elect one of its members to serve as Chairman until the next election. The Council shall meet at the call of the Chairman, but not less often than four times a year.

(6) Eleven of the voting members of the Council shall constitute a quorum necessary for the transaction of official business.

(c) The Associate Director for Civil Science Systems; the Assistant Secretary of Commerce for Science and Technology; the Assistant Secretary of Health, Education, and Welfare for Health and Scientific Affairs; the Assistant Secretary of Housing and Urban Development for Research and Technology; the Administrator of the National Aeronautics and Space Administration; the Chairman of the Atomic Energy Commission; the Assistant Secretary of Transportation for Systems Development and Technology;

the Administrator of the Environmental Protection Agency; the Director of the Office of Economic Opportunity; and the Chairman of the Council on Environmental Quality shall be nonvoting ex officio members of the Council.

(d) A representative designated by the National Governors Conference; a representative designated by the National Association of Counties; and a representative jointly designated by the National League of Cities and the United States Conference of Mayors shall be voting ex officio members of the Council.

(e) The Council shall—

(1) advise the Director with respect to the discharge of his responsibilities under this title;

(2) review and evaluate the effectiveness of Federal programs under this title;

(3) prepare and submit to the Director and the National Science Board such interim reports as it deems advisable, and an annual report of its findings and recommendations, together with any recommendations for changes in the provisions of this title; and

(4) disseminate its findings and recommendations to such extent and in such manner as it deems effective and advisable.

(f) The Director shall make available to the Council

such staff, information, and other assistance as it may require to carry out its activities.

PLANNING FOR CIVIL SCIENCE SYSTEMS

SEC. 207. (a) From funds available pursuant to section 214, the Director is authorized to conduct planning studies, to transfer funds to other departments and agencies of the Federal Government, and to make grants to, or to enter into contracts with, academic institutions, nonprofit institutes and organizations, State, regional, and local governmental agencies, and private business firms, for the conduct of planning studies for the design and demonstration of civil science systems capable of providing improved public services. Such studies will—

(1) be directed toward the objective of designing, testing, evaluating, and demonstrating civil science systems for subsequent incorporation in new communities, and for subsequent use, with appropriate adaptations, in existing communities;

(2) include long-range planning studies as well as intermediate and short-range studies;

(3) make maximum use of the results of activities undertaken under sections 103 and 104 and the scientific and technical information provided under section 211;

(4) encompass studies of a wide range of public service areas, including but not limited to health care,

public safety, public sanitation, pollution control, housing, transportation, public utilities, communications, and education;

(5) include specific studies of the economic, sociological, psychological, legal, administrative, and political factors which affect the design, development, and implementation of civil science systems to provide public services;

(6) include total civil systems studies which integrate the specific studies carried out under paragraphs (4) and (5) of this subsection.

(b) In delineating the goals and establishing the priorities for such planning studies as are conducted under subsection (a) of this section, the Director shall consult with the Civil Science Systems Advisory Council.

APPLIED SOCIAL RESEARCH

SEC. 208. (a) From funds available pursuant to section 214, the Director is authorized to transfer funds to other departments and agencies of the Federal Government, and to make grants to, and to enter into contracts with academic institutions, nonprofit institutes and organizations, public agencies, and private business firms, for the conduct of applied social research into the economic, sociological, political, legal, administrative, and psychological aspects of the design,

development, and implementation of civil science systems capable of providing improved public services.

(b) The scientific information which is currently available in these areas and which is generated as a result of the research undertaken under this section shall be fully taken into account by the Foundation in the development of programs and the design and evaluation of civil science systems under this title.

(c) In making grants or entering into contracts under this section, the Director shall take appropriate account of the results of the planning studies conducted or assisted under section 207.

CIVIL SCIENCE SYSTEM RESEARCH AND DESIGN

SEC. 209. (a) From funds available pursuant to section 214, the Director is authorized to transfer funds to other departments and agencies of the Federal Government, and to make grants to, and to enter into contracts with, academic institutions, nonprofit institutes and organizations, public agencies, and private business firms, for research with respect to, and design of, civil science systems capable of providing improved public services in areas such as health care, public safety, public sanitation, pollution control, housing, transportation, public utilities, communications, and education.

(b) In making grants or entering into contracts under

this section, the Director shall take appropriate account of the results of the planning studies conducted or assisted under section 207, and the applied social research studies conducted or assisted under section 208.

(c) Each contract awarded under this section shall contain provisions which assure that specific performance objectives, and any applicable physical, environmental, economic, social, and esthetic constraints are specified with particularity for each project conducted under said contract.

(d) To assure that civil science systems designed under this section are responsive to public needs and desires, the Director shall obtain community and public views in his determination of the performance objectives and priorities to be met by such systems.

TESTING AND EVALUATION

SEC. 210. (a)(1) From funds available pursuant to section 214, the Director is authorized to transfer funds to other departments and agencies of the Federal Government, and to make grants to, and to enter into contracts with, academic institutions, nonprofit institutes and organizations, State, regional, and local governmental agencies, and private business firms for testing and evaluating civil science systems which make use of advanced science and technology.

(2) Such testing and evaluation shall utilize all available, applicable analytical techniques, such as computer sim-

ulation, systems analysis, and technology assessment, to test and appraise such systems in terms of their conformance to performance objectives; adherence to stipulated constraints; costs and ancillary consequences; impact on the environment; impact on esthetic values; responsiveness to public needs and desires; and their comparison with alternative civil science systems which may provide similar public services.

(b) From funds available pursuant to section 214, the Director is authorized and directed to carry out final evaluations of civil science systems which make use of advanced science and technology, taking appropriate account of the results of the tests conducted or assisted under subsection (a) of this section, and the results of the applied social research conducted or assisted under section 208.

(c) In making grants or entering into contracts under this section, the Director shall take account of the results of the planning studies conducted or assisted under section 207.

INFORMATION DISSEMINATION

SEC. 211. From funds available pursuant to section 214, the Director is authorized to establish a computerized Civil Science Systems Information Service, which shall collect and integrate the scientific, technical, and social information pertaining to civil science systems resulting from programs under

this title, and shall provide such information to interested organizations in Federal, State, and local government, industry, academic institutions, and the nonprofit sector, upon request from such organizations, in accordance with such administrative procedures as are established by the Director.

SYSTEMS DEMONSTRATION

SEC. 212. (a) From funds available pursuant to section 214, the Director is authorized to transfer funds to other departments and agencies of the Federal Government, and to make grants to, and to enter into contracts with, academic institutions, nonprofit institutes and organizations, State, regional, and local governmental agencies, and private business firms, for the construction and public exhibition of civil science systems demonstration projects, which illustrate the functioning and associated benefits of alternative, effective civil science systems resulting from research and design activities conducted or assisted under this title.

(b) Such grants or contracts shall contain provisions which assure that such demonstration projects include—

(1) accurate and complete representations of the civil science systems involved in the demonstration, indicating the improved public services which they are capable of providing; and

(2) public exhibitions which are announced in advance and are open for inspection by any interested

organization or individual in accordance with such administrative procedures as are prescribed by the Foundation.

(c) Prior to entering into any demonstration project grant or contract, the Director will consult with all State and local governments in whose jurisdictions such demonstration may occur, and will take account of the views of such governments in determining to award such a grant or contract.

COORDINATION WITH OTHER GOVERNMENT AGENCIES

SEC. 213. In planning and conducting or assisting programs under this title, the Director shall maintain continuing consultation and coordination with appropriate Federal, State, regional, and local governmental agencies, including, but not limited to, the Departments of Commerce; Health, Education, and Welfare; Housing and Urban Development; and Transportation; the Council on Environmental Quality; the National Aeronautics and Space Administration; the Atomic Energy Commission; the Office of Economic Opportunity; the Environmental Protection Agency; the National Governors Conference; the National Association of Counties; the United States Conference of Mayors; and the National League of Cities. Such consultation and coordination shall be carried out through the Council established under section 206, and through appropriate staff contacts at other levels of the agencies involved.

AUTHORIZATION OF APPROPRIATIONS

SEC. 214. (a) To carry out the provisions of this title, there are authorized to be appropriated $200,000,000 for the fiscal year ending June 30, 1973, of which $25,000,000 shall be available to carry out the provisions of section 207, $30,000,000 shall be available to carry out the provisions of section 208, $120,000,000 shall be available to carry out the provisions of section 209, $15,000,000 shall be available to carry out the provisions of section 210, $5,000,000 shall be available to carry out the provisions of section 211, and $5,000,000 shall be available to carry out the provisions of section 212; $400,000,000 for the fiscal year ending June 30, 1974, of which $20,000,000 shall be available to carry out the provisions of section 207, $50,000,000 shall be available to carry out the provisions of section 208, $270,000,000 shall be available to carry out the provisions of section 209, $30,000,000 shall be available to carry out the provisions of section 210, $10,000,000 shall be available to carry out the provisions of section 211, and $20,000,000 shall be available to carry out the provisions of section 212; and $600,000,000 for the fiscal year ending June 30, 1975, of which $10,000,000 shall be available to carry out the provisions of section 207, $60,000,000 shall be available to carry out the provisions of section 208, $400,000,000 shall be available to carry out the provisions of section 209, $60,000,-

000 shall be available to carry out the provisions of section 210, $15,000,000 shall be available to carry out the provisions of section 211, and $55,000,000 shall be available to carry out the provisions of section 212.

(b) Funds appropriated pursuant to subsection (a) of this section shall remain available for obligation, for expenditure, or for obligation and expenditure, for such period or periods as may be specified in Acts making such appropriations.

TITLE III—TRANSITION OF TECHNICAL MANPOWER TO CIVILIAN PROGRAMS

SHORT TITLE

SEC. 301. This title may be cited as the "Technical Manpower Transition Act".

AUTHORITY OF THE NATIONAL SCIENCE FOUNDATION

SEC. 302. The Foundation is authorized to plan and assist in the transition of scientific and technical manpower from research and engineering programs which have been terminated or significantly reduced to other civilian-oriented research and engineering activities.

ADVISORY PANEL ON TRANSITION OF SCIENTIFIC AND TECHNICAL MANPOWER TO CIVILIAN PROGRAMS

SEC. 303. (a) There is hereby established an Advisory Panel on Transition of Scientific and Technical Manpower to Civilian Programs to be composed of thirty-one members,

of whom eighteen members shall be appointed by the Director for terms of three years, and of thirteen ex officio members designated in subsection (c) of this section. Appointed members shall be chosen from among persons who have, by reason of experience or accomplishments, demonstrated their qualifications to serve on the Panel, in equal numbers from the following categories:

(1) Engineering and natural sciences, including the environmental sciences;

(2) Economics and social sciences;

(3) Industry;

(4) Labor;

(5) Public affairs, education, and manpower training; and

(6) Unemployed or underemployed scientists, engineers, and technicians.

(b)(1) Of the members first appointed, six shall be appointed for a term of one year, six shall be appointed for a term of two years, and six shall be appointed for a term of three years, as designated by the Director at the time of appointment.

(2) Any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed only for the remainder of such term. Members shall be eligible for reappointment and

may serve after the expiration of their terms until their successors have taken office.

(3) Any vacancy on the Panel shall not affect its powers, but shall be filled in the same manner by which the original appointment was made.

(4) Each appointed member of the Panel shall, while serving on business of the Panel, be entitled to receive compensation at a rate not to exceed the daily rate prescribed for GS–18 of the General Schedule under section 5332 of title 5, United States Code, including traveltime, and while so serving away from their homes or regular places of business, they may be allowed travel expenses, including per diem in lieu of subsistence, in the same manner as the expenses authorized by section 5703(b) of title 5, United States Code, for persons in the Government service employed intermittently.

(5) Eleven of the voting members of the Panel shall constitute a quorum necessary for the transaction of official business.

(c) The Panel shall annually elect one of its appointed members to serve as chairman until the next election. The Panel shall meet at the call of the chairman, but not less often than four times a year. The Associate Director for Civil Science Systems; the Chairman of the Council of Economic Advisers; the Assistant Secretary of Commerce for

Science and Technology; the Assistant Secretary of Labor for Manpower; the Assistant Director for Economic Affairs of the United States Arms Control and Disarmament Agency; the Administrator of the National Aeronautics and Space Administration; the Director of Defense Research and Engineering; the Chairman of the Atomic Energy Commission; the Commissioner of Education; and the Assistant Secretary of Health, Education, and Welfare for Health and Scientific Affairs shall be ex officio nonvoting members of the Panel.

(d) A representative designated by the National Governors Conference; a representative designated by the National Association of Counties; and a representative jointly designated by the National League of Cities and the United States Conference of Mayors shall be voting ex officio members of the Panel.

(e) The Panel shall—

(1) advise the Director, with respect to the discharge of his responsibilities under this title;

(2) review and evaluate the effectiveness of Federal programs under this title;

(3) prepare and submit such interim reports as it deems advisable, and an annual report of its findings and recommendations, together with any recommendation for changes in the provisions of this title; and

(4) disseminate its findings and recommendations to such extent and in such manner as it deems effective and advisable.

(f) The Director shall make available to the Panel such staff, information, and other assistance as it may require to carry out its activities.

RESEARCH ON TRANSITION TO CIVILIAN PROGRAMS

SEC. *304. From funds available pursuant to section 313, the Foundation is authorized to—*

(1) make grants to, or to enter into contracts with, academic institutions, nonprofit institutes and organizations, public agencies, and private business firms, for the conduct of research designed to study and appraise the social, economic, and managerial aspects of transition from defense research and engineering activities to civilian-oriented research and engineering activities; and

(2) disseminate publicly, or enter into contracts with academic institutions, nonprofit institutes and organizations, public agencies, and private business firms for the public dissemination of, the significant results of such research conducted under subsection (1) of this section, as appear likely to aid in the transition from defense research and engineering activities to civilian-oriented research and engineering activities, particularly

those directed toward the resolution of priority national problems, as identified under section 103.

ASSISTANCE TO STATE AND LOCAL GOVERNMENTS

SEC. *305. (a) From funds available pursuant to section 313, the Foundation is authorized to make grants to State and local governments and regional governmental agencies for—*

(1) the conduct of programs at the State, local, or regional level, which are designed to facilitate the transition of scientific and technical activities to civilian programs within the particular State, local, or regional areas; and

(2) the hiring of currently unemployed or underemployed scientists, engineers, and technicians to work within State, local, or regional governmental agencies in positions which utilize their technical skills.

(b) The Director shall prescribe applicable salary rates for different types of technical positions in different areas of the country, none of which shall exceed the rate paid a person occupying grade GS–13, step 1.

(c) No one hired by a State, local, or regional governmental agency under this section may—

(1) receive compensation from Federal funds at a rate which exceeds the applicable rate as set by the Director; or

(2) remain in a position compensated under this section for a period in excess of two years.

TRAINING GOVERNMENT OFFICIALS

SEC. 306. (a) From funds available pursuant to section 313, the Foundation is authorized to make grants to, and to enter into contracts with, academic institutions, nonprofit institutes and organizations, and private business firms, for the purpose of their planning, developing, strengthening, or operating training programs for officers and employees of Federal, State, and local government who will be responsible for, or participate in, determining or administering government-assisted or conducted programs for civilian, socially oriented research and engineering activities.

(b) Such training programs will be directed at (1) acquainting the program participants with the potential contributions of science and technology to the resolution of public problems in such priority areas as are identified pursuant to this Act; and (2) teaching such participants how to utilize scientific and technical talent in an effective and economical manner.

(c) Organizations conducting such training programs may not charge any fee to a participant or participant's agency, which is not permitted by such regulations as the Foundation may prescribe.

(d) Participants in such training programs will be

selected by the grantee or contractor from nominations made by interested government agencies, in accordance with such criteria and regulations as the Foundation may prescribe.

GOVERNMENT EMPLOYEE PARTICIPATION

SEC. 307. (a) From funds available pursuant to section 313, the Foundation is authorized to transfer funds to other departments and agencies of the Federal Government, and to make grants to, and to enter into contracts with, State, regional, and local government agencies for the purpose of paying the travel and subsistence expenses of government employees incurred in connection with their participation in training programs carried out under section 306.

(b) Executive agencies of Federal, State, and local government are encouraged, to the extent consistent with efficient administration, to provide opportunities for appropriate officers and employees of such agencies to participate in training programs carried out under section 306.

COMMUNITY CONVERSION CORPORATIONS

SEC. 308. (a) From funds available pursuant to section 313, the Foundation is authorized to make grants to, or enter into contracts with, local governments or nonprofit corporations for the establishment and operation of community conversion corporations, which—

(1) function as nonprofit corporations;

(2) operate under the direction of a Board of Di-

rectors which is representative of a wide range of community interests, including citizen group and consumer participation, selected in accordance with such criteria as may be prescribed by the Foundation;

(3) conduct, contract for, or stimulate the conduct of civilian-oriented research and development activities which focus on the particular problems, or draw on the particular resources, of the community within which the corporation is located; and

(4) give preference in personnel recruitment to unemployed or underemployed scientists, engineers, and technicians, provided that they meet necessary qualifications for effective job performance.

(b) Existing nonprofit corporations are eligible to apply as community conversion corporations for financial assistance under this section, if such corporations meet the qualifications set forth under subsection (a) of this section.

(c) Each community conversion corporation receiving a grant or contract from the National Science Foundation is encouraged to seek additional financial support and payment for services from other agencies of Federal, State, or local government, private foundations, community organizations, and private business firms; and the National Science Foundation will give preference in awarding such community conversion grants or contracts to those corporations which show a likelihood of being able to obtain such additional financial support.

(d) The receipt by a community conversion corporation of a grant or contract from the National Science Foundation under this section does not make said corporation ineligible to receive other categories of grants and contracts from the Foundation.

(e) In awarding grants or contracts to community conversion corporations for specific research and development projects, the Foundation will give preference to those projects which offer the most promise of aiding in the resolution of national problems in priority areas as identified under section 103.

JOB TRANSITION PROGRAMS

SEC. 309. (a) From funds available pursuant to section 313, the Foundation is authorized, upon application, to make job transition grants to nonprofit institutes and organizations and to private business firms in order to enable them to hire scientists, engineers, and technicians for work on projects for which they are not yet fully qualified. Each such application shall contain provision to assure that—

(1) such projects shall consist of civilian-oriented research and engineering activities;

(2) the personnel participating in such job transition programs shall be selected from unemployed or

underemployed applicants by the grantees, in accordance with such criteria and regulations as shall be prescribed by the Foundation, including the requirement that the participants shall have a reasonable prospect of achieving full job qualification within a stipulated period of time;

(3) the personnel participating in such programs shall be afforded a reasonable opportunity to attend specialized training courses when such courses are deemed by the grantee to be necessary to supplement the on-the-job training of the participant; and

(4) no one may continue, or be selected, to participate in a job transition program under this section after such time that he receives a career transition fellowship under section 310.

(b) All significant scientific and technical information which is generated by the personnel participating in such programs shall be made available for public use, in accordance with such procedures as shall be prescribed by the Foundation.

CAREER TRANSITION FELLOWSHIPS

SEC. 310. (a) From funds available pursuant to section 313, the Foundation is authorized to award career transition fellowships to unemployed or underemployed scientists, engineers, and technicians to enable them to pursue a course

of study through which they can acquire specialized technical knowledge and skills in fields other than the ones in which they are already proficient.

(b) The Foundation shall allocate fellowships under this section in such manner, insofar as practicable, as will—

(1) attract highly qualified applicants; and

(2) provide an equitable distribution of such fellowships throughout those areas of the United States which are experiencing a higher than average level of technical unemployment.

For the purpose of this section, the Foundation shall consult with the Secretary of Labor to establish for each region in the United States the average level of technical unemployment.

(c) The Foundation shall award at least 10 per centum but not to exceed 20 per centum of the fellowships awarded under this section to scientists, engineers, and technicians who have completed their formal academic education within a five-year period prior to award of the fellowship, as certified in accordance with such regulations as the Foundation may prescribe.

(d) The Foundation shall pay to persons awarded fellowships under this section such stipends (including such allowances for subsistence, health insurance, relocation expenses, job placement expenses, and other expenses for such

persons and their dependents) as it may prescribe by regulation.

(e) Fellowships shall be awarded under this section upon application made at such times and containing such information as the Foundation shall by regulation require.

PLACEMENT ASSISTANCE

SEC. 311. (a) From funds available pursuant to section 313, the Foundation is authorized to transfer funds to other departments and agencies of the Federal Government, and to make grants to, and to enter into contracts with scientific, professional, technical, and business associations, and labor unions in order to establish and operate placement programs for unemployed or underemployed scientists, engineers, and technicians.

(b) Such grants and contracts may include provision for relocation expenses of the individual participant and his family when necessary, in accordance with such regulations as the Foundation shall prescribe.

(c) Grantees and contractors shall select applicants for such placement assistance in accordance with such criteria and regulations as the Foundation shall prescribe.

(d) No one shall be eligible for placement assistance under this section when he is—

(1) a participant in a job transition program under section 309; or

(2) a recipient of a career transition fellowship under section 310.

EDUCATION PROGRAM

SEC. 312. From funds available pursuant to section 313, the Foundation is authorized to make grants to, and to enter into contracts with, academic institutions, nonprofit institutes and organizations, and private business firms, for the purpose of their planning, developing, strengthening, or carrying out education programs which design courses and curriculums intended to prepare students for careers in civilian, socially oriented research and engineering activities, in areas such as pollution control, mass transit, solid waste disposal systems, public utilities, public safety systems, and health care technology.

AUTHORIZATION OF APPROPRIATIONS

SEC. 313. (a) There are authorized to be appropriated $152,000,000 for the fiscal year ending June 30, 1973, of which $5,000,000 shall be available to carry out the provisions of section 304, $15,000,000 shall be available to carry out the provisions of section 305, $4,500,000 shall be available to carry out the provisions of section 306, $500,000 shall be available to carry out the provisions of section 307, $30,000,000 shall be available to carry out the provisions of section 308, $75,000,000 shall be available to carry out the provisions of section 309, $15,000,000 shall be available

to carry out the provisions of section 310, $5,000,000 shall be available to carry out the provisions of section 311, and $2,000,000 shall be available to carry out the provisions of section 312; $203,000,000 for the fiscal year ending June 30, 1974, of which $5,000,000 shall be available to carry out the provisions of section 304, $25,000,000 shall be available to carry out the provisions of section 305, $9,000,000 shall be available to carry out the provisions of section 306, $1,000,000 shall be available to carry out the provisions of section 307, $30,000,000 shall be available to carry out the provisions of section 308, $100,000,000 shall be available to carry out the provisions of section 309, $20,000,000 shall be available to carry out the provisions of section 310, $10,000,000 shall be available to carry out the provisions of section 311, and $3,000,000 shall be available to carry out the provisions of section 312, $205,000,000 for the fiscal year ending June 30, 1975, of which $5,000,000 shall be available to carry out the provisions of section 304, $35,000,000 shall be available to carry out the provisions of section 305, $4,500,000 shall be available to carry out the provisions of section 306, $500,000 shall be available to carry out the provisions of section 307, $30,000,000 shall be available to carry out the provisions of section 308, $100,000,000 shall be available to carry out the provisions of section 309, $20,000,000 shall be available to carry out the

provisions of section 310, $5,000,000 shall be available to carry out the provisions of section 311, and $5,000,000 shall be available to carry out the provisions of section 312.

(b) Funds appropriated pursuant to subsection (a) of this section shall remain available for obligation, for expenditure, or for obligation and expenditure, for such period or periods as may be specified in Acts making such appropriations.

TITLE IV—PROTECTION OF PENSION RIGHTS OF SCIENTISTS AND ENGINEERS

SEC. 401. The Congress finds that because of rapid and frequent changes in Federal procurement objectives and policies, engineering and scientific personnel suffer a uniquely high rate of forfeiture of pension benefits under private pension plans, as such employees tend to change employment more frequently than other workers. The Congress declares that it is the policy of the United States to seek to protect scientists and engineers from such forfeitures by making protection against forfeiture of pension credits, otherwise provided, a condition of compliance with Federal procurement regulations.

SEC. 402. The Director shall develop, in consultation with appropriate professional societies and heads of interested Federal departments and procurement agencies, recom-

mendations for modifications of Federal procurement regulations to insure that scientists, engineers, and others working in associated occupations employed under Federal procurement, construction, or research contracts or grants shall, to the extent feasible, be protected against forfeitures of pension or retirement rights or benefits, otherwise provided, as a consequence of job transfers or loss of employment resulting from terminations or modifications of Federal contracts or procurement policies.

SEC. 403. Recommended changes in procurement regulations shall be developed by the Director, as required by section 402, within six months after enactment of this Act, and shall be published in the Federal Register within fifteen days thereafter as proposed regulations subject to comment by interested parties.

SEC. 404. After publication under section 403, receipt of comments, and such modification of the published proposals as the Director deems appropriate, the recommended changes in procurement regulations developed under this title shall be adopted by each Federal department and procurement agency within sixty days thereafter unless the head of such department or agency determines that such changes would not be in the national interest or would not be consistent with the primary objectives of such department or agency.

TITLE V—GENERAL PROVISIONS

DEFINITIONS

SEC. 501. As used in this Act:

(1) The term "academic institution" means any United States institution of higher education as defined in sections 491 and 1201 of the Higher Education Act of 1965.

(2) The term "Administration" means the Civil Science Systems Administration.

(3) The term "Assistant Director" means an Assistant Director of the National Science Foundation.

(4) The term "Associate Director" means the Associate Director for Civil Science Systems of the National Science Foundation.

(5) The term "civil science system" means any set of interrelated technological applications which are designed to perform certain public services, as defined in subsection (11) of this section.

(6) The term "civilian research and engineering activities" means all nondefense research and engineering activities as determined pursuant to regulations of the Director of the Foundation after consultation with the Directors of the Office of Management and Budget and the Office of Science and Technology.

(7) The term "Council" means the Civil Science Systems Advisory Council.

(8) The term "defense research and engineering activities" means any activity which involves—

(i) research, development, or engineering, including necessary supporting services, performed under grant from, or contract with, the Department of Defense or under subcontract to such a grant or contract; or

(ii) the construction, reconstruction, repair, or installation of any building, plant, structure, facility, or equipment connected or necessary to such research, development, engineering, or supporting services.

(9) The term "Deputy Associate Director" means the Deputy Associate Director for Civil Science Systems of the National Science Foundation.

(10) The term "Director" means the Director of the National Science Foundation.

(11) The term "Federal executive agency" means any department, agency, or independent establishment in the executive branch of the Government, including any wholly owned Government corporation.

(12) The term "Foundation" means the National Science Foundation.

(13) The term "Panel" means the Advisory Panel on Transition of Scientific and Technical Manpower to Civilian Programs.

(14) The term "public service" means any set of inter-

related organizations and activities which collectively perform certain related functions normally associated with life in our society, including but not limited to such public services as health care, public safety, public sanitation, pollution control, housing, transportation, public utilities, communications, and education.

(15) The term "State" includes each of the several States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Trust Territory of the Pacific Islands.

ADMINISTRATIVE PROVISIONS

SEC. 502. (a) The Director of the Foundation is authorized, in furtherance of the purposes and provisions of this Act, to—

(1) appoint such additional personnel as he deems necessary to carry out this Act;

(2) appoint such advisory committees as he deems advisable;

(3) procure the services of experts and consultants in accordance with section 3109 of title 5, United States Code; and

(4) use the services, personnel, facilities, and information of any other Federal department or agency, any agency of a State, or political subdivision thereof, or any

private research agency with the consent of such agencies, with or without reimbursement therefor.

(b) Upon request by the Director, each Federal department or agency is authorized to make its services, personnel, facilities, and information, including suggestions, estimates, and statistics, available to the greatest practicable extent to the Director, or his designee, in the performance of his functions under this Act.

(c) The Director shall establish such additional divisions or offices within the Foundation as he deems necessary to carry out his functions under this Act.

PAYMENTS AND WITHHOLDING

SEC. 503. (a) Payments under this Act may be made in installments, in advance, or by way of reimbursement, with necessary adjustments on account of underpayment or overpayment.

(b) Whenever the Director, after giving reasonable notice and opportunity for hearing to a grantee or contractor under this Act, finds—

(1) that the program or project for which such grant or contract was made has been so changed that it no longer complies with the provisions of this Act; or

(2) that, in the operation of the program or project, there is failure to comply substantially with any such provision—

the Director shall notify such grantee or contractor of his findings and no further payments may be made to such grantee or contractor by him until he is satisfied that such noncompliance has been, or will promptly be, corrected. The Director may authorize the continuance of payments with respect to any projects pursuant to this Act which are being carried out by such grantee or contractor and which are not involved in the noncompliance.

RECORDS AND AUDIT

SEC. 504. (a) Each recipient of assistance under this Act pursuant to grants received, agreements entered into, or contracts entered into under other than competitive bidding procedures shall keep such records as the Director shall prescribe, including records which fully disclose the amount and disposition of the proceeds of such assistance, the total cost of the project or undertaking in connection with which such assistance is given or used, and the amount of that portion of the cost of the project or undertaking supplied by other sources, and such other records as will facilitate an effective audit.

(b) The Director and the Comptroller General of the United States, or any of their duly authorized representatives, shall have access for the purpose of audit and examination to any books, documents, papers, and records of the recipients that are pertinent to the assistance received under this Act.

PATENT RIGHTS

SEC. 505. (a) Each grant, contract, or other arrangement executed pursuant to this Act which relates to scientific research or engineering shall contain provisions governing the disposition of inventions produced thereunder in a manner calculated to protect the public interest and the equities of the individual or organization with which the grant, contract, or other arrangement is executed. Nothing in this Act shall be construed to authorize the Foundation to enter into any contractual or other arrangement inconsistent with any provision of law affecting the issuance or use of patents.

(b) No officer or employee of the Foundation shall acquire, retain, or transfer any rights, under the patent laws of the United States or otherwise, in any invention which he may make or produce in connection with performing his assigned activities and which is directly related to the subject matter thereof. This subsection shall not be construed to prevent any officer or employee of the Foundation from executing any application for patent on any such invention for the purpose of assigning the same to the Government or its nominee in accordance with such rules and regulations as the Director may establish.

Amend the title so as to read: "A bill to amend the National Science Foundation Act of 1950 in order to establish a framework of national science policy and to focus the Nation's scientific talent and resources on its priority problems, and for other purposes."

Calendar No. 977

92D CONGRESS
2D SESSION

S. 32

[Report No. 92–1028]

A BILL

To authorize the National Science Foundation to conduct research, education, and assistance programs to prepare the country for conversion from defense to civilian, socially oriented research and development activities, and for other purposes.

By Mr. KENNEDY, Mr. ANDERSON, Mr. BAYH, Mr. BENTSEN, Mr. BROOKE, Mr. CANNON, Mr. CASE, Mr. CHILES, Mr. COTTON, Mr. CRANSTON, Mr. EAGLETON, Mr. GAMBRELL, Mr. GRAVEL, Mr. HARRIS, Mr. HART, Mr. HARTKE, Mr. HATFIELD, Mr. HOLLINGS, Mr. HUGHES, Mr. HUMPHREY, Mr. INOUYE, Mr. JACKSON, Mr. JAVITS, Mr. MAGNUSON, Mr. MANSFIELD, Mr. MCGEE, Mr. MCGOVERN, Mr. METCALF, Mr. MONDALE, Mr. MONTOYA, Mr. MOSS, Mr. MUSKIE, Mr. NELSON, Mr. PASTORE, Mr. PEARSON, Mr. PELL, Mr. RANDOLPH, Mr. RIBICOFF, Mr. SCHWEIKER, Mr. SPARKMAN, Mr. STEVENS, Mr. STEVENSON, Mr. TUNNEY, Mr. WEICKER, and Mr. WILLIAMS

JANUARY 25, 1971

Read twice and referred to the Committee on Labor and Public Welfare

AUGUST 9, 1972

Reported with amendments

THE PRESIDENT'S SCIENCE ADVISORY COMMITTEE

EXECUTIVE OFFICE BUILDING

WASHINGTON, D.C. 20506

MEMORANDUM FOR

Members of President's Science Advisory Committee

Dr. Carl York and Dr. Lawrence A. Goldmuntz terminated their services with OST at the end of September.

Dr. York, who had been with OST since December 1969, is now Vice Chancellor for Academic Affairs at the University of Denver.

Dr. Goldmuntz, who came to OST in February 1971, has returned to private industry.

David Beckler

David Z. Beckler
Executive Officer

Dr. R. L. Garwin - 10-16-72

Comments on National Science and Priorities Act of 1972

The Act has five titlesc arrying the following authorizations over a three-year period:

Title I - Science Policy and Priorities for Civilian Research and Engineering -- $50 M

Title II - Establishment of Civil Science Systems Administration (CSSA) -- $1.2 B

Title III - Transition of Technical Manpower to Civilian Programs $560 M

Title IV - Protection of Pension Rights of Scientists and Engineers

Title V - General Provisions

The National Journal article by Claude Barfield provides a reasonable description of the bill and the attitudes of various individuals toward it. My comments can do little more than help to focus the Committee discussion.

1. The bill is not perfect, but I cannot in three pages both rewrite it to suit myself and give convincing arguments why my version is the best of all possible. Therefore, I shall consider the main points and ask whether they or slight modifications would be of significant benefit.

2. I ignore most of the bureaucratic aspects, such as the structure of the Advisory Board and the degree of control by the National Science Board over these new responsibilities. The NSB would probably in any case have to develop more structure and discipline in order to handle these new responsibilities, even to the extent of creating a largely separate Board.

3. There is the danger that the assumption by the NSF of such large additional responsibilities for the development, demonstration, and application of science in highly visible areas could imperil the continued support by the NSF of longer-range science and technology. It would seem easy enough in some future year for the Congress to reduce the NSF budget by perhaps 30 per cent, directing that the CSSA programs be untouched, which could be tantamount to wiping out support for basic scientific research. Furthermore, the more basic science would have to fight for priority and funds in the annual budget process within the NSF, after the Congressional initiative which created the CSSA had died away. It seems to me that this is the most serious problem with the proposal, one which could be remedied by lodging the new programs in a different agency, which proposal has its own problems. On balance, I think that the problem is tolerable.

4. Protection of pension rights of scientists and engineers is a small part of the total social problem of protection of pension rights and job benefits in our mobile society.

It seems in the national interest to increase the mobility of the work force by such protection of pension rights, and it would right an inequity whereby many pensions are lost because the employer goes out of business or lays off workers before pension rights are vested. I see no reason why this major problem should not be attacked by such a beginning.

5. Title III (Transition of Technical Manpower) consumes half of the funds of the title and provides a subsidy or partial subsidy for the hiring of scientists and engineers by both business and non-profit organizations into jobs for which their previous background does not fit them. To the extent that such a program shifts the burden of unemployment to new graduates, it is hardly an unmixed blessing. An expansion of employment opportunities via Title II or some alternative might well achieve the aim of Title III.

The main context of the Act, and the most controversial, is contained in Title II, creating within NSF a Civil Science Systems Administration. The Foundation is to

". . . support programs . . . to design Civil Science Systems . . . to provide improved public services . . . Develop alternative civil science systems . . . support public demonstration; test and evaluate . . . appraise the results ... disseminate and demonstrate the results. . . transfer funds to the departments."

Regarding system demonstration projects . . . "which illustrate the functioning and associated benefits of alternative . . . systems. Accurate and complete representations . . . public exhibitions . . ."

I recommend that the Declaration of Policy be supplemented by the addition of a Section 2(a)(5):

"There is a severe lack of alternative programs ready to be supported at a large scale if funds were made available."

Comments on the Civil Science Systems Administration

It would seem preferable for the work of the CSSA to be initiated and performed within the mission-oriented agencies by competent individuals in contact with the real problems and possessed of the judgment and energy to plan, persuade, develop, demonstrate, and evaluate new systems in support of social goals. This would, of course, involve development and evaluation of more systems than can be widely deployed (even systems competitive for the same social niche).

At least 10 years of experience shows that it is difficult to nucleate and to support in the civil agencies a group competent to initiate and carry out technical programs, and that such a group may often be denied within the agency the funds, priority, and independence necessary to do this job. Even in the Department of Defense, the Advanced Research Projects Agency (ARPA) has been quite constrained in the nature of alternatives which it could support. A general concern is to avoid overlap between work done by one organization (say, the CSSA) and a mission-oriented agency. The real need is to ensure overlap and competition, and the availability of more alternatives than will be chosen.

Although the CSSA will be farther from the real world of the government departments and agencies, it need not suffer from the rather arbitrary categorization of the present department structure. Furthermore, a centralized group such as CSSA can maintain competence, spirit, and control over its programs which is not possible in a smaller development, test, and evaluation element submerged in a mission-oriented department.

Doubt has been expressed that CSSA could initiate and manage programs in fields as varied as urban transport and public health delivery in rural areas. I think that this is really a doubt as to the applicability of science and technology to social problems, because I don't see why the same group within CSSA as might exist, say, within HUD, could not do the same job. The "advantages" of contact with the operators, present in HUD, would be less in CSSA, but this loss will be compensated by greater independence, a management far more experienced in the choice and management of technical programs.

NSF could not assimilate the responsibilities of S-32 without substantial expansion of its staff of technical managers. I believe that a major expansion of NSF to meet the CSSA responsibility will result in a better staff than will a gradual expansion of RANN.

Finally, the funding pattern of S-32 should be modified, but this is a detail in comparison with a judgment that a Civil Science Systems Administration in NSF is achievable and beneficial in comparison with

any alternative proposal thus far discussed.

S. Buchsbaum - 10-16-72

Some Con Views on S. 32

S. 32 IS AN ABOMINATION -- for two relatively major reasons (and a host of lesser ones which are spelled out later).

1. S. 32, if it becomes law, is likely to set back rather than advance meaningfull programs in many of the areas -- health care, poverty, public safety, pollution, unemployment, housing, education, transportation, nutrition, communications, and energy resources -- which it addresses. By placing the burden on the National Science Foundation to provide prescriptions for the cure of all our ills -- a burden which the NSF alone cannot possibly discharge (no single organization could) -- S. 32 essentially is saying to the cognizant mission-oriented agencies of the Federal Government to rely on the NSF rather than on themselves to fulfill their missions. (One can imagine what might have happened if some years ago a single organization were given the much simpler task of doing the research and engineering for the DoD, NASA and the AEC!) At best, S. 32 would delay by years the time when the "responsible" agencies become truly capable of discharging their responsibilities. And it may delay, or even prevent, some necessary reorganizations and realignments of functions which must take place if problem areas are to be tackled which span the missions of several present-day agencies. To expect NSF to provide the sponsoring is unrealistic. But that the Committee which drafted S. 32 so intends is unmistakable. They state (on p. 45) "Accordingly, the Committee feels

it is essential that the programs set forth in S. 32 be administered by a single agency."

In the process of trying to reach the unreachable there is considerable danger that the NSF's present mission, the fostering of the nation's basic research and higher education, would become jeopardized.

What drove the framers of S. 32 isn't obviously clear. One of the factors could have been real frustration with the slowness of the progress that is being made to cure the ills which beset our society. Alas, the testimony which the Administration's spokesmen offered in opposition to the bill was not very helpful in dispelling such frustration. The testimony can be paraphrased: "We are already doing all that can and should be done." Such words, as they should, fall on deaf ears.

2. S. 32 elevates a) science and b) scientists and engineers to a pedestal which they do not deserve. It says, in effect, that science, having placed a man on the moon, can solve all our ills and that unemployed scientists and engineers are the vehicle for such salvation. Such confidence is touching, but it is misguided and dangerous. It is dangerous for the nation (and for its science and scientists!) to adopt the simplistic view embodies in S. 32 that science and technology alone can resolve "national problems in areas such as health care, poverty, public safety, pollution, unemployment, housing, education, transportation, nutrition, communications and energy resources." As PSAC well knows, much more than just science

and technology has got to be brought to bear to make progress in any one of these problem areas, and to place the burden on science alone is to bury one's head in the sand.

S. 32 makes particular point of unemployed scientists and engineers and sets up a whole range of programs to help ensure that every so-called scientist, or engineer, or technician, be paid for doing his thing whether or not the thing is worth being paid for. Laws of demand and supply cannot be thrown to the winds for long with impunity and without ultimate retribution.

Some "Lesser Reasons"

a) S. 32 would (p. 1) "prepare the country for conversion from defense to civilian . . . activities," implying that the nation no longer has need for defense R&D activities.

b) I agree (p. 2) that, as a matter of policy, "Federal investment in science and technology must be raised to an expenditure level which is adequate to the needs of the nation," but I disagree that it makes sense then to go on and state as policy that "(the investment) continue to increase annually in proportion to the growth in the gross national product . . ." and in the same breath that "Federal obligations for civilian research and engineering must be increased so as to reach a level of parity with Federal obligations for defense research and engineering . . ." (With NASA included, "civilian" R&D already exceeds defense R&D.)

c) The authorization for Section 207 of S. 32 (Planning for Civil Science Systems) betrays probably more than any other section of the bill the naivete of the framers of the bill regarding what it takes to do the job. For "Planning for Civil Science Systems," the bill authorizes $25 M for FY 1973, $20 M for FY 1974, and $10M for FY 1975. In other words, "planning" can be done and over with during the first two years and from then on it is clear sailing!

d) Equally revealing are pps. 33-41, which summarize the "Committee Views" on the bill. There we find that "to provide the NSF with . . . authority . . . to exercise a leadership role in determining national science priorities and in developing national policies . . ." will take 100 research projects at $0.5M per project; "Planning for Civil Science Systems" will take 110 planning projects; to do Applied Social Research will take 233 projects; and that "Civil Science System Research and Design," which is the heart of the bill, calling for the expenditure of most of the monies, will serve each of its twelve major areas with forty research projects (at $1M per research project), plus five design projects (at $5M per design project). It is hard to envisage a more enticing invitation to dissipation of resources.

e) On p. 40, the Committee states its view that "the enactment (of S. 32) would provide positions for 41,000 scientists, engineers, and other technical personnel in its <u>peak</u> year. Webster's dictionary defines

"peak" as "the sharp or pointed end of anything." Are we to interpret the phrase to mean that FY 1975 will see the "peak" effort in "civilian" RDT&E so far as the NSF is concerned?

f) On p. 44, the Committee says that "Science cuts across all fields and all problem areas, so that the existing programsof the NSF . . . cut across many other agencies' jurisdictions . . ." And because "These potential problems (of overlap and duplication) have never proved insurmountable in the past with existing NSF programs . . . there is no reason to assume that S. 32 programs could not be similarly handled." What a bit of wishful thinking!

g) That the Committee doesn't just have research in mind is made abundantly clear on p. 46 in its discussion of subsection (c) of section 202, which take the programs of that section from the jurisdiction of the National Science Board. "But the experience of DoD, NASA and AEC with management of systems procurement programs makes it abundantly clear that a high technology systems procurement program involving industry cannot be managed by a committee of twenty-four distinguished scholars which meets almost every month. In the Civil Science Ssystems Program there will be deadlines to be met, subcontractor projects to be re-evaluated, and costs and performance goals to be watched. Such a program requires

tight project management . . ." It sure does, and NSF, of course, has it!

NOTES ON AGENDA
PSAC MEETING
October 16-17, 1972

Item 1 Energy Policy Issues

This item is the first of a two-part discussion on national energy policy which will be continued at the November meeting of the Committee. Dr. Balzhiser will lead a discussion of the energy policy issues which have a bearing on the level, complexion and manner of Federal support of energy R&D. At the November meeting there will be a presentation of the results of an extensive OST study on energy technologies, requested by the President in his Energy Message to the Congress on June 4, 1971. Dr. David's statement before the Congressional Joint Committee on Atomic Energy on September 12, 1972, which comments on the national energy R&D strategy, was mailed to you on September 22. The OST study of energy technologies was described in the material sent you on September 11, which included Dr. David's statement before the House Committee on Science and Astronautics of May 25, 1972, a description of the energy study undertaken by the Federal Council for Science and Technology, and a statement on Federal Energy R&D Funding. It is hoped that, as a result of these two briefings and discussions, PSAC will assist the OST in developing positions on the Federal energy R&D efforts.

Item 2 PSAC Panel Activities and Status Reports on Selected Panels

Committee members are invited to comment on the general scope and nature of PSAC Panel activities. A list of PSAC panels is enclosed with this agenda. There will be brief status reports on selected Panels by the Panel Chairmen. The report of the Panel on Training for Research in Biomedical Sciences may be ready for presentation and discussion at the November meeting. Further discussion of the report of the Chemicals and Health Panel will be deferred to the November meeting to give the Panel additional time to consider the comments of PSAC members at the last meeting.

Item 3 Chairman's Report

a. Status of Preparations for Meeting of the US-USSR Joint Commission on Scientific and Technical Cooperation

The first meeting of the US-USSR Joing Commission will be held on October 24 and 25 in Washington, D. C. There

will be a meeting of the U.S. side of the Joint Commission on October 13 to review the final form of the Working Group proposals. Dr. David will summarize the results of this meeting and invite PSAC member comments, bearing in mind the presentations made by the Chairmen of the U.S. Working Groups at the September meeting of PSAC.

b. Further Discussions of Federal Science and Technology Organization

At the September PSAC meeting there was an initial discussion of S-32, the National Science Policy and Priorities Act of 1972, introduced by Senator Kennedy. Hearings were held by the House Committee on Science and Astronautics Subcommittee on Research on September 26 and 27, 1972. Enclosed are copies of the statements by the Director of the National Science Foundation and the Chairman of the National Science Board, together with copies of S-32 and the Senate Report on the bill. At the September meeting, Dr. Garwin was asked to prepare a three-page statement in support of the concept of the bill and Dr. Buchsbaum was asked to prepare a statement listing reasons to oppose the bill. These statements will be discussed at the meeting. Central questions to be addressed are: (1) is the Federal government seriously undersupporting R&D to meet human needs? and (2) is there a need for new organizational mechanisms to help remedy such deficiencies?

c. The Federal Advisory Committee Act (H.R. 4383)

Congress has passed and sent to the President H.R. 4383 governing the creation and operation of advisory committees in the Executive Branch of government. If this bill is signed by the President it would, unlike the recent Executive Order on Committee Management, specifically apply to the President's Science Advisory Committee and its Panels. It would not cover committees of the National Academy of Sciences. This bill would require advance notification of PSAC meetings in the Federal Register and the opportunity for interested persons to attend or appear before the Committee. The public disclosure of Committee agendas, minutes, reports, etc., and the opportunity for interested members of the public to attend meetings of the Committee would be subject to the provisions of the Freedom of Information Act, which exempts certain disclosures where they bear on policy considerations and recommendations. The Committee would have a two-year term which could be extended by action of the President for additional two-year periods.

Item 4 Russian Language Machine Translation

There is renewed interest in the question of machine-aided translation as the result of the new emphasis on US-USSR cooperative projects in science and technology and developments in computers and computer programs.

In 1965, PSAC was briefed on a report (copy enclosed) by the Automatic Language Processing Advisory Committee of the National Research Council chaired by J. R. Pierce. At that time, it was concluded that: (a) considerably more basic knowledge in computational linguistics is needed before fully automatic translation can be achieved; and (b) machine translation serves no useful purpose without postediting, and that with post-editing the overall process is slow and probably uneconomical.

Since that time, the development of a sophisticated computer program for machine translation and further work by the Foreign Technology Division of the Air Force Systems Command appear to make machine translation more attractive -- at least for specialized arts. The FTD personnel believe that their experience sets the stage for much broader application of Russian language machine translation.

A special panel of the National Academy Advisory Committee to the Air Force Systems Command has been examining the FTD work but is not expected to report in the near future. We have invited some of the members of this group in a personal capacity, together with members of the earlier NRC study, to be present for the presentation by FTD so that PSAC can have the benefit of a range of viewpoints. The attached background statement on this item was prepared by Dr. John Martin of the OST staff.

David Beckler

David Z. Beckler
Executive Officer

Summary of FTD Presentation on Machine Translation

Language translation by computers generally referred to as machine translation (MT) has been of interest for a decade or more. In view of the present interests of cooperating with the USSR on science and technology matters and in view also of the desire to exploit fully exchanges of technical documentation, the interest in MT has again been focussed.

The landmark assessment of MT was carried out by the Automatic Language Processing Advisory Committee of NAS-NRC, whose findings were published in 1961 as "Language and Machines." A copy of the report is available.

The Committee concluded that there was at that date no real machine translation. What passed as machine translation was translation in which human post-editing of "machine translation" was an essential step. Such post-editing required a knowledge of the source language and was about as difficult as translation. The resulting quality was enough inferior to that of human translation (Appendix 10) as to result in some misunderstanding. Including key posting and post editing time and cost, such translation was neither faster nor more economical (Appendix 9) than superior human translation. Translators told the Committee that the essentials necessary for a satisfactory translation are: (1) good knowledge of the target language (2) comprehension of the subject matter (3) adequate knowledge of the source language (pg. 1). The Committee believed that these are essential and that the problem of putting such knowledge into a machine (pg. 24) seemed overwhelming.

Further the Committee found that the amount and cost of translation was moderate ($13M per year in the federal government, pg. 9) and the field to be over-populated and under-remunerated (pg. 11-12).

In translation, quality and speed vie for first place, independent of circumstances, with cost important but definitely second. With this in mind, the Committee's recommendations included (pg. 34) aids for translation, including machine aids, evaluation of quality and cost of translation, and study of delays in the overall translation problem. The Committee also proposed a wider learning of foreign languages for those who deal with considerable foreign materials (pg. 5).

Subsequently, the USAF Scientific Advisory Board undertook a study of MT also. The AF report to the SAB on the machine translation of languages, December 1962, was prepared to assess a presentation proposal developed by the AF Systems Command. This proposal was limited

to a 10,000 word per day Russian capability. The Committee recommended the acquisition of the system recognizing its limited initial operating capabilities. They reported that the application was constrained more by software state-of-the-art than by hardware. The slow input process (flexowriter) and the lack of sophisticated linguistic systems were cited as principle liabilities. The Committee proposed a controlled evaluation of future actions in the MT area, citing the limited quality of syntactic and semantic capability inherent in computer supported translations.

Following on these recommendations to the USAF, FTD has developed a MT capability which is the subject of today's briefings. This presentation is broken into two parts:

1. This briefing on the Russian-to-English machine translation (MT) operation of the Foreign Technology Division of the USAF Systems Command was designed to explain the present capabilities of the SYSTRAN MT software system, around which the operation is built, placing it in perspective both with earlier operational MT systems and with a conceivable future fully automatic, high quality translation system. The significance of earlier MT developments and their limitations are emphasized. Descriptions are provided of the functions in our translation production system and of the linguistic techniques which are used in the SYSTRAN software to resolve linguistic problems encountered in the Russian-to-English translation. The orientation of AF R&D activities in machine translation is discussed and a description of the anticipated configuration of the MT system of the future is provided.

2. The second presentation on the Russian-to-English machine translation operation of the FTD of the USAF Systems Command describes the hardware configuration on which SYSTRAN Russian-to-English machine translations are processed and the design and operation of the computer programs which SYSTRAN contains. The computer requirements of the system and details on its performance are provided. The various sequences in the translation process are described in terms of the programs which accomplish these functions. The functions of the utility and maintenance programs used with SYSTRAN are also explained.

Present at the presentation in addition to the FTD presentation team are Professor John Pierce, Chairman of the NAS-NRC study referred to, now of California Institute of Technology; Professor Anthony Oettinger of Harvard, who was a member of the study group; Dr. Hood Roberts of the Center for Applied Linguistics, who has participated in MT study activities and whose organization is involved in such work; and, tentatively, Dr. Willis Ware of the RAND Corporation, who has also participated in these studies.

STATEMENT BY DR. ROGER W. HEYNS
VICE CHAIRMAN, NATIONAL SCIENCE BOARD
BEFORE THE
SUBCOMMITTEE ON SCIENCE, RESEARCH, AND DEVELOPMENT
HOUSE COMMITTEE ON SCIENCE AND ASTRONAUTICS
SEPTEMBER 27, 1972

Mr. Chairman and Members of the Subcommittee:

I appreciate the invitation to appear before you today to testify on S. 32, the NATIONAL SCIENCE POLICY AND PRIORITIES ACT OF 1972. I very much regret that Dr. H. E. Carter, the Chairman of the National Science Board, could not be here today, but I am honored to represent the Board in his absence.

INSERT → What I shall do today is to report as accurately as I can the results of several hours of discussion of S. 32 by the Board at its September meeting. It will be clear as I proceed that the discussion did not deal with all aspects of this complex legislation. The Board did, however, reach some conclusions on the principal provision, and I pass them on in the hope that they may be useful to the Committee. Before I state them, however, it is only accurate to report that none of these conclusions was without its critics within the Board.

The Board approved the intention of Title I to strengthen the role of the National Science Foundation (NSF) in the development of national science policy. The increase in responsibility draws upon existing strengths of the Foundation. The Foundation has the ability to call upon the scientific community for program design, analyses, and evaluation,

INSERT

Before proceeding to my formal statement, I would like to make two statements.

1. The Board clearly wants to express its basic support for the objectives of this legislation which is to strengthen the role of science and technology in the solution of national problems.

2. The Board recognizes that this legislation involves administrative and organizational questions that need further exploration. Many Federal agencies are involved in the development of science and technology policy and the conduct of research and development.

all vital activities for sound policy decisions. The Board noted further that Title I is key to the successful operation of the programs referred to in Title II.

Title II would assign new responsibilities to NSF for development, testing, and demonstration of civilian science systems. In addition, it would increase NSF responsibilities for studies and applied research leading to the design of such systems.

The Board recognizes that a greater effort must be made to try to utilize science to deal with civilian problems. Here I would note the strong steps already taken by the Administration to increase research and development in civilian agencies and to provide support for applied programs. The Board concluded that the Foundation, while not uniquely capable, is a reasonable locus of this responsibility. It has effective relations with the scientific community and it has demonstrated in the recently established Research Applied to National Needs (RANN) Program that it can develop support in that community for research programs in which science is applied to civil problems. At the same time, however, the Board has a genuine concern about the impact of these new commitments on the basic science obligations of the Foundation. The Board recognizes that Title II markedly changes the basic and applied research balance of the Foundation and that this new balance may jeopardize its ability to discharge its responsibilities for the health of basic science.

It is this concern with basic science and the effective integration of the basic science and applied science activities which led the Board to comment on the administrative provisions of Title II. The Board recognizes that the adequate discharge of the responsibilities of this title may well require changes in its present arrangements, perhaps along the lines suggested by the legislation. Since, however, the principal argument for NSF involvement in Title II activities is the Foundation's unique ability to relate to the scientific community, there should not be any language in the bill which appears to diminish the Board's responsibility for determining the policies under which the Civil Science System Administration would function.

Finally, if it were given the responsibilities under Title II, the Board would reaffirm its commitment to certain well established policies: It is committed to strengthen the research capabilities of existing agencies. It does not want to separate these agencies from their constituencies. It intends to continue its commitment to the principle of multiple sources of research funds within the Federal Government.

With respect to Title III, the Board recognizes the manpower dislocations the Nation has been experiencing in the scientific and technical fields and recognizes that these have caused significant losses to the Nation as well as to the individuals affected.

However, the appropriate solution to this manpower problem must be found through public programs which utilize the skills of scientists and engineers for specific program ends rather than through programs where employment per se is the primary objective. Temporary employment and retraining programs with no permanent job opportunity in sight are palliative and do not allow either the Nation or the individual to achieve maximum potential.

It would appear to the Board that the task contemplated in this title can be performed by the Federal Government more effectively if continued to be coupled with the responsibilities of Title II. With respect to Title III the Board agreed that this is a problem that must be solved. It is an urgent one and one with which the Board must concern itself in some manner.

Turning to Title IV, the Board supports the concept of portability of pensions. Scientists and engineers constitute only a small fraction of the millions who are affected by the loss of pension and retirement rights. The Board believes, therefore, that any solution for scientists and related professionals should be a part of the solution to the larger problem and that an effort to find the larger solution is more appropriately the task of another agency such as the Department of Labor.

In conclusion, Mr. Chairman, I emphasize that the National Science Board offers these views fully aware of the fact that this is legislation of enormous significance.

Undoubtedly, the Board in subsequent discussions will refine and expand its position. The Board would want me to emphasize the significance it attaches to the basic science responsibilities of the Foundation, and its eagerness to preserve the Foundation's strength in that area. The Board, as my report indicates, recognizes, however, that the problems the Nation faces call for added emphasis on the application of science--a position this Administration has taken, as already reflected in the President's Science and Technology Message.

The Board stands ready to work with the Congress and the Administration in developing a balanced program of research and development and in playing an enlarged role in that program.

STATEMENT BY DR. H. GUYFORD STEVER
DIRECTOR, NATIONAL SCIENCE FOUNDATION
BEFORE THE SUBCOMMITTEE ON SCIENCE, RESEARCH, AND DEVELOPMENT
HOUSE COMMITTEE ON SCIENCE AND ASTRONAUTICS
SEPTEMBER 26, 1972

MR. CHAIRMAN AND MEMBERS OF THE SUBCOMMITTEE:

I am pleased to appear once again before this committee. As you are aware, both Dr. McElroy, my predecessor at the National Science Foundation, and I have commented previously on aspects of the NATIONAL SCIENCE POLICY AND PRIORITIES ACT of 1972.

The bill this committee is now considering is substantially different from the earlier versions on which we testified, but I believe that many of our past comments are still appropriate.

We recognize that this bill addresses significant, recognized needs in our society. As I will develop later in this testimony, I believe that the Administration and the Congress are already taking constructive steps toward meeting the national needs which are perceived by S. 32's sponsors. The bill addresses the following:

-- The use of Federal support to maximize science's contribution to the solution of national needs;
-- The devotion of at least as much effort to solving domestic problems as is devoted to maintaining our national defense;

-- The assurance that our scientific and technical manpower are fully and productively employed; and

-- The added emphasis upon research to help solve the high priority civilian sector problems we now face.

As this committee well realizes, most of these societal problems are highly complex, and the potential contributions of science and technology to their solution vary in degree and kind. Although I am convinced that science and technology will make major contributions towards solving many of these problems, I feel that the ways and even the problems in which science can most contribute are not always clear.

The goals and objectives of S. 32 are ones on which many reasonable men could agree. I do not think we need to discuss those here today, but rather I would like to discuss the appropriate means for achieving them.

The President, in his first Science and Technology Message, sent to the Congress on March 16 of this year, placed heavy emphasis on the need for a strong new effort to marshall science and technology in the service of our society. In that message he described several steps that are being taken to achieve this goal, including:

-- The efforts to develop a coordinated, cooperative involvement in science and technology by the Federal government, private enterprise, State and local government and the scientific community.

-- The specific new thrusts in energy, transportation, biomedical research and other areas; and

-- The encouragement of more widespread use of research results derived from Federally sponsored research.

In the State of the Union Message and the Budget for FY 1973, the President emphasized increased support for science and technology in the civilian sector and outlined the responsibility of all agencies -- including the National Science Foundation -- to encourage, focus, and support our Nation's scientific effort.

The administration has responded to the need for more civilian R&D through a 65 percent increase since 1969 (from $3.3 billion to $5.4 billion). In FY 1973 alone, the President requested $700 million more than the year before in the civilian R&D budget.

The National Science Foundation has been responsive to national needs since its inception. In fact, the establishment of the Foundation was itself an outgrowth of a recognition by the Congress and the Executive Branch that Federal support would be necessary for basic research and for building the capabilities needed to keep the nation strong in science and engineering. This mission of supporting basic research is of continuing importance to civilian science in this country and, I believe, will be the most crucial role in the long term

that the NSF can play in advancing the goals under discussion. A strong, broad base of support for science -- both basic and applied -- is necessary. We will see in the years ahead, as we have in the past, a continuing flow of ideas from the frontiers of basic research into applications throughout our society.

Since its establishment, the National Science Foundation has continuously demonstrated its responsiveness to national needs. For instance, early in the growing national emphasis on science and its application following World War II, and especially during the development of the space program, NSF recognized the need for major improvements in Science Education. This led to programs contributing to the development of the new math, physics, biology, and earth sciences curricula as well as other inquiry-oriented courses in the sciences.

Again in the late 1950s, the increasing importance of the atmospheric sciences was recognized by the Foundation, and this area of science was established as a separate major program within the family of science programs supported by the NSF. In parallel with this development, the Foundation undertook a problem-focused program of weather modification. This was designed originally to seek methods to increase rainfall and lately to try to find ways to moderate severe thunder storms, to reduce damage caused by hail, to dissipate fog, and otherwise to deal with weather conditions that are

hazardous to man.

Later, through the initiative of this Committee and the Congress, changes were made in the NSF Act in 1968 which increased NSF's ability to respond to national needs. Subsequently, the Foundation developed the program of Interdisciplinary Research Relevant to Problems of Our Society (IRRPOS) which in 1971 was transformed into the major program, Research Applied to National Needs (RANN).

With the concurrence of Congress, the Foundation is undertaking two new programs in FY 1973 -- the Experimental R&D Incentives Program and the National R&D Assessment Program. Both of these programs, in different ways, are designed to identify, assess, test and evaluate the opportunities and incentive mechanisms available for the Government to use in stimulating research and innovation aimed at achieving major goals.

It is within the context of these significant Executive and Congressional activities that we must consider S. 32.

Title I of this Bill would formally assign responsibility to the National Science Foundation for developing recommendations on priorities and policies in civilian-oriented science. The authority needed to fulfill the role of recommending national policies for the promotion of basic science research was contained in NSF's original legislation. The role of developing broader national policies and

priorities was assigned in 1962 to the Office of Science and Technology (OST) by Reorganization Plan #2. The Foundation has for some time been active in this area and supportive of other agencies, notably OST. For instance, the National Science Board has a responsibility to render an annual report on the status and health of science. Earlier this year you received the Fourth Report of the National Science Board. This report, The Role of Engineers and Scientists in a National Policy for Technology, emphasized the need for a strong commitment to civilian technologies and identified steps necessary to provide a favorable climate and a broad base of support for science and technology in the civilian sector. The report by the Board indicates the current broad interpretation of their science responsibilities, a matter which is discussed in S. 32.

Another example of responsiveness to need is the now-familiar RANN program. The distinguishing characteristics of this program of Research Applied to National Needs is that the Foundation is sponsoring assessments, studies and research on selected national problems which:

-- Fall between or outside the areas of responsibility of other agencies;

-- Span the areas of responsibility of other agencies;

-- Relate to meeting longer range and special requirements

of other agencies; and

-- Are uniquely suited to solution by NSF supported university teams working with industries, national laboratories, and non-profit organizations.

Under NSF sponsorship, a number of study reports are prepared each year by scientists at universities and other research institutions. For example, we supported research on technology assessment leading to the report, Technology and Public Policy, the Process of Technology Assessment in the Federal Government -- a study published in July 1972 by George Washington University -- and, a Survey of Technology Assessment Today, a study completed in June 1972. In May 1972 a report, Power to the States: Mobilized Public Technology, was prepared by the Council of State Governments under the sponsorship of the National Science Foundation. This report contained recommendations designed to bring the benefits of science and technology to the operation of State and local governments. I hardly need to comment on our nation's energy problem, since the members of the Committee have been particularly aware of the impending crisis and have been leaders in the effort to develop public awareness and programs to deal with it. NSF has supported a major effort to examine this problem, resulting in a

number of reports containing specific recommendations for action. In conjunction with those recommendations, NSF is sponsoring significant research on conversion of solar energy to meet future needs.

These few examples amply illustrate my earlier statement that NSF is doing the kind of work contemplated in part by Title I.

Within the Executive Branch, the identification of priority areas of civilian R&D which would be assigned by S. 32 to NSF is currently a continuing responsibility of the Office of Science and Technology, Office of Management and Budget, and other elements of the White House staff.

I would note that many of the problem areas identified in S. 32 are already the responsibility of a mission agency of the Government. These agencies are closer than NSF to the problems and to the environment in which specific solutions must be applied. Consistent with our decentralized federal organization for funding research and development, mission agencies should conduct problem assessments and to sponsor the research and development necessary to resolve these problems. Without assuming the supra-agency role envisioned for NSF by Title I, the Foundation can continue to contribute to the objectives of Title I by conducting studies on the applications of science and technology to the solution of national needs.

Title II, as proposed, established the Civil Science System Administration within the National Science Foundation to support and

administer programs authorized under the Title. As I mentioned earlier, NSF has been increasing its programs in civilian science through RANN and the new R&D Incentives and Assessment programs. Title II would increase the rate at which that change is occurring and provide for NSF's increased involvement in the development, testing and evaluation phases of civil science systems. I believe that development, testing and evaluation activities of major civil science systems are, in most cases, more appropriately done in mission agencies responsible for implementing the systems.

No one agency can successfully pursue major civil science system programs in all of the areas suggested in S. 32.

One of the key factors in the success of RANN has been its ability to select those problems where NSF could make a unique contribution and to focus its efforts.

In short, the Foundation is concerning itself with those civil science areas for which NSF has a unique capability. Generally, we believe that many of the CSSA-type development activities should be done by mission agencies.

Title III, the Technical Manpower Transition Act, contains many of the provisions of H. R. 34 upon which the Foundation has previously commented. The problems addressed in Title III extend far beyond

scientists and technicians. Any solution to these problems must include other groups of the unemployed. Without reiterating earlier comments, let me again emphasize that the solution to the manpower problems in science and technology lies in the creation of specific new job opportunities. These must be found through programs in the civilian sector and through a revitalized economy. Many of these jobs will be provided by the $1.4 billion increase the President's FY 1973 R&D Budget if it is approved by the Congress.

You may recall that in his science message the President directed his Science Advisor, in cooperation with the Office of Intergovernmental Relations, to serve as a focal point for discussions among various Federal agencies and the representatives of State and local governments. These discussions are to lay the basis for developing a better means for collaboration and consultation of scientific and technological questions in the future.

For its part, the NSF, through its Intergovernmental Science Program, is already working with State, local and regional governments to identify areas where scientific and technical skills and manpower can contribute to the effectiveness and efficiency of their operations. We are providing funds to assist these non-Federal government groups in designing programs and hiring scientific manpower at the local level. The challenges faced by State, local and regional governments

are large, and science and technology alone cannot meet them all. At1 the same time, science and technology can assist in the solution of these problems, and it is fair to note that the use of scientific and technical capabilities in this regard is only beginning.

Let me repeat my reservations about the feasibility of one feature of Title III, the Community Conversion Corporations. First, I believe this would be an artificial and far less effective way of creating meaningful jobs than by providing incentives for use of skilled people within expanded private and public programs. I am advised that current Federal efforts include job assistance and placement under the Emergency Employment Act; Special Department of Labor programs, such as the Technical Mobilization and Reemployment Program, funded at $42 million; The National Registry of Engineers; The Volunteer Engineers, Scientists and Technicians Program; and other efforts.

Second, I believe that the manpower problem is temporary. Thus, when we are again enjoying full employment these Corporations, which would have been developed as government-supported bodies, will themselves pose a problem as a proliferation of government and quasi-government agencies.

Title IV addresses the very real concern of forfeiture of important pension and retirement benefits which often results from job transfer or loss of employment. The Administration and the Foundation are

deeply concerned over this problem and are aware that scientists, engineers and other related employees working on Government contracts are often among those affected. However, the problem extends beyond this group and I feel that protection from such losses should be provided to all workers. The Administration is taking the lead on this matter through other agencies, principally the Departments of Labor and Treasury, and has sent to Congress, two pension reform bills, the Individual Retirement Benefits Act, (H. R. 12272, S. 3012), and the Employees Benefit Protection Act, (H. R. 12337, S. 3024).

In summary, the bill which we are discussing is another expression of the fact that there are urgent needs and problems in areas where civil science can contribute. These needs are being approached in a variety of ways by many agencies of government. For example, the NSF RANN program is being prudently expanded. We are continuing to assemble the institutional capabilities and the skilled personnel to undertake the work that must be done.

We are increasing our support of fundamental science in recognition that this research provides the basis on which future contributions from science must come. The President has launched a major effort in civilian science. The funds going in this area in FY 1973 are more than 65% greater than those in FY 1969, and it is the most rapidly expanding sector of the Federal R&D budget. We must understand that the progress we are seeking in our society will require a new

partnership among science, government, and the rest of society.

I believe that the programs and activities which I have mentioned, and the many others being supported by the Administration, are the appropriate approach to the problems and challenges we face.

Science Report/Congress moves to reset priorities in federal research and development

by Claude E. Barfield

1524
9/30/72
NATIONAL
JOURNAL

Congress appears likely to take the lead within the next year in attempting to redirect the thrust of the federal government's research and development programs, by passing legislation designed to speed conversion of defense and aerospace technology to civilian uses.

The first step was taken last month, with passage by the Senate of a bill (S 32) to establish a new agency within the National Science Foundation with a three-year budget of almost $1 billion and to give the NSF authority to establish new priorities for the expenditure of federal R and D dollars.

Although the Nixon Administration has deep reservations about the bill, and time probably will not permit action in the House this year, the Senate's approach has broad bipartisan appeal and undoubtedly will be resurrected early in the next Congress.

The legislation represents the culmination in Congress of years of study and debate focused on the question of whether the federal government can take an active part in redirecting the energies, capital and technological know-how it has built up in the defense and aerospace industries for use in solving transportation, pollution, education and other domestic problems, especially in the nation's cities.

Originally titled the "Conversion Research, Education and Assistance Act" when it was introduced in 1971 by Sen. Edward M. Kennedy, D-Mass., the bill reflects more than a year of work by Kennedy's Labor and Public Welfare Special Subcommittee on the National Science Foundation.

It also reflects a changing perception of what the federal role in conversion can and should be. Senators who have studied the conversion issue now feel that ideas on the matter that were prevalent in recent years—programs to retrain scientists and engineers and measures to force defense and aerospace contractors to plan for conversion—are simply not practical. *(For a report on congressional proposals for conversion, see Vol. 3, No. 35, p. 1810.)*

Reported unanimously by the Labor and Public Welfare Committee on Aug. 9 and passed 70-8 by the Senate on Aug. 17, Kennedy's bill would expand NSF's mission far beyond its traditional work in basic research by granting it the authority and resources to act as the central focal point for federal civilian applied research and development programs.

Now called the "National Science Policy and Priorities Act of 1972," the bill also seeks to expand the government's commitment to civilian R and D by declaring as national policy that civilian R and D expenditures grow at the same rate as the Gross National Product and that they should equal expenditures for defense R and D.

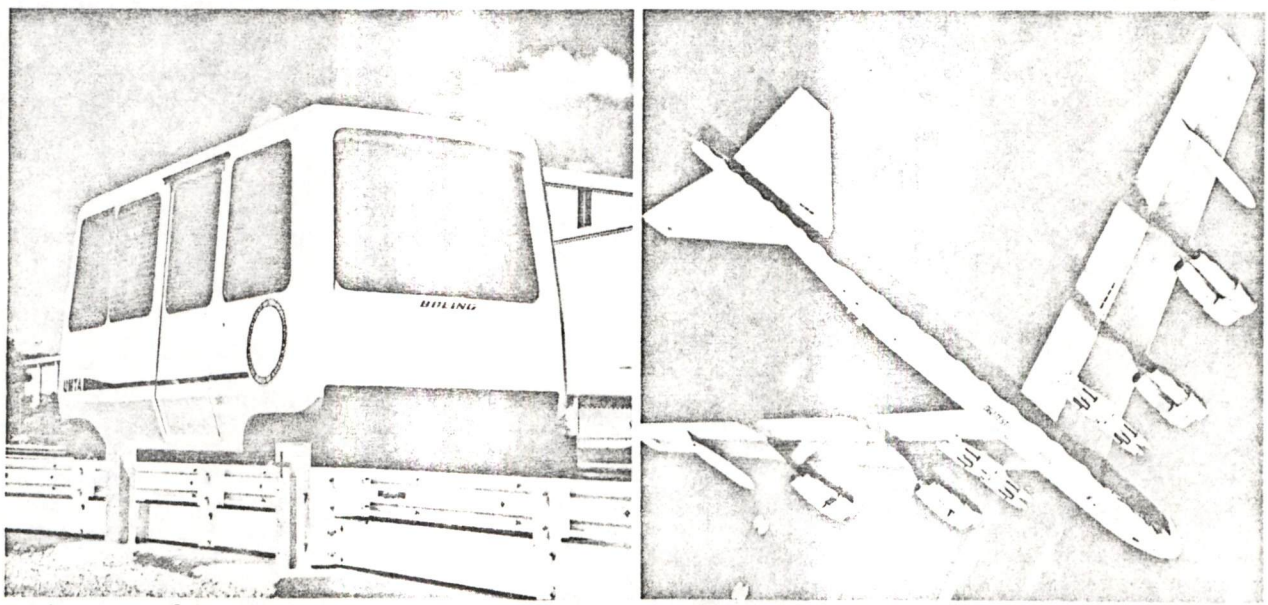
The major part of the NSF's new activities would be directed by a new Civil Science Systems Administration, which would have $800 million to spend over three years to fund the design, development, testing and demonstration of technological advances in various public services.

The Senate committee report is careful to note that CSSA contracts would provide employment for large numbers of scientists and engineers. In fact, the report provides employment estimates for each section of the bill, and projects that full funding of the legislation would provide jobs for 200,000 scientists and engineers in future years.

The new shape of Kennedy's bill has attracted the support of groups that opposed previous conversion measures. Many of the earlier bills on the subject concentrated on federally funded retraining for technological personnel. Opponents including aerospace companies and professional engineering societies viewed the bills as useless in light of the shortage of jobs in high-technology industries.

But Kennedy's bill, with its emphasis on federal subsidies for concrete research projects, appeals to a broad constituency. For the groups representing engineers, it offers the promise of jobs on the research projects it would fund. For the aerospace companies, and for labor unions serving those companies, it offers some hope that the infusion of new research money might produce ideas that could be commercially marketable. And to a variety of other groups, including education associations, the bill represents a shift of priorities in government R and D funding away from the defense and aerospace fields. Kennedy and his aides say that a coalition of these groups now is forming that will force such a shift in priorities, if not this year, in the near future.

Administration: Within the past year, a White House team led by special



Diverse uses of aerospace technology—all made by Boeing: Experimental People Mover and B-52 with SRAM missiles

Presidential assistant William M. Magruder spent months studying whether the government should undertake a large-scale R and D program like the one Kennedy envisions.

The White House ultimately decided that the government did not know enough to spend large sums of money wisely in subsidizing R and D in most domestic fields, where private industry traditionally has held sway. So it opted for a number of small, experimental programs, while at the same time increasing R and D expenditures in selected areas where it felt the money could be put to good use. *(For two reports on the White House technology search, see Vol. 4, No. 20, p. 819, and No. 19, p. 756.)*

The White House opposes S 32, believing that the money it authorizes could not be spent profitably and that there is no need to establish a new agency within NSF to set priorities for federal R and D.

Future: The fate of the bill in the current session of Congress has been clouded by Presidential election politics. The Democratic Presidential candidate, Sen. George S. McGovern, D-S.D., is a strong supporter of the measure. McGovern plans a major speech on science and technology in October, and aides say that the Kennedy bill will serve as the centerpiece of his position.

With McGovern's backing, Kennedy has pressed Rep. George P. Miller, D-Calif., chairman of the House science committee, and the House leadership to bring the bill to the floor without additional hearings. Despite the blandishments of Kennedy and the House leadership, Miller, after conferring with senior members of the committee, decided to hold two days of hearings—Sept. 26 and 27—and in effect greatly lessened the chances that the bill will reach the House floor before Congress adjourns in mid-October.

Senior committee members felt strongly that there should be no hurried approval of a measure that makes such important changes in federal science and technology policy.

Though the bill almost certainly is doomed to failure this year, it may well be a harbinger of changes to come later. Its powerful bipartisan backing in the Senate is indication that, whatever doubts the White House may harbor, Congress is likely to mandate establishment of a new policy-making structure to oversee and manage a shift in R and D priorities.

Evolution of S 32

It was not until early summer that S 32 began to move in the Senate.

Then, in less than three months, it was reported out of Kennedy's subcommittee, approved by the full Labor and Public Welfare Committee and passed by an overwhelming margin in the Senate.

This rapid action caught the Administration, the scientific and technological community and the House Science and Astronautics Committee by surprise.

"It was midsummer before a lot of people began to take the bill seriously," said Ellis R. Mottur, who was hired by

Edward M. Kennedy

Kennedy last year as adviser to his NSF subcommittee specifically to work on the conversion bill. A former management official at the NSF, Mottur is the author of *Conversion of Scientific and Technical Resources: Economic Opportunity—Social Opportunity* (George Washington University, 1971).

Mottur takes issue with critics of the bill—particularly from within the Nixon Administration—who argue that there was no opportunity to make a public record on its far-reaching provisions.

"Almost every one of the provisions that we've heard are causing surprise or consternation in some circles has been in the bill at least since last fall," Mottur said. "It's not our fault if they refused to pay attention to them."

At the same time, Mottur readily admitted that the bill has changed substantially since 1970, especially with the addition of provisions that could result in significant changes in civilian science and technology policy-making.

Development of bill: Kennedy began to develop his legislation in the 91st Congress.

In March and April of 1970, he chaired Labor and Public Welfare Committee hearings in Lexington and Framingham, Mass., on postwar economic conversion and then, in August, introduced a preliminary conversion bill (S 4241), asking for comments from leading experts in the field.

In January 1971, at the opening of the 92nd Congress, Kennedy introduced a revised version of the bill (S 32). At the same time, Reps. John W. Davis, D-Ga., and Robert N. Giaimo, D-Conn., along with more than 100 co-sponsors from both political parties, introduced a virtually identical bill (HR 34) in the House.

Davis is chairman of the House Science and Astronautics Committee's Subcommittee on Science, Research and Development. Under his direction, the subcommittee held eight days of hearings on HR 34 during June and July of 1971.

S 32, HR 34—The Conversion Research, Education and Assistance Act, as the bills were called, authorized $500 million for aid to communities, companies and individuals to make the transition from defense and aerospace activities to civilian programs.

Among the key programs authorized were: $63 million to establish local conversion corporations that would employ scientists and engineers to help find solutions to community problems; $45 million to enable state and local governments to employ scientists and engineers; $45 million to help small aerospace and defense firms convert to civilian activities; and $225 million to provide unemployed technical personnel with placement and relocation assistance and on-the-job training.

The bill also declared as national policy that the annual federal investment in science and technology should grow in proportion to the GNP and that federal obligations for civilian R and D be increased to a level of parity with defense R and D obligations.

Amendment 469—In October, two weeks before Kennedy's NSF subcommittee held hearings on S 32, the Senator filed an amendment to the bill that greatly expanded its significance and substantially changed its thrust.

Amendment 469, as it was designated, sought in effect to create a civilian technology agency that would

design, develop and test technologies to aid in the solution of urban problems facing the nation. The new agency—then called the New Cities Research and Experimentation Administration—would have been placed within the NSF and authorized to spend $1 billion in fiscal 1973-75.

The single Administration witness who appeared at the October hearings, then-NSF Director William D. McElroy, opposed both the original version of S 32 and Amendment 469.

During the winter and early spring Kennedy and Mottur further revised the measure in light of the comments and suggestions they received, and on April 5 the full subcommittee met to consider the updated version.

The only other subcommittee member who followed the development of the bill closely was Sen. Peter H. Dominick, R-Colo. Dominick and his legislative assistant, Thomas D'Alonzo, kept in touch with the Nixon Administration and particularly with Presidential Science Adviser Edward E. David Jr.

At a subcommittee meeting April 5, Dominick strongly urged that the group solicit comments from federal departments and agencies before taking final action. Subsequently, letters were received from 16 federal agencies, all expressing opposition to S 32.

Despite this negative response, the subcommittee unanimously reported the bill to the full committee on May 30, after making a few minor changes. The full Labor and Public Welfare Committee, after two days of executive meetings, unanimously reported it to the Senate on June 28.

Legislative juggernaut—While the bill was still in its formative stages, Kennedy and Mottur were working to line up support from outside groups and from Members of the Senate.

"Kennedy and Mottur did a superb job of garnering support for the bill," said D'Alonzo. "They quietly built up a real legislative juggernaut."

By the time S 32 came before the Senate in August, it had 46 co-sponsors, ranging the political spectrum from Hubert H. Humphrey, D-Minn., to John G. Tower, R-Tex. The payoff for Kennedy and Mottur came with the 70-8 vote for the bill, which has enabled them to argue that the measure has consensus support from both political parties, the Nixon Administration's opposition notwithstanding.

Final version—The report (SRept

McGovern and Conversion

Democratic Presidential nominee George S. McGovern of South Dakota is one of the Senate's earliest backers of legislation to promote conversion of defense industries to peacetime production, and he is now an active supporter of S 32, the Senate-passed "National Science Policy and Priorities Act of 1972."

According to his campaign staff, McGovern plans to use the bill, which would authorize about $1 billion for civilian research and development projects over the next three years, as the centerpiece of a policy on science and technology to be enunciated later in his campaign.

Advocate of conversion: McGovern's sponsorship of conversion legislation goes back as far as 1963. He introduced his first bill on the subject that year after a Defense Department munitions depot in Igloo, S.D., was shut down, almost wiping out the town's economy.

In the 92nd Congress the Senator has put forward several conversion bills built around proposals offered in 1969 by Walter P. Reuther, the late president of the United Auto Workers union.

One bill (S 1191), co-sponsored by McGovern and Sen. Charles McC. Mathias Jr., R-Md., would establish a National Economic Conversion Commission. The measure would require companies receiving contracts from the Pentagon, Atomic Energy Commission or the National Aeronautics and Space Administration to submit conversion plans and to set aside 12.5 per cent of their defense profits to finance conversion efforts.

Another McGovern bill (S 1631) would provide benefits for displaced defense workers.

But the success of S 32 in the Senate has caused the Presidential candidate to swing solidly behind the approach to conversion it embodies.

In a statement submitted for publication in the *Congressional Record* on Aug. 17, the day the Senate passed S 32 by a 70-8 vote, McGovern said: "In our effort to establish new peacetime priorities, we must pay special attention to science and technology. This legislation will permit the nation to harness its technological efforts in pursuit of peaceful, civilian development. . . . The nation's research and development effort must be increased and new institutional arrangements must be made if we are to effectively deal with (the) ever-growing international technology gap, and with the acute unemployment crisis facing American scientists, technicians, and engineers. . . . I strongly urge . . . prompt passage."

Campaign plan: Larry L. Goldstein, who is in charge of national security and science issues research at McGovern campaign headquarters, said that "S 32 will form the backbone of Sen. McGovern's science policy during the campaign." Goldstein is working on the text of a major speech on science, technology and conversion to be given by McGovern some time in October.

"If Sen. McGovern is elected, this will be one of the first pieces of legislation he'll push in the 93rd Congress," said Goldstein. "It will be on a much grander scale, however, in order to take up the slack from the planned Defense Department cuts."

McGovern is a co-sponsor of S 32 and, along with Sen. Edward M. Kennedy, D-Mass., has urged the House leadership to act on the bill before the election. The Nixon Administration has opposed the measure, and, said Goldstein, "We'd really like to put this legislation up to the President's nose and make him bite the bullet on it with a veto—if he dared."

But the effort to secure House action apparently has failed, as leaders of the House Science and Astronautics Committee are not inclined to rush the legislation to the floor in the last weeks of the 92nd Congress.

Department of science: In backing the bill, McGovern has retreated from a position he took in April favoring establishment of a new cabinet-level Department of Science and Technology. George Kistiakowsky, vice president of the National Academy of Sciences and a member of the Scientists for McGovern Committee, said: "Most scientists are very much against this kind of sweeping centralization, and members of the committee convinced Sen. McGovern to back off from the proposal."

92-1028), of the Subcommittee on the National Science Foundation states that "the specific comments (of the 16 agencies) were taken into careful account," but in truth the strong opposition of the Administration, as expressed by the individual agencies, was largely ignored.

The most important provisions of S 32 in its final version include:

- a declaration of national policy that federal support of R and D grow at a pace with the GNP and that funds for civilian R and D increase to a parity with defense R and D appropriations;
- the grant to NSF of authority to identify priority areas in civilian R and D, and expansion of the membership of the National Science Board, NSF's governing body, to include representatives from the social sciences, agriculture, engineering, industry and public affairs;
- establishment of a Civil Science Systems Administration within the NSF to contract for the design, development, testing and demonstration of civilian science systems in such areas as health care, sanitation, pollution, housing, transportation, communications and education;

(CSSA would be responsible to the NSF director but not to the National Science Board and it would have the authority to contract with industry, universities, nonprofit organizations and to transfer funds to other government agencies.)

- the establishment of a group of manpower programs to assist in the transition of individuals and corporations from defense to civilian activities;

(The programs, which are focused more on actual employment than on retraining, include fellowships for individuals, loans to corporations and grants to set up nonprofit community conversion corporations.)

- a portable pension plan to guard scientists and engineers from losing their pension rights in the defense and aerospace industries.

(This provision was added by the Labor and Public Welfare Committee just before it reported the bill.)

The bill originally authorized $1.2 billion for the new CSSA; $560 million for the job-transition programs and the community conversion corporations; and $50 million to advance the state of the art in priority research areas—adding up to a total authorization over three years of $1.8 billion.

However, on Aug. 17, the day the bill passed the Senate, Kennedy "reluctantly" accepted an amendment offered by Dominick reducing the total authorization to $1.025 billion; under this revision, CSSA would receive $795 million, and the conversion programs would receive $200 million through fiscal 1975. (In earlier committee negotiations, Dominick had won the deletion of a $500-million loan program to aid individuals in transferring from defense to civilian work; it had constituted an entire separate title of the bill.)

Dominick failed on Aug. 17 to get Senate approval of two other amendments. One would have dropped the declarations of policy tying civilian R and D funding to the GNP and mandating a parity between civilian and military R and D spending; the other would have given the National Science Board a veto over all CSSA contracts over $2 million.

Peter H. Dominick

Dominick: Dominick had voted with the rest of the Labor and Public Welfare Committee to report S 32 favorably and then after his funding-cut amendment was accepted he also voted for the bill on the Senate floor.

Dominick told *National Journal*, however, that despite his "yea" vote, he still has "major reservations about some sections of the bill."

"But," said Dominick, "I wanted to record my belief that science and technology are not yet being effectively utilized in solving both rural and urban problems. . . . This legislation represents to me the opening of an important debate on how the nation should proceed in these areas."

Dominick added that he assumed when he voted for S 32 that it had no chance of passage this session. "I think that both houses should hold extensive hearings next year before we take final action," he said. "Neither the scientific community nor the Administration has had a chance to make a public record on the bill in its present form."

Dominick said he would urge the House committee to delay action until the 93rd Congress.

Administration position

The Nixon Administration is keenly aware of the election-year implications of S 32. Administration officials have closely watched the progress of the bill, fearful that the President would face a veto decision before November.

Even though this prospect has now lessened, Administration spokesmen privately concede that the overwhelming bipartisan support S 32 attracted in the Senate—as well as Kennedy's deep personal interest in the legislation—make it certain that the next Congress will take up the issue again.

David: Both the short-term election complications and the long-range implications were clearly on Presidential science adviser David's mind as he discussed S 32 in a recent interview.

"The bill does identify and attempt to resolve a number of the issues that have worried science policy makers here in Washington for a long time," he said.

However, sensitive to the implication in the legislation that the Nixon Administration has been negligent or derelict in the areas of civilian research and technology, David also argued that "the idea that there is now no planning or direction at the top for civilian technology is false. Since 1969, there has been a major redirection of federal R and D policy." To buttress his case, David cited the following Administration actions and proposals:

- increasing by 65 per cent since 1969 annual federal obligations for civilian R and D (excluding space and defense);
- pinpointing and funding key areas—energy, transportation, protection from natural disasters, drug control and emergency health care—where additional federal R and D spending seem likely to "produce major breakthroughs";
- broadening the mission of the two high-technology agencies, NASA and the AEC, to push them particularly into the areas of energy and transportation R and D;
- increasing support for small, technology-oriented firms through loans, tax breaks and relaxed stock regulations;

• stimulating non-federal investment in R and D and speeding the conversion of R and D efforts into new or improved products or processes through a $40-million Experimental Incentives Program.

"We don't claim to have all the answers," David said. "But we have developed the beginnings of a set of strategies to focus R and D on national needs."

CSSA—Regarding the specific details of S 32, David objected strongly to the decision to create a central civilian technology agency within the NSF.

"We've wrestled with the problem of central-planning versus mission-agency R and D at various times since I've been here; and I'm still convinced that the decentralized structure, with the OST (Office of Science and Technology) working in conjunction with the Office of Management and Budget and the individual mission agencies, is on balance the best solution."

David said he would "very much oppose moves to take development, testing and evaluation of civilian systems" away from the appropriate mission agencies.

"Whether it's a mass transit system or a new housing idea," he said, "it should be user-related—and a central agency would inevitably foster the idea of R and D as an end in itself."

Mission-agency response—David's arguments were strongly echoed in the statements during May and June to the Kennedy subcommittee by the mission agencies, including the Transportation, HUD and HEW Departments, the AEC and NASA. The OMB had coordinated the replies, but the vehemence of the opposition betokened genuine bureaucratic alarm over the consequences of the bill.

The protest from HEW, for instance, stated: "We consider it unwise to transfer major resources for problem solving research to a separate, central agency. . . . If a major portion of the budget for research on any social problem existed in two different agencies there would be substantial likelihood of overlap among projects and of failure to coordinate projects so that their outcome and timing fit together to achieve specific problem solutions. . . . Mission-oriented agencies can be expected to have a better understanding of the nature of the problems being researched . . . than would exist in a separate, central research agency."

HEW controls the major research bureaucracy at the National Institutes of Health, and also is in the process now of setting up a new National Institute of Education to centralize its own education research.

HUD stated that the "applied research and demonstration authority would overlap the authority presently existing in this department, thus fragmenting the resources which would be made available by the Congress for applied research." And the Transportation Department wrote: "The mechanism proposed by the act is not necessary and would be less effective than our present methods of accomplishing R and D. . . . It is desirable

Edward E. David Jr.

that the conduct of R and D be closely coupled to the agency that has the responsibility for applying and utilizing the results."

NSF: The agency that would be affected most directly and profoundly by S 32 is the NSF.

Stever—In an interview, NSF Director H. Guyford Stever detailed what he called his "deep reservations about certain provisions in the bill."

In the first place, said Stever, "Though the language is unclear, Title I of the bill seems to make NSF responsible for setting scientific and technological priorities—in other words for cutting up the pie and also coordinating the R and D activities of other departments. That would seem more properly a White House function."

But Stever is concerned mostly with the placement of a new civilian technology administration within NSF. The CSSA, he said, "would inevitably distort the basic mission of NSF to support basic scientific research."

Since its statutory charter was broadened in 1968 to allow movement into the applied research area, NSF has instituted the Research Applied to National Needs (RANN) program. In fiscal 1973, the agency is requesting $81 million for the program, as part of its total budget request of $646 million.

However, Stever maintained there are two sharp distinctions between RANN and the civilian technology plan encompassed in S 32.

The most important, he said, is that RANN is limited to research and does not get into actual development, demonstration, testing and evaluation of particular systems. That work is the responsibility of the mission agencies.

Second, he said, it was the consensus of NSF's governing body, the National Science Board, that applied research projects never should take up more than one-quarter to one-third of NSF's budget. "The problem with the CSSA," said Stever, "is that with its sizable outlays the tail will wag the dog."

Finally, he said, the independence given the CSSA from the National Science Board—the board would have no veto over contracts let by CSSA—"would cause great problems and might well become an administrative nightmare."

"What the bill really does," said Stever, "is to establish a virtually independent agency within NSF."

NTO drive: Nixon Administration officials share the frustration at the lack of results in application of technology to domestic problems which is reflected in S 32.

And their opposition to the bill stems largely from their experience last year in attempting to find ways the government could encourage civilian technological breakthroughs.

It was almost exactly a year ago that the President commissioned a crash drive—the New Technological Opportunities program—headed by White House assistant Magruder, to assemble a large package of civilian R and D projects involving a substantial commitment of new federal funds.

Proposals were screened for their impact on the U.S. balance of trade in high-technology products; their applicability to domestic problems; and their effect on the high rate of unemployment among scientists and engineers.

Four of the President's top advisers made the final decisions on the NTO program: John D. Ehrlichman, execu-

tive director of the Domestic Council staff; George P. Shultz, then director of OMB; Peter G. Peterson, then assistant to the President for international economic affairs, and Peter M. Flanigan, special assistant to the President. After wrestling with the proposals and problems throughout December, the group advised the President to draw back and not to unveil any spectacular new program.

Administration officials cite three reasons for the decision: lack of precise knowledge about the innovation process, uncertainty about the proper federal role and tight budgetary conditions.

In place of a large-scale effort, the Administration chose an experimental approach over the next few years; and in the fiscal 1973 budget asked for $40 million to establish the Experimental Incentives Program, jointly administered by the Commerce Department and the NSF.

Commenting on S 32 in the light of his experience in the NTO program, Magruder said that though he had a lot of sympathy for its goals, "the bill is wrongheaded in several ways."

The most important fault," he said, is that "it tends to give credence to the view that the answer to R and D problems is more money. But if there's one thing we learned from the NTO drive it's that money right now is not the answer. The fact is that the federal government does not yet know how to effectively use its resources on R and D projects, and until we get some answers from the experimental programs, a crash multi-billion R and D effort could produce tremendous waste."

And Commerce Under Secretary James T. Lynn argued: "Where we really must put more money and effort is not in the creation of new technologies—though this is important—but in finding means of removing the barriers to getting new ideas from the drawing boards to the marketplace. The innovation process is exceedingly complex, and what we need to know more about are such things as the impact of trust and tax policy, how to aggregate markets and how to communicate to government and private users the benefits of new technologies."

Defense of bill

Many of the arguments against S 32 now being advanced by the Nixon Administration and outside critics also were raised while the bill was still in committee earlier this year. Thus Kennedy and Mottur have developed point-by-point responses to the arguments, most of which were cited in the committee report that accompanied the bill.

Money: Nixon Administration objections to tying civilian R and D funding to the Gross National Product and to parity with defense R and D spending are shared by Sen. Dominick, who tried hard but to no avail to persuade Kennedy to drop the provisions in committee.

Mottur explained Kennedy's reasoning this way: "In 1963, federal funds for R and D stood at 2.6 per cent of the GNP; in 1971, they had dropped to 1.6 per cent. Had the declaration

H. Guyford Stever

embodied in S 32 been law, some of the $10 billion lost to R and D over that time period would have been salvaged. . . . As for the parity between defense and civilian R and D, there is no better symbol than this of the necessity for reordering national priorities."

As to whether or not the new CSSA could spend $800 million wisely over the next three years, Mottur said: "The only way to really get results is to commit the resources and the best talent available and gain the necessary experience through actually tackling the problems."

CSSA: Regarding Title II, which creates the new civilian technology agency and has become the focal point of critics' attacks, Mottur said: "It evolved from two lines of reasoning. In the first place, Sen. Kennedy came more and more to think that there was a real need for a central agency to set civilian technology priorities and coordinate—but not supplant—the activities of the mission agencies. In addition, almost all of the witnesses and statements we got on the original conversion and technological unemployment bills argued that without major new civilian technology programs we would be just creating a kind of WPA for scientists and engineers. The creation of the CSSA gets around that legitimate criticism."

Mottur made two points about the placement of the new administration within NSF:

- There is a great deal of opposition in Congress to the creation of new agencies, and thus putting CSSA in NSF got around that hurdle.
- Though NSF does not today have experience in managing and testing new technologies, it can develop this capability with new personnel and administrative techniques.

In addition, said Mottur: "Basic science needs the crutch of applied research and technology. It can rarely show the concrete results that attract public support and congressional appropriations. . . . NSF will really benefit by the tie-in to a new civilian technology agency."

In the committee report, Kennedy took dead aim at arguments that the National Science Board should have veto power over CSSA contracts. The report stated: "This approach is fine for the traditional academic programs of the National Science Foundation. But the experience of the Defense Department, NASA and AEC with management of systems procurement makes it abundantly clear that a high-technology systems procurement involving industry cannot be managed by a committee of scholars meeting almost every month. . . . Such a program requires tight management which can make procurement decisions on a day-to-day basis, not a committee of scholars which meets intermittently."

On the issue of placing the civilian technology agency in NSF, Kennedy and Mottur received vital support from Dominick, despite Administration opposition and reservations on this point by House science committee leaders.

Dominick told *National Journal* that he "would very much oppose the creation of a new agency" and that NSF's traditional basic research role "can be protected through careful reconstruction of its administrative apparatus and through budgetary restrictions on its new applied research and technology role."

9/30/72
NATIONAL
JOURNAL

After the Senate passed S 32, the spotlight turned to the House Science and Astronautics Committee and its Subcommittee on Science, Research and Development.

The key men who decided the fate of the bill in the House this year were Reps. George Miller, retiring chairman of the full committee; Olin E. Teague, D-Tex., the ranking Democrat who likely will succeed Miller as chairman in the 93rd Congress; John Davis, chairman of the Subcommittee on Science, Research and Development; and Charles A. Mosher, R-Ohio, ranking Republican on the full committee and a member of the subcommittee.

Kennedy and Mottur orchestrated a brief but strenuous lobbying campaign directed at the House committee members. Letters, telegrams and personal visits were used by a coalition of labor unions, teachers, state church councils, professional engineering societies and some aerospace companies to get the House to move quickly.

Kennedy persuaded House Speaker Carl Albert, D-Okla., to give a go-ahead, and then talked personally with Chairman Miller.

Kennedy wanted the committee to go directly into executive sessions without hearings and move to the House floor in late September or early October. He argued that before the election the President would be reluctant to veto a bill that contained so much for unemployed scientists and engineers and for defense and aerospace companies converting to civilian tasks. After the election, he said, whatever the will of Congress, the White House would be much less likely to accept the measure.

However, after conferring with the senior members of the committee, Miller announced on Sept. 18 that two days of hearings would be held, Sept. 26-27. The unstated but real significance of the announcement was that the committee had decided not to bring the bill to the floor this session.

Kennedy's campaign failed for several reasons, the most important being:

- a tradition in the committee of careful, extended deliberation before going to the full House with legislation;
- a tradition of bipartisanship that the Democratic committee leadership is reluctant to jeopardize in the highly partisan atmosphere of the Presidential election;
- serious reservations about key sections of the bill among committee members of both parties.

Congress and science policy: The irony of the fact that the most far-reaching piece of legislation regarding federal science and technology policymaking has come from the Senate is not lost on House committee members.

Sen. Kennedy's subcommittee has no broad authority over science policy. Its jurisdiction—and entering wedge into the field—is limited to the National Science Foundation. This is a key, though unstated, reason why Kennedy would place the new CSSA in NSF. Had a new agency been created, the Senate Government Operations Committee would have assumed jurisdiction over the bill.

Daddario subcommittee — The House Science and Astronautics Committee is the only congressional committee with a broad mandate to oversee federal science and technology policy making. In 1963, to carry out that mandate, the committee created the Subcommittee on Science, Research and Development, which, under the chairmanship of former Rep. (1959-71) Emilio Q. Daddario, D-Conn., became the focal point in Congress for science.

Under Daddario, and now under Davis, the subcommittee has systematically taken soundings from the nation's science and technological establishment in hearings and symposia and through personal contact.

Over the past four years, as the federal investment in R and D has failed to keep pace with inflation, as unemployment among scientists and engineers has risen, and as unrest has grown over a seeming inability to use science and technology to solve domestic problems, pressures on the subcommittee to strike out in new directions have increased.

But during the past two years it has been Kennedy who has seized the initiative, first with conversion and employment legislation and now with a sweeping proposal for basic structural change.

One government science administrator, who has long observed the two committees, contrasted them this way: "The House committee members are able, conscientious and have really educated themselves on the complex problems of science and technology policy. However, they've never had too much clout in the House and, for all its excellence, the Daddario (now Davis) subcommittee tended to be a very restricted debating society.

"Kennedy, on the other hand, doesn't know a hell of a lot about the whole subject. But he's action-oriented and willing to plunge in and demand results. He's bound to make the area more politicized, but his active intervention certainly increases the likelihood that sooner or later substantial changes will come about."

Politics: Although Kennedy and Mottur have tried to mute the partisan overtones to the legislation, the fact that McGovern is a strong supporter of the bill and plans to use it as the centerpiece of his position on R and D has complicated their efforts to secure action in the House. It is an open secret that key Democratic members of the House science committee either are hostile to McGovern or feel that his candidacy is jeopardizing their own chances for reelection. Moreover, committee Democrats and Republicans alike are angry about McGovern's attacks on the space program, which is under their jurisdiction.

The fact that some Senate opponents of the space shuttle, such as Sen. Walter F. Mondale, D-Minn., are trumpeting S 32 as a substitute for expensive new space programs also does not contribute to the bill's popularity in a committee that includes many of the leading space proponents in the House.

Rep. Teague, who will succeed to the committee chairmanship in January, recently engaged in a caustic exchange over the space shuttle with Jean M. Westwood, McGovern's choice as the new chairman of the Democratic National Committee. McGovern opposes the shuttle, and Mrs. Westwood called the project "an outrageous misuse of this country's tax revenues." Teague immediately issued an angry rebuttal, saying that Mrs. Westwood (and by implication McGovern) "was uninformed on the space program."

The fifth-ranking Democrat on the committee, Rep. Thomas N. Downing, D-Va., has publicly declared his non-support of the Democratic ticket.

And finally, Rep. Davis, chairman of the Subcommittee on Science, Research and Development, faces a tough reelection fight. The national Democratic ticket is not popular in his Georgia district and Davis counts

it as one of the main burdens of his campaign.

(Davis decided not to chair the Sept. 26-27 hearings on S 32. Rep. James W. Symington, D-Mo., led the sessions.)

Timing: In separate interviews, Reps. Davis, Symington and Mosher explained their opposition to swift passage of the measure.

Davis said: "The end of a session during a Presidential campaign is a very poor time to move on something this important—it's the worst kind of atmosphere."

Mosher echoed Davis with almost the same words: "This is potentially the most significant piece of legislation on science policy we've had in many years. I find parts of the bill very attractive, but it doesn't seem sensible to me—in fact, it would really be irresponsible—to go to the floor during the closing days of the session in an election year."

And Symington commented: "I think there's a definite need for Congress to act in this area, but the issues are too complicated and important to deal with in the time we have remaining in this session."

Reservations: Politics aside, House committee leaders also doubt the wisdom of moving rapidly because they have substantial reservations about certain specific provisions of S 32.

Science Adviser David and NSF Director Stever both talked with committee and subcommittee members just after Senate passage, and their arguments struck responsive chords.

Davis says, for instance, that he is "very worried about the future of the NSF under the new bill."

"It is not ideally suited," he said, "to the new duties that would be thrust upon it. It might well be drawn increasingly into political controversies divorced from science."

Similarly, Mosher commented that his "first reaction to placing a new civilian technology inside NSF is negative."

"I know some people argue that the CSSA is just an expanded RANN program," he said, "but in actuality it goes far beyond RANN into development and into areas best left to the mission agencies."

"Placing a technology agency in NSF," said Rep. Symington, "would be awkward at best, and potentially disastrous at worst."

Although each said his thoughts on the matter had not crystallized, all three Representative suggested that a new agency, patterned on the Defense Department's Advanced Research Projects Agency, might be a better alternative.

"It's true Congress is generally hostile to the creation of new bureaucracies," said Symington. "But I think a kind of civilian ARPA could perform a real function. It could undertake long-range planning, act as a kind of technological ombudsman and become a kind of early warning system for weaknesses in mission agency R and D programs."

All three also opposed a direct linkage of federal R and D funding with a specific GNP percentage. Said

Charles A. Mosher

Mosher: "I'm inherently suspicious of arbitrary formulas like this.

"R and D programs ought to have to be defended on individual priority grounds just as other federal programs are."

Daddario: S 32 rated a tentative approval from former Science, Research and Development Subcommittee chairman Daddario. Daddario, who is now a vice president of Gulf and Western Corp., told *National Journal* that "if carefully written, S 32 could allow the federal government for the first time to begin to plan ahead and anticipate problems for science and technology."

He said he "was not disturbed by the addition of the new technology agency to NSF."

But he said that the NSF "should be given time to adjust to a new role and responsibility."

"It should be done on a step-by-step basis," said Daddario. "Otherwise, NSF—*and* U.S. science—could be set back greatly."

New coalition

Kennedy and Mottur are optimistic that legislation similar to S 32 ultimately will pass, in the next Congress if not this year. Their optimism stems from what Mottur sees as the "emergence of a new and powerful coalition of interest groups" behind the drastic changes encompassed in the bill.

"It's true," said Mottur, "that we didn't canvass the scientific establishment as carefully as the House committee usually does. But the fact is this legislation goes well beyond matters of pure science. It really concerns domestic priorities and the need for a major new effort to apply science and technology—and the skill of currently unemployed scientists and engineers—to urban and rural problems."

The broad scope of S 32, said Mottur, has attracted the strong lobbying support of the urban and education lobbies, the labor unions, the aerospace industry and many professional societies, particularly in engineering fields.

On the Senate floor Aug. 17, Kennedy listed some of the groups which had indicated support, including: The National League of Cities-U.S. Conference of Mayors; American Federation of Teachers; National Educational Association; American Federation of State, County and Municipal Employees; United Auto Workers; Council of AFL-CIO Unions for Scientific, Professional and Cultural Employees; International Association of Machinists and Aerospace Workers; International Conference of Police Associations; American Institute of Architects; American Society of Mechanical Engineers; National Society of Professional Engineers; and Federation of American Scientists.

The diversity of the groups supporting S 32 has impressed Philip Handler, president of the National Academy of Sciences.

"You have only to compare the people who used to testify before the Daddario subcommittee with those groups that have gotten behind this bill to see that important new elements and interest groups are involved," Handler said.

Interviews with spokesmen for two of the most powerful interest groups on the list—the labor and urban lobbies—reveal that their expressions of support are more than perfunctory. Both groups are putting lobbying muscle behind the drive to enact S 32.

1532
9/30/72
NATIONAL
JOURNAL

Handler: A Qualified Endorsement of S 32

Although the U.S. scientific community generally has been opposed to the centralization of federal research and development programs in a single agency, the president of the most prestigious scientific institution in the country sees some merit in a Senate-passed bill (S 32) that would give the National Science Foundation greatly expanded authority to set government research priorities.

Philip Handler, president of the National Academy of Sciences, has reservations about some sections of the legislation. But in an interview he gave qualified approval both to the legislation's goals (a shift in R and D priorities from defense to civilian projects) and to the means it provides to attain the goals (increased funding and authority for the NSF).

Handler said he believes that enactment of S 32 as passed by the Senate or in revised form could be of high importance to the future of U.S. science policy. For that reason he opposes immediate action in the House, saying that in the next Congress there should be a "careful sorting out of the issues and implications of each of the bill's major titles. . . . Most members of the scientific community don't know a thing about this legislation."

Policy preamble: Handler characterized S 32's opening declaration of policy as "highly satisfactory in many ways."

Of its statement that federal R and D funding should grow at the same rate as the GNP, he said: "If nothing else it would assist in fostering the idea that as the economy grows and becomes ever more complex there is a greater need for R and D. This is not to say that I think there is any magic number or percentage of the GNP that is the optimum level."

And he said that "as a statement of philosophy I wholly subscribe" to the bill's declaration that parity should be established between defense and civilian R and D. "This does not mean that I expect the NSF budget to rise to $8 billion in the next two or three years, however," he said.

Titles I, II: Handler's main interest is with Titles I and II of the bill. The first title expands the authority of the NSF to identify, on a government-wide basis, priority areas for civilian R and D to recommend policies and programs for these areas. Title II creates a new Civilian Science Services Administration within NSF to design and test civilian technology systems.

Taken together, Handler said, "Titles I and II have much to recommend them. . . . In effect, the Senate has created a new civilian technology agency and attached it to NSF."

Title I—Handler sees a close link between the first two titles of the bill. If the proposed CSSA is to operate effectively in managing its own resources, "clear statutory authority for the NSF to set priorities for other federal R and D efforts would be almost indispensable," he said.

He noted that until 1962 the NSF theoretically had this responsibility. In that year, the President's Office of Science and Technology took over this duty under a Presidential executive order.

Handler also praised the grant of funds for studies of the state of the art in priority areas of science and technology. "Neither NSF nor OST has ever had the funds or resources to analyze the real strengths and weaknesses of the U.S. R and D effort," he said.

Title II—"I think," said Handler, "there is general agreement both in and out of government that the research capabilities of the civilian agencies—HUD, HEW, etc.—are insufficiently developed. We don't really know whether these weaknesses stem from lack of funds, poor leadership, bureaucratic ineptness, congressional hobbling or some mix of factors. But perhaps with a central focus, with more vigor and political clout, the fallout from R and D accomplishments to society could be significantly increased."

Handler said that thus he had "an instinct that there is a need" for a civilian technology agency, either one within the NSF, as provided in S 32, or perhaps an independent agency that would be a "civilian counterpart to the Pentagon's Advanced Research Projects Agency."

Assuming that Congress does enact S 32 in some form, Handler said that the "gut questions that will bear the most careful study concern the relationship between NSF and the mission agencies—what is a reasonable division of labor under a new system?"

There are certain parameters and guidelines within which compromises could be worked out, Handler thought. For instance, he argued that "NSF should never have operating responsibilities." Also, contrary to the provisions of S 32, Handler said that he doubts "if NSF ought to get involved in developing, testing or evaluating individual systems or programs."

At the other end of the spectrum, the mission agencies should not "discontinue applied and even far-out research in their particular areas," he said. "The problem is to find the right mix of responsibilities."

He said he felt that "no more than one-third of NSF's budget" should be devoted to civilian technology programs.

Basically, what Handler envisions is a high-level planning and priority-setting agency that could spot weaknesses, supplement the work of the mission agencies as well as coordinate programs that cut across single-mission responsibilities.

Dangers: Handler also stressed that there were "real dangers for NSF" in the proposed legislation.

"NSF has developed a reputation for high competence and disinterested integrity in its management of basic research," he said. "However, the societal problems S 32 would plunge NSF into are replete with difficult political questions. And some of these problems may not be solvable, at least not with technology alone. It's not like the Apollo program, where you set a single engineering goal and worked to accomplish it. . . . NSF could end up with a lot of egg on its face and a greatly diminished stature."

Labor: Jack Golodner, executive secretary of the 16-member Council of AFL-CIO Unions for Scientific, Professional and Cultural Employees, is coordinating the labor lobbying effort. He said the most active support for the legislation has come from the UAW and the machinists union.

Both Sen. Dominick and Mottur say they believe that labor played an important role in lining up co-sponsors for the bill and in producing the 70 votes in favor of its passage.

Said Golodner: "We started pounding the Senate corridors on this back in the spring when nobody thought it had much chance. But we found a great response in office after office."

Golodner said that labor's interest in legislation on the problem goes back to the Johnson Administration "when we started trying without much initial success to get people interested in conversion."

"We also have thought since the late 1960s," he said, "that the rate of unemployment among scientists and engineers was a lot higher than either the Johnson or the Nixon Administration would admit. . . . Only recently has NSF conceded that its employment statistics for scientists were incomplete and probably not representative."

Golodner thinks that the final shape of the Senate bill will ensure its ultimate success.

"The real stroke of genius," he said, "was the addition of the new civilian technology agency. The measure then became a real vehicle for a redirection of national priorities and can't be criticized as special interest or make-work legislation."

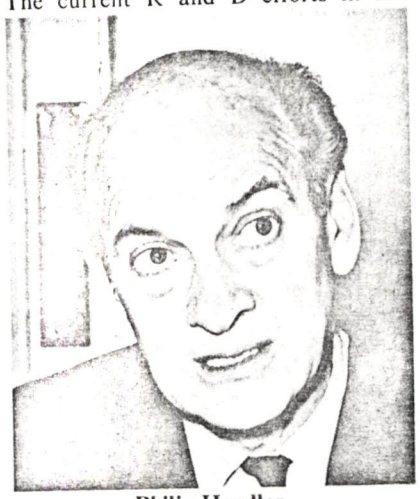
Although he is not optimistic about the prospects for S 32 this session, Golodner, like Mottur, thinks that "the coalition behind the bill is too powerful to stop ultimately."

Cities: The National League of Cities-U.S. Conference of Mayors also has "been in close touch with Sen. Kennedy" and plans to "actively lobby for the bill," according to Larry S. Snowhite, who is monitoring the legislation for the organization.

During the spring and early summer the organization got several mayors around the country to wire key Senators as the bill was working its way through committee. And it had a hand in redrafting sections of the legislation to give the urban lobby a stronger voice on the Advisory Board to the CSSA.

Explaining the reasons behind the urban lobby's interest in S 32, Snowhite said: "The cities don't have the capability or the money to utilize scientific talent or new technology systems in the solution of urban problems. . . .

"We think that the time has come for more direct action by the federal government and for a focusing of government resources in one place. The current R and D efforts in the functional mission agencies just aren't strong enough."



Philip Handler

Like Golodner, Snowhite said that the combination of manpower, conversion and reordered priorities included in S 32 "make it an almost irresistible legislative package. It's just a question of time before it goes through."

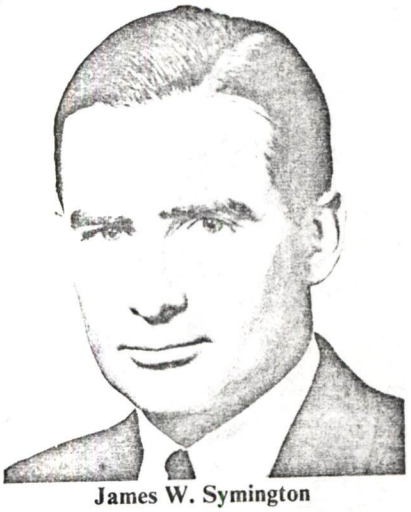
Aerospace industry: The aerospace industry, which evinced no enthusiasm for earlier conversion bills, is favorably disposed toward S 32, according to Carlyle A. Jones, a vice president of the Aerospace Industries Association.

The bill offers the companies the prospect of government money to pay for their own civilian research projects and to subsidize the hiring and training of technological personnel. And the civilian research that would be undertaken all over the country under the legislation might produce ideas that the companies could adopt as commercially marketable.

Jones said his association would not actively campaign for the bill, at least not until after the election. He also said: "We haven't polled our membership, but from what I've heard, some companies are very much interested. . . . If really put together right it could help us a lot."

Jones added that some companies were skeptical of the legislation, fearing it "might be just another bureaucratic complication."

Opposition: The only interest group opposition thus far, says Mottur, has come from the Chamber of Commerce of the United States and the National Association of Manufacturers. Both organizations have written Sen. Kennedy to oppose the portable pension plan for scientists and engineers that was attached to the bill at the last minute.



James W. Symington

Outlook

Sen. Kennedy and Mottur were deeply disappointed by the decision of the House committee leadership not to bring S 32 to the floor this session.

They argued that the President would be under considerably less pressure next year to accept the bill, and that with routine NASA and NSF authorization bills to clear next year the House committee may not take up the legislation again until the summer or fall.

Senior members of the House science committee disagree with this assessment. Rep. Symington says that "holding hearings now will allow us to move with dispatch in the next Congress." He predicts that, rather than waiting until summer, the House committee will take up the bill again "soon after the 93rd Congress convenes."

Symington also said that "the problem is not going to go away and the Administration as well as Congress will still have to face up to the possible need for major changes in the structure of federal science and technology policy making."

FOR IMMEDIATE RELEASE JULY 21, 1972

Office of the White House Press Secretary

THE WHITE HOUSE

The President today announced the appointment of four persons to serve as members of the President's Science Advisory Committee for terms expiring December 31, 1975. The new appointees are:

Dr. Luis W. Alvarez of Berkeley, California, Professor of Physics, University of California, Berkeley, California

Dr. Gerald F. Tape of Bethesda, Maryland, President, Associated Universities, Inc., Washington, D. C.

Dr. Howard S. Turner of New York, New York, President, Turner Construction Company, New York, New York

Dr. James B. Wyngaarden of Durham, North Carolina, Professor of Medicine and Chairman of the Department Duke University, Durham, North Carolina

These appointments fill the positions of three members whose terms have expired and add one new member to the Committee, bringing its total membership to 20. The members whose terms on the Committee have expired are: Dr. Herbert A. Simon of Pittsburgh, Pennsylvania; Dr. Harland G. Wood of Cleveland, Ohio; and Dr. Gerald F. Tape who was filling a short term appointment and is now being reappointed for a full term, expiring in December 1975.

The President's Science Advisory Committee was established in 1951 within the Office of Defense Mobilization and was transferred to the White House in 1957. The Committee advises the President on any matters relating to science and technology and is chaired by Dr. Edward E. David, Jr., the Science Adviser to the President.

# # #

LANGUAGE AND MACHINES

COMPUTERS IN TRANSLATION AND LINGUISTICS

National Academy of Sciences National Research Council

LANGUAGE AND MACHINES

COMPUTERS IN TRANSLATION AND LINGUISTICS

A Report by the
Automatic Language Processing Advisory Committee
Division of Behavioral Sciences
National Academy of Sciences
National Research Council

Publication 1416

National Academy of Sciences National Research Council
Washington, D. C. 1966

First printing, November 1966
Second printing, February 1967
Third printing, December 1967

Available from
Printing and Publishing Office
National Academy of Sciences
2101 Constitution Avenue
Washington, D.C. 20418

Library of Congress Catalog Card Number 66-61843

August 20, 1965

Dear Dr. Seitz:

In April of 1964 you formed an Automatic Language Processing Advisory Committee at the request of Dr. Leland Haworth, Director of the National Science Foundation, to advise the Department of Defense, the Central Intelligence Agency, and the National Science Foundation on research and development in the general field of mechanical translation of foreign languages. We quickly found that you were correct in stating that there are many strongly held but often conflicting opinions about the promise of machine translation and about what the most fruitful steps are that should be taken now.

In order to reach reasonable conclusions and to offer sensible advice we have found it necessary to learn from experts in a wide variety of fields (their names are listed in Appendix 20). We have informed ourselves concerning the needs for translation, considered the evaluation of translations, and compared the capabilities of machines and human beings in translation and in other language processing functions.

We found that what we heard led us all to the same conclusions, and the report which we are submitting herewith states our common views and recommendations. We believe that these can form the basis for useful changes in the support of research aimed at an increased understanding of a vitally important phenomenon—language, and development aimed at improved human translation, with an appropriate use of machine aids.

We are sorry that other obligations made it necessary for Charles F. Hockett, one of the original members of the Committee, to resign before the writing of our report. He nonetheless made valuable contributions to our work, which we wish to acknowledge.

Sincerely yours,

J. R. Pierce, Chairman
Automatic Language Processing
Advisory Committee

Dr. Frederick Seitz, President
National Academy of Sciences
2101 Constitution Avenue
Washington, D.C. 20418

July 27, 1966

Dear Dr. Seitz:

In connection with the report of the Automatic Language Processing Advisory Committee, National Research Council, which was reviewed by the Committee on Science and Public Policy on March 13, John R. Pierce, the chairman, was asked to prepare a brief statement of the support needs for computational linguistics, as distinct from automatic language translation. This request was prompted by a fear that the committee report, read in isolation, might result in termination of research support for computational linguistics as well as in the recommended reduction of support aimed at relatively short-term goals in translation.

Dr. Pierce's recommendation states in part as follows:

The computer has opened up to linguists a host of challenges, partial insights, and potentialities. We believe these can be aptly compared with the challenges, problems, and insights of particle physics. Certainly, language is second to no phenomenon in importance. And the tools of computational linguistics are considerably less costly than the multibillion-volt accelerators of particle physics. The new linguistics presents an attractive as well as an extremely important challenge.

There is every reason to believe that facing up to this challenge will ultimately lead to important contributions in many fields. A deeper knowledge of language could help:

1. To teach foreign languages more effectively.
2. To teach about the nature of language more effectively.
3. To use natural language more effectively in instruction and communication.
4. To enable us to engineer artificial languages for special purposes (e.g., pilot-to-control-tower languages).
5. To enable us to make meaningful psychological experiments in language use and in human communication and thought. Unless we know what language is we don't know what we must explain.
6. To use machines as aids in translation and in information retrieval.

However, the state of linguistics is such that excellent research that has value in itself is essential if linguistics is ultimately to make such contributions.

Such research must make use of computers. The data we must examine in order to find out about language is overwhelming both in quantity and in complexity. Computers give promise of helping us control the problems relating to the tremendous volume of data, and to a lesser extent the problems of data complexity. But we do not yet have good, easily used, commonly known methods for having computers deal with language data.

Therefore, among the important kinds of research that need to be done and should be supported are (1) basic developmental research in computer methods for handling language, as tools to help the linguistic scientist discover and state his generalizations, and as tools to help check proposed generalizations against data; and (2) developmental research in methods to allow linguistic scientists to use computers to state in detail the complex kinds of theories (for example, grammars and theories of meaning) they produce, so that the theories can be checked in detail.

The most reasonable government source of support for research in computational linguistics is the National Science Foundation. How much support is needed? Some of the work must be done on a rather large scale, since small-scale experiments and work with miniature models of language have proved seriously deceptive in the past, and one can come to grips with real problems only above a certain scale of grammar size, dictionary size, and available corpus.

We estimate that work on a reasonably large scale can be supported in one institution for $600 or $700 thousand a year. We believe that work on this scale would be justified at four or five centers. Thus, an annual expenditure of $2.5 to $3 million seems reasonable for research. This figure is not intended to include support of work aimed at immediate practical applications of one sort or another.

This recommendation, which I understand has the endorsement of Dr. Pierce's committee, was also sent out for comment to the membership of the Committee on Science and Public Policy. While the Committee on Science and Public Policy has not considered the recommended program in computational linguistics in competition with other National Science Foundation programs, we do believe that Dr. Pierce's statement should be brought to the attention of the National Science Foundation as information necessary to put the report of the Advisory Committee in proper perspective.

Sincerely yours,

Harvey Brooks, Chairman
Committee on Science and Public Policy

Dr. Frederick Seitz, President
National Academy of Sciences
2101 Constitution Avenue
Washington, D.C. 20418

In computational linguistics and automatic language translation, we are witnessing dramatic applications of computers to the advance of science and knowledge. In this report, the Automatic Language Processing Advisory Committee of the National Research Council describes the state of development of these applications. It has thus performed an invaluable service for the entire scientific community.

Frederick Seitz, President
National Academy of Sciences

AUTOMATIC LANGUAGE PROCESSING ADVISORY COMMITTEE

John R. Pierce, Bell Telephone Laboratories, Chairman
John B. Carroll, Harvard University
Eric P. Hamp, University of Chicago*
David G. Hays, The RAND Corporation
Charles F. Hockett, Cornell University†
Anthony G. Oettinger, Harvard University
Alan Perlis, Carnegie Institute of Technology

STAFF

A. Hood Roberts, Executive Secretary
Mrs. Sandra Ferony, Secretary

*Appointed February 1965
†Resigned December 1964

Preface

The Department of Defense, the National Science Foundation, and the Central Intelligence Agency have supported projects in the automatic processing of foreign languages for about a decade; these have been primarily projects in mechanical translation. In order to provide for a coordinated federal program of research and development in this area, these three agencies established the Joint Automatic Language Processing Group (JALPG).

Early in its existence JALPG recognized its need for an advisory committee that could provide directed technical assistance as well as contribute independent observations in computational linguistics, mechanical translation, and other related fields. In October 1963 the Director of the National Science Foundation, Leland J. Haworth, requested on behalf of the three agencies that the National Academy of Sciences establish such a committee.

This was done, and in April 1964, with funds made available by the three agencies, the Automatic Language Processing Advisory Committee of the National Academy of Sciences—National Research Council, under the chairmanship of John R. Pierce, held its first meeting.

The Committee determined that support for research in automatic language processing could be justified on one of two bases: (1) research in an intellectually challenging field that is broadly relevant to the mission of the supporting agency and (2) research and development with a clear promise of effecting early cost reductions, or substantially improving performance, or meeting an operational need.

It is clear to the Committee that the motivation for support of much of the work in automatic language processing has been the practical aim represented in (2) above. In the light of that objective, the Committee studied the whole translation problem. This report presents the findings and recommendations of the Committee.

Contents

Human Translation

In order to have an appreciation either of the underlying nature and difficulties of translation or of the present resources and problems of translation, it is necessary to know something about human translation and human translators. Thus, early in the course of its study the Committee heard from a number of experts in translation. These experts seem to agree that the three requisites in a translator, in order of importance, are (1) good knowledge of the target language, (2) comprehension of the subject matter, and, (3) adequate knowledge of the source language.

Therefore, while good translations into English are made by some translators whose native tongue is not English, in general, translators whose native tongue is English are preferable. Furthermore, while good translations are made by some translators who have a general appreciation of scientific knowledge, the best technical translations are generally made by experts in the technical field covered. It also seems clear that a restricted competence in the source language is adequate when the translator is expert in the subject matter.

It was emphasized by several persons who made presentations to the Committee that translators need good dictionaries and reference books. This need is especially important when a long work is split up for translation, for in such cases adequate dictionaries or glossaries are essential if technical terms are to be translated consistently.

Translators use a variety of aids, including dictating machines and typewriters, but they do not always produce a final copy suitable for reproduction. The final copy, with figures and equations inserted, is usually produced by the central service. Despite the substantial services performed by the Joint Publications Research Service (JPRS) or by similar agencies, the greater part of the cost of translation usually goes to the translator.

One experiment that has come to the attention of the Committee indicates that a rapidly dictated translation is almost as good as a "full translation" and takes only about one fourth the time (see Appendix 1).

Types of Translator Employment

The two main types of translator employment are in-house and contract. Each type has particular advantages and disadvantages for the translator and for the individual or organization requiring the translation.

IN-HOUSE

The advantages to the in-house translator are that he is employed full time and enjoys all the benefits (leave and retirement, for example) that are offered to other full-time employees in the organization. In addition, he has available to him better reference facilities than his free-lance counterparts.

The advantages to the employer of an in-house translator are chiefly the following:

1. The translator can give spot or oral translations when needed.
2. There is greater possibility for mutually beneficial collaboration between the translator and the requester.
3. The translator can provide fast service when needed.
4. The security of classified information is easily maintained.

The disadvantages to the employer of the in-house translator are:

1. The arrangement (counting overhead and fringe benefits) is generally more expensive than using free-lance translators.
2. Problems in scheduling may arise from time to time, with the translator having either too much or too little to do.
3. Since it is impossible for the in-house translator to be an expert in all fields, it is difficult to get consistently good technical translations done in-house.

CONTRACT

The advantages of a free-lance contract arrangement for the translator are:

1. If he can handle a relatively wide range of subject matter in some of the more uncommon and therefore higher-paying languages, he may earn considerably more than he would as an in-house translator.
2. He has considerably more freedom in deciding when and how much he will work.

The advantages of the contract arrangement to the buyer of translations are:

1. He can obtain technically competent translations in many fields of subject matter.
2. He never pays for time not spent in translating.
3. He has a much lower overhead.

The disadvantages of the contract arrangement to the buyer are:

1. The translator is not on the premises for immediate consultation.
2. Security of classified documents is more difficult to maintain.

English as the Language of Science

It is easy to overestimate the need for translation if one simply looks at the rapidly increasing volume of scientific literature being published throughout the world. The United States is in a particularly fortunate position because English is the predominant language of science. A survey [R. T. Beyer, "Hurdling the Language Barrier," Phys. Today 18 (1), 46 (1965)] of 3,000 abstracts listed in Physics Abstracts and 350 physics abstracts listed in Referativny Zhurnal gave the following results:

Language of Paper Abstracted	Physics Abstracts	Referativny Zhurnal
English	76 percent	63 percent
Russian	14 percent	24 percent
French	4 percent	3 percent
German	4 percent	2 percent
Other	2 percent	8 percent

Although the ratio of English-language articles to non-English articles varies with the subject field, it is generally true that the English-speaking scientist has less need to read in a foreign language or to have translations made than does a scientist of any other native tongue.

Time Required for Scientists to Learn Russian

The Committee believes that in some cases it might be simpler and more economical for heavy users of Russian translations to learn to read the documents in the original language. An article by J. G. Tolpin, titled, "Surveying Russian Technical Publications: A Brief Course" [Science 146, 1143 (1964)], indicates that in eight to sixteen 2-hr class periods scientists can learn to identify articles of interest in Russian publications. Sometimes they can extract what they need from equations, tables, graphs, and figures. In many other cases, a partial oral translation of the material of interest is all that is needed. These are illustrations of the generally acknowledged fact that the technically competent reader needs only a little knowledge of a foreign language in order to make use of foreign journals in his field.*

Indeed, several well-known studies† indicate that in 200 hr or less a scientist can acquire an adequate reading knowledge of Russian for material in his field. An increasing fraction of American scientists and engineers have such a knowledge.

The capability for teaching government personnel to read Russian scientific text already exists, but so far this service has remained largely unused. The Defense Language Institute, West Coast Branch (formerly the Army Language School), has developed two courses of instruction and special texts for this purpose. One course runs 6 weeks, the other 10. The Committee has been informed that the Defense Language Institute would welcome the enrollment of students. Information concerning the 10-week course is presented in Appendix 2.

*A corollary that should be given more emphasis is that even the best translation is of no use to a man who cannot fully understand the subject matter and place it in the context of other work here and abroad.

†R. D. Burke, Some Unique Problems in the Development of Qualified Translators of Scientific Russian, P-1698, The RAND Corp. (May 12, 1959).

W. N. Locke, J. Chem. Educ. 27, 426 (1950).

M. Phillips, The Foreign Language Barrier in Science and Technology, Aslib, London, England (1962), p. 15.

Translation in the United States Government

It should be emphasized that there is no single official government translation system. Indeed there is considerable variety in the methods used by the various government agencies for filling their translation needs. The methods used include contract only, in-house translation, the services of the Joint Publications Research Service (Appendix 3), and a combination of these methods.

Certain agencies are using PL 480 counterpart funds to augment their domestically obtained translations (Appendix 4). Others, principally the U.S. Air Force, utilize the postedited machine output of the Foreign Technology Division, Wright-Patterson Air Force Base (Appendix 5).

In addition, the National Science Foundation, while not a primary producer of translations, is supporting the cover-to-cover translation of 30 journals (Appendix 6, Table 1).

Number of Government Translators

The exact number of government in-house translators is impossible to determine, although it is a simple matter to determine the number of persons in the Civil Service classification, "Translator." It sometimes happens that the translator who decides to better his economic situation must first contrive to secure a more prestigious occupational title. Thus the way is open for advancement, even though the bulk of his duties might remain the same.

The picture is further obscured by the fact that bilingual persons in other job categories are often called upon to produce rough or oral translations for their colleagues or superiors. This situation is not, of course, peculiar to agencies of the U.S. Government.

Keeping in mind the indefiniteness of the number of persons actually classified under "Translator," we give the figures obtained from the Civil Service Commission for October 1962:

Translators and clerk-translators employed in the United States	262
Translators and clerk-translators employed worldwide	453

(For the number of translators in each division and grade, in each agency, and for the CSC salary schedule for 1964, and CSC qualification standards, see Appendix 7.)

From the data supplied by the CSC, we have figured the average yearly salary of the federal translator (clerk-translator not included) employed in the United States to be approximately $6,850.

When one compares this figure with the median annual salary of government scientists ($9,000. American Science Manpower, 1962, A Report of the National Register of Scientific and Technical Personnel, NSF 64-16, National Science Foundation, Washington, D.C., 1964), it is apparent that technically trained bilingual persons would derive more advantages from working as scientists and technologists in their subject specialties than from serving as technical translators in their respective fields.

Despite the fact that the average pay for government translators

is not as high as the average for government scientists, there seems to be a very low rate of turnover among government translators. Indeed, the facts are that the supply exceeds the demand. Although there is not now on hand at the U.S. Employment Service (Washington, D.C.) a single request for a full-time translator, there are approximately 500 translators on its rolls who desire work (part time or full time). (For the availability of translators and their languages, see Appendix 8.)

Amount Spent for Translation

Considering the various methods used to secure translations, it is not surprising that federal agencies have paid many different prices for translation—prices ranging from $9 to $66 per 1,000 words. (It is not altogether unheard of for a translation purchaser to pay a translator who does exceptionally good work for more words than he actually translates.)

At its first meeting, the Committee decided that it would be useful to have a fairly reliable estimate of the amount of money the government was spending for translation. Although the figures collected by the Committee constitute only an estimate—and a rough estimate, at that—we feel that it is the best estimate of the government's translation expenditures made up to this time.

Amounts spent by government agencies for translations done by:

		$ Millions
JPRS	Fiscal Year 1964	1.3
Commercial Agencies	Fiscal Year 1964 (Est. by H. R. Select Committee)	3.6
PL 480	Fiscal Year 1965	1.5
NSF Domestic	Fiscal Year 1965	1.1
In-House	Fiscal Year 1963	5.3
FTD MT	1 March - 2 October 1964	0.27
	Total	13.07

It is clear from the above figures that translation in the government is a very small field of activity when compared with most undertakings in which the government supports research and development.

Bernard Bierman, a New York translation agency owner and a director of the American Translators Association has estimated that the commercial translation agencies in the United States do about $7.5 million worth of business each year. When this figure is added to the $13 million spent by the government, the sum is

about $20 million. To this should be added perhaps $2 million for the amount spent for nongovernment in-house translators. Thus the estimate of the amount of money spent on translation would be raised to approximately $22 million.

Is There a Shortage of Translators or Translation?

In the past, it has been said that there is an unfulfilled need for translation or a shortage of translators. With respect to translators of other languages into English, the Committee finds that this is not so. This conclusion is based on the following data:

1. The supply of translators greatly exceeds the demand. The rolls of the U.S. Employment Service, the availability of translators to work at rates as low as $6 per 1,000 words (or lower), and conversations with translators confirm the Committee's conclusion.

2. The Joint Publications Research Service has the capacity to double its output immediately (with a very small increase in office staff) if called upon. The JPRS has 4,000 translators under contract, and in the average month it utilizes the services of only some 300 of them. To choose one important language as an example, the JPRS could with no difficulty handle up to two and a half times the present demand for Chinese translation.

3. The National Science Foundation's Publication Support Program will carefully consider, through a proper professional society, the support of the translation of any foreign journal that such a society nominates. Thirty journals were being translated cover to cover in Fiscal Year 1964 (see Appendix 6, Table 1). One translation has a circulation of only 200 copies. This comes close to providing individual service. In 12 years of NSF support, 19 translated journals have become self-supporting (see Appendix 6, Table 2).

The Committee rejects any argument, based on the fact that the demand for the PL 480 translations is five times greater than the program can satisfy, that there is a shortage of translation. Such an argument is rejected on the grounds that the demand for almost any free commodity is insatiable.

Forty-five (mostly government) information facilities, in response to a questionnaire issued by the Select Committee on Government Research (House of Representatives, 88th Congress),

indicated that the work of their facilities had been limited by a lack of translators. These 45 facilities were again asked by the Automatic Language Processing Advisory Committee whether their facility had been limited by a lack of translators, and if so whether this lack was attributable to a lack of authorized positions for translators or to a lack of qualified translators. The Committee received 25 replies. Some said that their facilities had no translation function. One said that it had not been limited by a lack of translators and that this situation was attributable to a lack of authorized positions. Six indicated that they were not limited by a lack of translators. Of the nine facilities that answered clearly in the affirmative that they had been limited by a lack of translators, seven indicated that this was attributable to a lack of authorized positions. Of the two remaining, only one, the nongovernment research center, said its lack was attributable to a lack of qualified translators. The others simply replied by saying that they did not have sufficient requests for services to justify permanent positions.

The results of the survey confirm the Committee's belief that there is no shortage of translators, although there may be a shortage of authorized positions for translators. This, then, is a fiscal problem for the agencies and the Civil Service Commission, and not a problem for research and development offices supporting research in mechanical translation.

The Committee concludes that all the Soviet literature for which there is any obvious demand is being translated [see A. G. Oettinger's "An Essay in Information Retrieval or the Birth of a Myth," Information and Control 8 (1), 64 (1965) concerning a claim of duplicated research], and, although it is less easy to evaluate the needs or coverage of open or closed material for intelligence, the Committee regards it as decisive that it has not encountered a single intelligence organization that is demanding more money for human translation. The Committee has heard statements that the use of translation is analyst-limited; that is, even if more material were translated, analysts would not be available to utilize it. Thus, it is ironic that several agencies propose to spend more money for "machine translation." The Committee is puzzled by a rationale for spending substantial sums of money on the mechanization of a small and already economically depressed industry with a full-time and part-time labor force of less than 5,000.

Regarding a Possible Excess of Translation

While the Committee is not concerned with any lack of translation, it does have some concern about a possible excess of translation. Translation of material for which there is no definite prospective reader is not only wasteful, but it clogs the channels of translation and information flow. Routine translation should be confined to journals or books with reasonably assured paid circulation and additional translations should be made only in response to specific requests. In support of this position we quote from a letter received by the Committee from a research organization of the Department of Defense:

> We have found that the available translation services generally do not cover our technical areas to the depth that we require for our studies. As a result, we are continually putting in requests for translations of additional journal articles and such things as Soviet patents. Our problem has been the inability to obtain quick reaction to these special requests and it is this factor that has hampered rather than limited our work. If we had one recommendation to make to a survey such as yours, it would be that a better balance should be established between what is routinely translated and the special translation requests of users. We have found that many articles are being translated in our area that do not warrant the effort and it appears to us that some of the routine translations could be abandoned in order to make more translation services available for quick reaction to special requests.

It is possible that the cover-to-cover translations contain, in addition to much valuable information, many uninspired research reports that the U.S. scientist could have been mercifully spared.

An interesting study, conducted in 1962, investigated the value of the articles contained in the Soviet journals translated in the National Library of Medicine/Public Health Service translation program [Report of Study of NLM/PHS Russian Translation Program (Contract PH-86-62-9), Institute for Advancement of Medical Communication (Jan. 15, 1962)]. The method of evaluation used was

parallel editorial refereeing of the Soviet articles by counterpart American journals. Copies of the translated articles were sent to the editors in chief of counterpart American journals for distribution to their referees. The preliminary results were as follows.

Of the total of 36 articles taken from two issues of the Sechenov Physiological Journal of the USSR, 31 percent were judged acceptable for publication in the American Journal of Physiology or the Journal of Applied Physiology.

Of the total of 41 articles taken from two issues of Biophysics (USSR), 23 percent were judged acceptable for publication in the Biophysical Journal. In addition the referees indicated that another eight articles should be acceptable to the appropriate American journal.

Of the 25 papers taken from two issues of Problems of Oncology, 76 percent were considered acceptable to Cancer. The referees indicated that another two articles would have been acceptable at one time but "would not now be considered new enough to merit publication."

Further evidence of a possible excess of translation is to be found in The Need for Soviet Translations Among American Chemists, a report to the American Chemical Society by Herner and Company (June 4, 1962):

> On the other hand, the biggest argument that the respondents had with the translations presently available to them was not with their quality but with time lags in their issuance. The translation process—particularly when cover-to-cover translations are involved—is a relatively slow one. In view of the finding of the medical editors, one might well wonder whether a relatively high proportion of mediocre or inferior papers are not delaying the appearance of a small proportion of superior and significant papers.
>
> Perhaps even more revealing than the specifically stated reasons for nonuse of Soviet translations are the answers to the question in the questionnaire in regard to preferred media for receiving Soviet scientific information. Three methods outranked all others. These were: English-language abstracts of Russian publications, regular English-language reviews of Soviet developments in specific fields, and translations of individual articles as needed. These three methods are of course not mutually exclusive but complementary. Interestingly, the number of respondents who preferred to get their Soviet information in the form of cover-to-cover translations was only half the number who preferred to get their translations as needed.
>
> . . . The only things that might be done to round out the Soviet coverage that is presently available in chemistry is, first, to make sure that Soviet papers that are worthwhile in the opinion of the abstractors or editors are given detailed abstracting because they are likely not to be readily available in English; second to provide means of obtaining cheap copies of cited Soviet papers, possibly through the Chemical Abstracts Service; and third to develop a mechanism for making selected translations available on request, again possibly through the Chemical Abstracts Service. All three areas of improvement would probably require subsidization by the Government. However, it would probably mean a far smaller expenditure than would be required to support an expanded program of cover-to-cover translations. It would also probably produce a far greater return.

It is the Committee's belief that the total technical literature does not merit translation, and it is futile to try to guess what someone may at some time want translated. The emphasis should be on speed, quality, and economy in supplying such translations as are requested.

A service such as the Joint Publications Research Service, which charges the user for a translation, is less conducive to translation without use than is a service such as the U.S. Air Force Systems Command's Foreign Technology Division, which supplies translations free within certain areas.

The Crucial Problems of Translation

There is no emergency in the field of translation. The problem is not to meet some nonexistent need through nonexistent machine translation. There are, however, several crucial problems of translation. These are quality, speed, and cost.

QUALITY

The Committee believes strongly that the quality of translation must be adequate to the needs of the requester. The production of a flawless and polished translation for a user-limited readership is wasteful of both time and money. On the other hand, production of an inferior translation when one of archival quality is called for is even more wasteful of resources. It seems clear to the Committee that, in many cases, translations of adequate quality are not being provided.

Despite the fact that adequate quality is essential, the government has no reliable way to measure the quality of translation. In view of this, one member of the Committee has set up an experiment in the evaluation of quality. This work is described briefly in Appendix 10. A reliable way to measure quality would be of great importance in determining proper cost of translation. The correlation between cost and quality is far from precise. Concerning this correlation, we quote from the presentation made to the Committee on September 30, 1964, by Dr. Kurt Gingold, President of the American Translators Association:

> There is no absolute correlation between cost and quality. There are some excellent translators who charge moderate rates, while some incompetents manage—at least temporarily—to charge much higher prices. Such correlation as exists is probably better at the low than at the high end; in other words, a cheap translation is almost always defective in some way, while an expensive translation is not always of superior quality. By and large, however, one gets what one pays for.

SPEED

Reasonable speed and promptness are essential in translation. The Committee is convinced that in this regard there is considerable room for improvement.

Of 2,258 scientists responding to a questionnaire concerning translated Soviet journals, 1,407 commented on lag time of publication; 24.5 percent of the comments were to the effect that lag time should be reduced (American Use of Translated Soviet Scientific Journals, a user study prepared by the Syracuse University Research Institute for the National Science Foundation and available from the Clearinghouse for Federal Scientific and Technical Information, Report No. TT-65-64026).

The lag time (from receipt) for the average document processed by the AN/GSQ-16 (XW-2) Automatic Language Translator of the USAF Foreign Technology Division (FTD) is 109 days (44 days for high-priority items). Also at FTD, the average processing time for documents translated by outside contractors was usually 65 days plus 1.3 days for each 1,000 words of Russian translated.

The most rapid translation service offered on a customary basis at regular prices that has come to the attention of the Committee is that of the Joint Publications Research Service (JPRS), which guarantees 50 pages in 15 days, 100 pages in 30 days.

The lag time (from receipt) in publication of the translated journals supported by NSF ranges from 15 to 26 weeks. On the average, half of this lag is accounted for by time spent in translation and editing (Appendix 6, Table 3).

Thus, we see that many of the delays in "translation" do not lie in the process of translation itself, but rather in time spent in editing and production, and sometimes in avoidable delays. In the FTD machine-aided translation, the delays are in production and postediting, together with the delays caused by queues in the many operations that must be done in tandem in this particular form of machine-aided translation.

It should be mentioned that for high-priority items extra fast translation service can be had by splitting long texts into segments, or by paying an additional fee that may range from 25 to 50 percent of the base rate or even higher, depending on the particular circumstances.

COST

Cost is important because in many cases it is the only measure the government can sensibly use in deciding how its translation is to

be done. As we have seen, it varies considerably—from $9 to $66 per 1,000 words. Machines are probably inappropriate for some forms of translations, such as very high-quality diplomatic translation and literary translation. But translations of scientific material can be done with or without machine aids. As to quality and speed, at extra cost, better quality and higher speed can be attained if long texts are split into segments. Thus, cost for a particular result is the criterion that the government should apply in deciding on means of translation. (See Appendix 9 for estimates of the costs of various types of translation.)

The Present State of Machine Translation

"Machine Translation" presumably means going by algorithm from machine-readable source text* to useful target text, without recourse to human translation or editing. In this context, there has been no machine translation of general scientific text, and none is in immediate prospect.

The contention that there has been no machine translation of general scientific text is supported by the fact that when, after 8 years of work, the Georgetown University MT project tried to produce useful output in 1962, they had to resort to postediting. The postedited translation took slightly longer to do and was more expensive than conventional human translation. The "mechanical translation" facility of the USAF Foreign Technology Division (FTD) postedits the machine output when it produces translations. Dr. Gilbert King of Itek Corporation told the Committee that Itek plans to establish a "machine translation" service, but that it will provide postedited translations. Dr. J.C.R. Licklider of IBM and Dr. Paul Garvin of Bunker-Ramo said they would not advise their companies to establish such a service.

Unedited machine output from scientific text is decipherable for the most part, but it is sometimes misleading and sometimes wrong (as is postedited output to a lesser extent), and it makes slow and painful reading.† (See Appendix 10.)

A recent study by the American Institutes for Research [D.B. Orr and V.H. Small, "A Reading Comprehension Test," Prelim. Rept., Contr. No. AF30(602-3459), June 30, 1965] had as its principal objective comparison of the accuracy and speed with which the

*Machine-readable text is simply text that can be used as an input to a computer. It includes punched cards, punched paper tape, and magnetic tape, and is ordinarily prepared from printed text by a keyboard operator.

†Excellent machine output of simple or selected text has been attained in several experiments; this is of no practical and limited theoretical significance.

same Russian documents can be read when they have been translated into English by the FTD machine translation (MT) system (one set postedited, the other set just as it came out of the computer) and when they had been translated into English by a human translator in the conventional manner.

In physics, tests showed that the reader of raw MT output was 10 percent less accurate, 21 percent slower, and had a comprehension level 29 percent lower than when he used human translation. When he used postedited output, he was 3 percent less accurate, 11 percent slower, and had a comprehension level 13 percent lower than when he used human translation.

In the earth sciences, when he used raw MT output, he was 16 percent less accurate, 21 percent slower, and had a 25 percent lower comprehension level than when he used human translations. When he used postedited output, he was 5 percent less accurate, 11 percent slower, and had a comprehension level 23 percent lower than when he read human translations.

Subjectively, a lot of the trouble seems to lie in unnatural constructions and unnatural word order, though strange translations of individual words or multiple translations of one word, with the choice left to the reader, are bothersome. (For a classification of the types of errors common in machine translation see Appendix 11.)

The paragraphs below are typical of the recent (since November 1964) output of four different MT systems. Each sample gives the first and last (except for translation No. 4) paragraphs and a paragraph from the middle of a Russian article on space biology.

Bunker-Ramo Corporation No. 1

Biological experiments, conducted on various/different cosmic aircraft, astrophysical researches of the cosmic space and flights of Soviet and American astronauts with the sufficient/rather persuasiveness showed/indicated/pointed, that momentary/transitory/short orbital flights of lower/below than radiation belts/regions/flanges of earth/land/soil in the absence of the raised/increased/hightened sun/sunny/solar activity with respect to radiation are/appear/arrive/ report safe/not dangerous/secure. Received/obtained by astronauts of the dosage of the radiation at the expense of the primary cosmic emission/radiation and emissions/radiations of the external/outer radiation belt/region/flange are so/such a small, that can not render/show/give the harmful influence/action/effect on/in/at/to the organism of man.

Mammals (dog, mouse/mice, rat, guinea pigs), fly/flies of the drosophilae, vegetable/vegetational objects/items/objectives. Seeds of higher/superior/supreme plants/vegetables (wheat, peas, onion/bow, the pine tree, beans, radish, carrot etc), microspore of the tradescantia/spiderwort, the

culture of the alga/seeweed chlorella on/in/at/to tissue, cellular, subcellular, and molecular levels (Gyurdzhian, 1962A. . Antipov et al., 1962) were used in these experiments. In experiments on/in/at/to mammals the special/particular/peculiar attention/consideration/was given to the research/analysis/investigation of the state/condition/position of the system of the blood/hemogenesis formation, the determination/definition/decision of intermediate products of the exchange of nucleic acids (desoxycytidine and di)epolo$itel* substances), the study/investigation of the state/condition/position of the natural immunity, the determination/definition/decision of the maintenance/content of serotonin in the blood. Moreover, the control for/during/per/beyond the condition/state pigmentation of hair for/at/by/from black mice (the line/strain CSUB57 BL) was conducted. Physiological shifts/improvements were studied also/as well on/in/at/to seeds of higher/superior/supreme plants, vegetables microorganisms, cells of various different tissues/cloth in the culture etc.

Thus, the consideration/investigation certain/some from/of principal/basic radiobiological problems shows/indicates/points/displays, that in the given region/area still/yet/more/back/some more very many/very much unsolved questions. This is clear/plain, since cosmic radiobiology is very the young section/division of young science--the cosmic biology. However there is/there are/is/eat basis to hope, that by common/general/total efforts of scientific various/different professions of different/various countries of the world/peace radiobiological researches in the cosmic space will be sucessfully continued/carried on and were expanded/broadened.

Computer Concepts, Inc. No. 2

The biological experiments that were carried out on different cosmic flying apparatus, ASTROFIZICESKIE the research of cosmic PROSTRANSTVA and the flights of Soviet and American KOSMONAVTOV with sufficient UBEDITEL6NOST6H showed, that the short-time orbital flights below of the radiational belts of earth in the absence that was raised by the SOLNECNOI one of activity in a radiational attitude are BEZOPASNYMI. Dose of radiati on at the expense of primary cosmic radiation and the radiation of an exterior radiational belt the obtained by KOSMONAVTAMI are so little, that aren't able to render a harmful influence to the organism of a man.

Mammals (dogs, meeth, rats, sea SVINKI) were utilized in these experiments. The flies of drosophila, vegetable objects, semena of higher plants (wheat, GOROX, LUK, a pine tree, BOBY, REDIS, a carrot and others), MIKROSPORY of TRADESKANQII the culture of an alga chlorella in different nourishing mediums, the numerous biological and QITOLOGICESKIE ones objects on the TKANEVOM, cellular, subcellular and molecular levels (Ghrdjian, 1962 and Antipov from Soavt 1962) and in experiences to mammals particular attention was being allotted to the research of the condition of the system of KROVOTVORENI4, to the definition of the intermediate products of the exchange of nucleic acids DEZOKSIQITIDINA and DIWEPOLOJITEL6NYX substances), to the study of the condition of natural IMMUNITETA, to

the definition of the content of SEROTONINA in KROVI. Besides, control after the condition of PIGMENTAQII of VOLOS at CERNYX meeth (the line of C(57) of Y) was being carried out. Physiological SDVIGI were being studied also on SEMENAX of higher plants, microorganisms, the cells of different tissues in culture and T. of D.

Thus, the examination of some from fundamental RADIOBIOLOGICESKIX problems shows, that in this a field still very much NEREWENNYX questions. This is clear, since cosmic RADIOBIOLOGI4 is very young RAZDELOM young science efforts of the scientific different specialties of the different countries of the world successful PRODOLJENY will be expanded there are.

FTD, USAF No. 3

Biological experiments, conducted on different space aircraft/vehicles, astrophysical space research and flights of Soviet and American astronauts with/from sufficient convincingness showed that short-term orbital flights lower than radiation belts of earth in the absence of heightened solar activity in radiation ratio are safe. Obtained by astronauts of dose of radiation at the expense of primary cosmic radiation and radiation of external radiation belt are so small that cannot render harmful influence on organism of person.

In these ESKPERIMENTAKH were used mamals (dog, mice, rat, guinea pig), fly of Drosophilae, vegetable objects, seeds of highest plants (wheat, pea, onion/bow, pine, beans, radish, carrot and others), microspore of tradescantia, culture of alga chlorella on different nutrient media, numerous biological and TSITOLOGICHCHESKIE objects on tissue, cellular, subcellular and molecular levels (Gyurozhian 1962A, Anti-Pov with/from Soavt, 1962). In experiments on mammals special attention was allotted investigation of state of system of sanguification, determination of intermediate products of exchange of nucleic acids (deoxycytidine and Dische-positive substances), study of state of natural immunity, determination of contents gray-fineness in blood. Furthermore, was conducted counterol for/after state of pigmentation of hairs for black mice (line bl). Physiologic shifts were studied also on seeds of highest plants, microorganisms, cages of different fabrics in culture etc.

Thus, consideration of certain from basic radiobiological problems shows that in given region still very many unsolved questions. This and intelligibly, since space radiobiology is very young division of young science--space biology. However is base to trust that jointly scientists of different specialties of various countries of world/peace radiobiological investigations in outer space will be successfully continued and expanded.

EURATOM, Ispra, Italy No. 4
(Essentially the Georgetown MT system)

Biological experiments, which were conducted on different cosmic LETATEL6NYX APPARATI, the astrophysical investigations of cosmic space and the flights of Soviet and also American KOSMONAVTOV with the sufficient convincingness showed, that the short-term orbital flights of below radiation belts of ground upon the absence of the increased solar activity in radiation relation are safe. Obtained by KOSMONAVTAMI of dose of radiation at the expense of initial cosmic radiation and the radiations of external radiation belt are so small, that cannot have harmful action on the organism of man.

In these experiments there were used mammals (dogs, mice, KRYSY, the maritime piglets), MUXI DROZOFILY, vegetable objects. The seeds of higher plants (wheat, the pea, LUK, pine, beans, REDIS, MORKOV6 etc.) MIKROSPORY TRADESKANQII, the culture of alga of chlorella on the different feed environments, numerous biological and QITOLOGICESKIE objects on TKANEVOM, cellular, SUBKLETOCNOM and molecular levels (Ghrdjian, 1962 and Antipov with Soavt 1962). In experiments on mammals special attention was devoted to the investigation of state of system of KROVOTVORENI4, the determination of intermediate products the exchange of nucleinic acids (DEZOKSIQITIDINA and DIWEPOLOJITEL6NYX substances), the study of the state of natural IMMUNITETA The determination of content of SEROTONINA in blood. Besides this, there was conducted the check for the state or PIGMENTAQII the hair at black mice (the line C(57) Y)the Physiological) shifts were studied also on the seeds of higher plants, microorganisms, the cells of the different tissues in culture and T D.

The reader will find it instructive to compare the samples above with the results obtained on simple, or selected, text 10 years earlier (the Georgetown IBM Experiment, January 7, 1954) in that the earlier samples are more readable than the later ones.

The quality of crude oil is determined by calory content.
The quality of saltpeter is determined by chemical methods.
TNT is produced from coal.
They obtain dynamite from nitroglycerine.
Ammonite is obtained from saltpeter.
Gasoline is prepared by chemical methods from crude oil.
They prepare ammonite.
Gasoline is produced by chemical methods from crude oil.
The price of crude oil is determined by the market.
Calory content determines the quality of crude oil.
TNT is prepared from coal.

The development of the electronic digital computer quickly suggested that machine translation might be possible. The idea captured the imagination of scholars and administrators. The practical

goal was simple: to go from machine-readable foreign technical text to useful English text, accurate, readable, and ultimately indistinguishable from text written by an American scientist. Early machine translations of simple or selected text, such as those given above, were as deceptively encouraging as "machine translations" of general scientific text have been uniformly discouraging. However, work toward machine translation has produced much valuable linguistic knowledge and insight that we would not otherwise have attained.

No one can guarantee, of course, that we will not suddenly or at least quickly attain machine translation, but we feel that this is very unlikely. Victor H. Yngve of the MIT Research Laboratory of Electronics, in answer to a request from Committee Chairman John R. Pierce, expressed his views as follows:

> I concur with your view of machine translation, that at present it serves no useful purpose without postediting, and that with postediting the over-all process is slow and probably uneconomical.
>
> As to the possibility of fully automatic translation, I am convinced that we will some day reach the point where this will be feasible and economical. However, there is considerable basic knowledge required that we simply don't have at the moment, and it is anybody's guess how soon this knowledge can be obtained. However, I am dedicated to trying to obtain some of this knowledge. The question as to whether fully automatic translation will ever be economical must wait until we see whether it is possible at all. I feel that if it is possible, then it will be economical in the future because of the rapid advances in computer technology.

In his paper, "Implications of Mechanical Translation Research" [Proc. Am. Philosophical Soc. 108, 275 (1964)], Dr. Yngve notes:

> Work in mechanical translation has come up against a semantic barrier... We have come face to face with the realization that we will only have adequate mechanical translation when the machine can "understand" what it is translating and this will be a very difficult task indeed... "understand" is just what I mean... some of us are pressing forward undaunted.

The Committee indeed believes that it is wise to press forward undaunted, in the name of science, but that the motive for doing so cannot sensibly be any foreseeable improvement in practical translation. Perhaps our attitude might be different if there were some pressing need for machine translation, but we find none.

Machine-Aided Translation at Mannheim and Luxembourg

As it becomes increasingly evident that fully automatic high-quality machine translation was not going to be realized for a long time, interest began to be shown in machine-aided translation. The Committee has knowledge of two important machine-aided translation systems in operation: the Federal Armed Forces Translation Agency, Mannheim, Germany, and the Terminological Bureau of the European Coal and Steel Community, Luxembourg. At these centers the approach is conservative; a machine is used to produce specialized glossaries helpful in the translation of particular documents. (Although the translation system in operation at the USAF Foreign Technology Division, Wright-Patterson Air Force Base, is being called, with increasing frequency, "machine-aided translation," it is actually a system of human-aided machine translation, relying, as it must, on posteditors to make up for the deficiencies of the machine output.)

MACHINE-AIDED TRANSLATION AT THE FEDERAL ARMED FORCES TRANSLATION AGENCY, MANNHEIM, GERMANY

The Federal Armed Forces Translation Agency conducted an experiment designed to determine to what extent and in what areas machine output could aid the human translator. Two translators were given identical English texts to be translated into German. Neither translator was a specialist in the technical field treated in the text. Translator A had the conventional dictionaries and other reference works found in technical libraries and access to experienced experts. Translator B was given only a text-based or text-related glossary (TRG) that listed all and only the technical terms in the original text in the sequence in which they occurred plus their German equivalent or equivalents. To minimize any differences in the translators' abilities, a second text was

translated in which translator A used the TRG and translator B worked in the conventional way.

The procedure above was repeated with two different translators and two different technical texts. Results of the test indicated that a translator working with conventional aids requires between 50-86 percent (average, 66 percent) more time than a translator working with a text-related glossary. In addition to increased speed, another advantage of the TRG type of translation was that using this method the translators made one third fewer errors.

We quote below from a translation of a paper titled "Production of Text-Related Technical Glossaries by Digital Computer, A Procedure to Provide an Automatic Translation Aid," by F. Krollmann, H. J. Schuck, and U. Winkler (the German original appeared in the January 1965 issue of Beiträge zur Sprachkunde und Informationsverarbeitung):

> These two experiments have shown that the speed (and thus the cost) of the translator's work as well as the quality of his product (and thus the output of the editor) can be considerably improved if it is possible to relieve the translator of the unproductive and tiresome search for the correct technical term that frequently cannot possibly be included yet in any of the conventional dictionaries. These figures would suggest that, ideally, the error quota in translations of technical-scientific texts can be reduced by approximately 40 percent—a figure which experience indicates can be improved by at least another 10-15 percent since better understanding of the text frequently results in improved linguistic rendition (unambiguity of style)—and that translator productivity can be increased by over 50 percent.

The system works in the following way. The translator reads through the text to be translated and underlines the English words for which he desires to know the German equivalent. The text is then given to a keypunch operator who punches the cards for the underlined words and at the same time performs morphological reduction of the English words (in most cases this simply involves omitting the inflectional suffixes). The information on the cards is then put into the computer, which can produce three or four text-related glossaries in about 10 min. The TRG system became operational in 1965 and in early 1966 was connected by a data-link with a Telefunken TR-4 computer in Trier.

At present the Federal Air Force Translation Agency has a cooperative agreement for exchange of terminologies with the U.S. Defense Language Institute/West Coast Branch, the British Admiralty, the European Coal and Steel Community, and others.

An analysis of a test run and some sample output is to be found in Appendix 12. This technique was developed by the Federal

Ministry of Defense of West Germany which very kindly made available for the Committee use of the material in Appendix 12.

MACHINE-AIDED TRANSLATION AT THE EUROPEAN COAL AND STEEL COMMUNITY, LUXEMBOURG

The Terminological Bureau of the European Coal and Steel Community (CECA) was established in 1950 to provide assistance to the Translation Bureau, which had the task of performing translations into and out of the four official languages of CECA—French, Dutch, Italian, and German.

The Head of the Terminological Bureau, Mr. J. A. Bachrach, estimates that a minimum of 25 percent of the translator's time is spent on terminological questions and that, in difficult documents, up to 75 percent of the translator's time is spent on these problems. In collaboration with Mrs. Lydia Hirschberg of the Free University of Brussels and her group, various approaches to this problem were considered. Soon a system was devised by which the translator's time-consuming job of finding the answers to questions of terminology was made easier.

The system utilized at CECA is one of automatic dictionary look-up with context included. The operation is similar to that used at Mannheim, but the output is somewhat different. It is similar in that the translator indicates, by underlining, the words with which he desires help. The entire sentence is then keypunched and fed into a computer. The computer goes through a search routine and prints out the sentence or sentences that most nearly match (in lexical items) the sentences in question. The translator then receives the desired items printed out with their context and in the order in which they occur in the source.

The translation of the sentence is not done by the computer, but by a human translator. However, since the data produced by each query are added to the data base, the more the system is in use, the greater is the probability of finding sentences that have the desired term in the proper context. A sample of typical CECA French-English output in shown in Appendix 13.

The information that has been built up by CECA not only is of value in answering the queries of translators but also enables CECA to publish specialized glossaries in a very short time. Appendix 13, a copy of one extract from a five-language glossary prepared for the Congress on Steel Utilization is attached.

The Committee finds it difficult to assess the difficulty and cost of postediting. An initial reaction is apt to be like that of R. T. Beyer [Phys. Today 18 (1), 50 (1965)]:

I must confess that the results were most unhappy. I found that I spent at least as much time in editing as if I had carried out the entire translation from the start. Even at that, I doubt if the edited translation reads as smoothly as one which I would have started from scratch. I drew the conclusion that the machine today translates from a foreign language to a form of broken English somewhat comparable to pidgin English. But it then remains for the reader to learn this patois in order to understand what the Russian actually wrote. Learning Russian would not be much more difficult. Someday, perhaps, the machines will make it, but I as a translator do not yet believe that I must throw my monkey wrench into the machinery in order to prevent my technological unemployment.

The Committee had some postediting done as an experiment (see Appendix 14). Postediting took as long as translation, yet people said they were willing to do it for less per word! FTD figures indicate that in-house postediting is done faster than in-house translation.

Studies of the FTD operation indicate that keyboard transcription of the cyrillic text is a very minor part of the total cost. Thus, automatic character recognition could cut the cost of the operation only a little. On the other hand, a large fraction of the cost is in putting the final translation together, with figures and equations, and reproducing it.

If we compare the cost of human in-house translation ($40 per 1,000 Russian words) with the cost of machine-aided translation within FTD ($36 per 1,000 Russian words), machine-aided translation appears to be somewhat less expensive. But FTD machine-aided translation is costlier than contract translation ($33 per 1,000) and far costlier than Joint Publications Research Service (JPRS) translation ($16 per 1,000 English words).

Appendix 15 gives data on a comparison by experts of the quality of some recent JPRS translations and FTD machine-aided translations. The text of the JPRS translations was judged to be better than that of the FTD translations. The quality of the reproduction of text and figures was judged to be poor in both cases, with JPRS superior to FTD. We wonder why the Air Force pays more for translations made by FTD than superior and prompter JPRS translations would cost.

Automatic Language Processing and Computational Linguistics

Over the past 10 years the government has spent, through various agencies, some $20 million on machine translation and closely related subjects (see Appendix 16). This is more than the government cost of translation for 1 year. Other moneys have been allocated to information retrieval, library automation, and programmed instruction.

Although techniques of machine construction and programming for time-shared operation have been developed with partial support from the government, the computer industry has spent its own resources in machine development, and expenditures in connection with automatic language processing have played a distinctly minor role in advances in computer hardware.

Industry has also been responsible for the development of important techniques of computer justification and hyphenation of newsprint and related matters of composition (see Appendix 17), perhaps because the market was easy to determine.

As opposed to its small effect on computer hardware, work toward machine translation, together with the computational linguistic work that has grown out of it, has contributed significantly to computer software (programming techniques and systems). These contributions are discussed in considerable detail in Appendix 18.

By far the most important outcome of work toward machine translation has been its effect on linguistics, which is described in more detail in Appendix 19.

The advent of computational linguistics promises to work a revolution in the study of natural languages. A decade ago, most linguists believed that syntax had to do with word order, inflection, function words (e.g., prepositions and conjunctions), and intonation or punctuation. They also believed that most sentences uttered by native speakers in ordinary contexts were syntactically unambiguous. Today, they know that these two beliefs are mutually inconsistent. Their knowledge is the immediate result of computer parsing of

ordinary sentences, using reasonable grammars as hitherto conceived and programs that expose all ambiguities under a fixed grammar.

Today there are linguistic theoreticians who take no interest in empirical studies or in computation. There are also empirical linguists who are not excited by the theoretical advances of the decade—or by computers. But more linguists than ever before are attempting to bring subtler theories into confrontation with richer bodies of data, and virtually all of them, in every country, are eager for computational support. The life's work of a generation ago (a concordance, a glossary, a superficial grammar) is the first small step of today, accomplished in a few weeks (next year, in a few days), the first of 10,000 steps toward an understanding of natural language as the vehicle of human communication.

The revolution in linguistics has not been solely a result of attempts at machine translation and parsing, but it is unlikely that the revolution would have been extensive or significant without these attempts.

We see that the computer has opened up to linguists a host of challenges, partial insights, and potentialities. We believe these can be aptly compared with the challenges, problems, and insights of particle physics. Certainly, language is second to no phenomenon in importance. And the tools of computational linguistics are considerably less costly than the multibillion-volt accelerators of particle physics. The new linguistics presents an attractive as well as an extremely important challenge.

There is every reason to believe that facing up to this challenge will ultimately lead to important contributions in many fields. A deeper knowledge of language could help

1. to teach foreign languages more effectively;
2. to teach about the nature of language more effectively;
3. to use natural language more effectively in instruction and communication;
4. to enable us to engineer artificial languages for special purposes (e.g., pilot-to-control tower languages);
5. to enable us to make meaningful psychological experiments in language use and in human communication and thought (unless we know what language is we do not know what we must explain); and
6. to use machines as aids in translation and in information retrieval.

However, the state of linguistics is such that excellent research, which has value in itself, is essential if linguistics is ultimately to make such contributions.

Such research must make use of computers. The data we must examine in order to find out about language is overwhelming both in quantity and in complexity. Computers give promise of helping us control the problems relating to the tremendous volume of data, and to a lesser extent the problems of data complexity. But, we do not yet have good, easily used, commonly known methods for having computers deal with language data.

Therefore, among the important kinds of research that need to be done and should be supported are (1) basic developmental research in computer methods for handling language, as tools for the linguistic scientist to use as a help to discover and state his generalizations, and as tools to help check proposed generalizations against data; and (2) developmental research in methods to allow linguistic scientists to use computers to state in detail the complex kinds of theories (for example, grammars and theories of meaning) they produce, so that the theories can be checked in detail.

Avenues to Improvement of Translation

We have already noted that, while we have machine-aided translation of general scientific text, we do not have useful machine translation. Further, there is no immediate or predictable prospect of useful machine translation.

We have noted that the important contributions of machine translation have been primarily to linguistics and secondarily to computer programming. We have noted that while translation itself is vital, needs for translation are being met by a small though capable activity. We find, however, that there are attractive opportunities for improvement in translation, and we urge work aimed at such improvement. We have noted the importance of quality in translations. We have noted that cost varies markedly with asserted quality.

It is important, therefore, to achieve some objective evaluation of accuracy and quality. Work toward practical useful tests, such as that described in Appendix 10, is of the greatest importance.

Machine aids may be an important adjunct to human or machine-aided translation. USAF Foreign Technology Division (FTD) figures show that production costs (assembly and reproduction of the final translations) are very high. It appears that delays in translated journals are attributable to production rather than to translation. Adoption of mechanized means of editing and production might be desirable (see Appendix 17). Here the main cost of research and development can best be borne by other, larger fields than translation.

Machine-aided translation may be an important avenue toward better, quicker, and cheaper translation. What machine-aided translation needs most is good engineering. What will help the human being most—special glossaries, dictionary look-up of some or all words in the text, or a rough translation such as that produced by FTD? How can the delays due to queues at many tandem steps be avoided? How can production costs be cut?

Automatic character recognition is often mentioned as important to machine-aided translation. FTD figures indicate that automatic character recognition could slightly decrease the cost of the operation. Automatic character recognition work is being supported heavily in connection with several kinds of activity (information retrieval, post office, for example) where the financial savings through successful character recognition would be much greater than in machine-aided translation. Hence, character recognition should be adopted when and if it will save money, but research and development need not be supported in connection with machine translation.

Finally, how much should be spent on research and development toward improving translation? It would be unreasonable to spend extravagantly on a relatively small business that is doing the job satisfactorily.

The Committee cannot judge what the total annual expenditure for research and development toward improving translation should be. However, it should be spent hardheadedly toward important, realistic, and relatively short-range goals.

Recommendations

The Committee recommends expenditures in two distinct areas.

The first is computational linguistics as a part of linguistics—studies of parsing, sentence generation, structure, semantics, statistics, and quantitative linguistic matters, including experiments in translation, with machine aids or without. Linguistics should be supported as science, and should not be judged by any immediate or foreseeable contribution to practical translation. It is important that proposals be evaluated by people who are competent to judge modern linguistic work, and who evaluate proposals on the basis of their scientific worth.

The second area is improvement of translation. Work should be supported on such matters as

1. practical methods for evaluation of translations;
2. means for speeding up the human translation process;
3. evaluation of quality and cost of various sources of translations;
4. investigation of the utilization of translations, to guard against production of translations that are never read;
5. study of delays in the over-all translation process, and means for eliminating them, both in journals and in individual items;
6. evaluation of the relative speed and cost of various sorts of machine-aided translation;
7. adaptation of existing mechanized editing and production processes in translation;
8. the over-all translation process; and
9. production of adequate reference works for the translator, including the adaptation of glossaries that now exist primarily for automatic dictionary look-up in machine translation.

All such studies should be aimed at increasing the speed and decreasing the cost of translations and at specifying degrees of acceptable quality.

Appendix 1

Experiments in Sight Translation and Full Translation

In 1963, an experiment in sight translation was conducted by Dr. H. Wallace Sinaiko of the Institute for Defense Analyses ("Teleconferencing, Preliminary Experiments," Research Paper P-108, IDA, Nov. 1963). Sight translation is a procedure in which written material being received via teleprinter is read and a translation is dictated to a typist simultaneously. In this experiment, professional conference interpreters translated the complete text of the minutes of the 921st meeting of the U.N. Security Council into English and French.

This experiment showed that the accuracy of the sight translation was uniformly high and that when the interpreters were working in an unaccustomed direction, i.e., English into French or French into English, both the time required for the sight translation and the number of errors were increased somewhat, although not seriously.

Another experiment (full translation) used highly experienced Department of State translators in two-man translating - review teams. The partners in each team divided the incoming batches of material between themselves, each translating a part and then reviewing the part translated by his colleague. The quality of the translations was very high, but scarcely higher than the sight translation.

COMPARISON OF SIGHT AND FULL-TRANSLATION METHODS

	Time, hr	Rate, words per min
Original U.N. Security Council Meeting, consecutive interpretation	2.0	102.0
Sight translation	9.7	21.0
Full translation	37.6	5.4

Although the sight translation was four times faster than the full translation and of comparable quality, it would be dangerous to conclude from this that present translation output could be quadrupled

by use of the sight-translation method. Since the material translated in this experiment was, presumably, all straight text, it lent itself nicely to this type of translation. It is doubtful that such a system could operate with the same efficiency on scientific texts containing photographs, charts, tables, formulas, and other graphics.

Nevertheless, the Committee feels that certain features of this system might be applicable to certain circumstances. One agency in Washington that uses the dictation method states that on texts that are suitable (few graphics to be inserted) the daily output per translator is doubled—from 2,400 to about 5,000 words.

These experiments stress an important difference between human and machine approximation in translation. Once the deeper meaning of the content of a text is grasped, the human translator immediately leaps to relatively grammatical output. The time taken by him in successive approximation probably involves choices among optional transformations, seeking the best base from which final stylistic polishing may be made in order to recapture the flavor of the original. On the other hand, the machine does its approximating by moving through successive choices among ungrammatical versions. Therefore, it would seem that there are good reasons why cheap, hasty, and truncated jobs might be better done by humans than by machines.

Appendix 2

Defense Language Institute Scientific Russian Course

The following information, provided by the Defense Language Institute, West Coast Branch, concerns the 10-week DLIWC Scientific Russian Course.

The purpose of the course is to train students to read and translate Russian technical and scientific texts in their fields of interest with the help of dictionaries and to speak and understand conversational Russian to a limited degree.

The length of the course is 10 weeks; 5 days per week; 6 hr per day.

For teaching purposes the classes are divided into sections of usually not more than eight students.

The teaching materials used during the course consist of four textbook volumes specially developed for this course and dealing with essential Russian grammar, speech patterns, and exercises in the translation of scientific texts. A special reference volume is also provided. Recent Soviet publications on scientific topics in the students' particular fields of interest are introduced in the form of supplementary training materials.

The teaching materials for the Scientific Russian Course were developed so as to ensure maximum effectiveness. After an initial period, during which the essentials of the Russian language are taught, the students switch over to teaching materials entirely corresponding to their aims and specialities. The course is, therefore, flexible and can accommodate specialists in various fields of scientific knowledge.

In conformity with the objectives outlined above, the main emphasis in the implementation of the course is laid on reading and on translating from Russian into English.

The course involves the study of essential structural patterns of the Russian language that are indispensable for the understanding of scientific texts. Since Russian is a highly inflected language, special stress is laid on the recognition of morphological change

in words and its importance in grasping the exact meaning of sentences.

This is especially important in texts involving mathematical formulas and definitions where any distortion of meaning might easily lead to entirely erroneous conclusions.

While speaking and aural-comprehension abilities are not specially emphasized in the course, the students are taught to speak and understand conversational Russian, though only to a limited degree. Work in this particular field involves the use of tape recorders. At the end of the course the graduates have a vocabulary of approximately 750 words used in everyday exchanges.

With respect to scientific terminology, the course features the study of so-called "cognates"—internationally used terms derived from the same root. The aim here is to teach the students to recognize such words without the help of dictionaries and thus to facilitate and speed up their work.

After completing the course, the graduates are able to read, understand, and translate very complex texts in their fields of interest.

The first scientific Russian course was implemented at this Institute in 1961. In the past 4 years, this 10-week course was attended by specialists in space mechanics, applied mathematics, electrical engineering, chemistry, physics, and aeronautics.

In view of the important scientific and technological achievements that have been taking place in the Soviet Union in the last few decades, it is hardly necessary to stress the utility of a course that makes it possible for the specialists to learn in a comparatively short time enough Russian to read contemporary Soviet scientific literature in their fields of interest, and thus to keep abreast of developments in that country.

Appendix 3

The Joint Publications Research Service

The Joint Publications Research Service (JPRS), a component of the Clearinghouse for Federal Scientific and Technical Information, U.S. Department of Commerce, was established in 1957 by a group of federal agencies that needed English translations of books, newspapers, periodical articles, and other materials being published in a variety of languages.

Using a small staff of professional linguists, a search was made to locate the thousands of specialists—chemists, physicists, political scientists, economists—who, although already working in their special fields, possessed knowledge of a foreign language and were willing to translate materials in their fields on a part-time, contract basis at home.

New York was chosen for the first office because of its large population, which, it was felt, would yield the greatest number of linguists of any single area in the United States. Success in finding competent translators was immediate, and another office was opened in Washington, D.C., in August 1957. Three years later, with a still-growing load, a third JPRS office was opened in San Francisco. Although begun as a cooperative venture in 1957, the JPRS was absorbed by the Office of Technical Services in 1958, when it assumed responsibility for collecting translations and making them available to the public.

The growth of the JPRS can be seen by comparing the 38,000 published pages produced from March 1957 through June 1958 with the 273,449 pages published in Fiscal Year 1964. The first year's production was about 70 percent scientific and technical material, whereas production for Fiscal Year 1964 was about half that, or 35 percent.

A considerable number of translations published by the Atomic Energy Commission (AEC) are translated by the JPRS but sent to the AEC for publication as a part of its series; the same holds for translations done for the Army Biological Laboratory, Redstone

Arsenal, the National Institutes of Health, the Federal Aviation Agency, and other agencies.

Materials of broad current interest spotted by analysts, scientists, and others in government are sent to the JPRS for translation and for publication. Over the years, under this program, JPRS has developed serial titles under which a great deal of similar information has been placed. For example, Translations on International Communist Developments contains materials from any foreign newspaper or periodical that sheds light on the developments, policies, debates, or other activities of the Communist parties of all countries. Copies of these and of all other translations are then distributed not only to the initiating component, but to all participating organizations. The series are then available on subscription to anyone outside the government who is interested.

In science and technology, the JPRS series on Foreign Developments in Machine Translation and Information Processing, 173 issue, of which have been published, has proven valuable to researchers in the field. For example, a recent Office of Technical Services special bibliography on machine translation lists 250 citations of reports and translations on the subject; 118 of these were JPRS reports

JPRS charges the government agencies for which it works the same price for all translations regardless of subject matter or language. This price is currently $16 per 1,000 words of English. This figure has been arrived at by a study of the total costs involved and includes overhead. Of the $16 per 1,000 words paid by the requesting agency, the translators are getting, on the average, $8 to $11 for simple newspaper-type material (the low) and $20 for Chinese (the high).

Editing costs about $1.50 per 1,000 words, the typing about $1.50, and the overhead about $2.00. The translation comes back from the contractors on tapes, in rough draft, and in completed typewritten form.

The amount paid the translator is dependent (in addition to the language of the original) upon how much extra work the JPRS has to do on the translation after the contractor has submitted it.

The policy of the JPRS regarding lag-time is as follows: 50 pages of translation will be done and returned to the requester in 15 days; 100 pages will be done in 30 days.

The JPRS currently has about 4,000 translators under contract, with a potential of an additional 1,500 available almost immediately. On the average, JPRS utilizes the services of about 300 of its translators in any given month. Thus, it appears that JPRS is producing translations reasonably quickly and quite economically, and, furthermore, that it has the capability of immediately expanding its operations

Appendix 4

Public Law 480 Translations

The National Science Foundation is responsible for conducting a science-information program financed exclusively with excess foreign currencies that have accrued to the credit of the U.S. Government from the sale of U.S. surplus agricultural commodities in a number of foreign countries. Title I of the Agricultural Trade Development and Assistance Act of 1954 (Public Law 480), as amended, authorized the President to enter into agreements with friendly nations for the sale abroad of U.S. surplus commodites for foreign currencies. These currencies are inconvertible and may not be used outside the country involved.

Under the law cited above, U.S. Government agencies are authorized to use foreign currencies "to collect, collate, translate, abstract, and disseminate scientific and technological information and to conduct research and support scientific activities overseas including programs and projects of scientific cooperation between the United States and other countries." In January 1959, the President assigned to the Foundation the responsibility for initiating a unified coordinated program for meeting the requirements of the agencies of the Executive Branch for translation and other science-information activities authorized under Public Law 480.

The Foundation entered into contracts with Israel and Poland in 1959 and with Yugoslavia in 1960. Each contract provides for translation and publication of scientific literature and patents, translation and preparation of abstracts (in cooperation with U.S. abstracting and indexing services), publication of critical review papers, compilation of bibliographies, and the preparation of guides to their scientific institutions and information systems.

At the present time, the Foundation coordinates and administers this program for the Departments of the Interior, Agriculture, Commerce, and Health, Education and Welfare, the Atomic Energy Commission, the National Aeronautics and Space Administration, and the Smithsonian Institution.

The Foundation does not select the material to be translated. The selection is done by research scientists in the participating federal agencies. In Poland, Polish scientific information is translated; in Yugoslavia, Yugoslavian material; and in Israel mainly, although not exclusively, Russian scientific literature. Russian books and monographs must have been published at least 1 year before they are translated by the overseas contractor; Yugoslavian and Polish journals only are translated on a current basis. The translation programs overseas are supplemental to, and not competitive with, the "domestic" translation program. In these programs no dollar expenditures are involved.

The combined efforts of the programs in Israel, Poland, and Yugoslavia represent the translation and republication of about 250,000 pages of foreign scientific literature (95 volumes of scientific journals, 374 books, 1,004 selected articles, 18,495 abstracts, 13,000 patents).* This covers the period from Fiscal Year 1959 through fiscal 1965.

*The statement above was taken from "A Summary of U.S. Translation Activities" (in Seminar on Technical and Scientific Translation, Apr. 15-17, 1965, Indian National Scientific Documentation Centre, New Delhi) by Ernest R. Sohns of the Office of Science Information Service, National Science Foundation. The Committee appreciates Dr. Sohns' cooperation in providing this report.

Appendix 5

Machine Translation at the Foreign Technology Division, U.S. Air Force Systems Command

In December 1962, the USAF Scientific Advisory Board Ad Hoc Commitee on Mechanical Translation of Languages recommended the implementation of "a limited initial operational capability for mechanical translation of at least 100,000 words of Russian per day using the IBM Mark II translation equipment and Phase II translation system." This system became fully operational in February 1964 at the U.S. Air Force Systems Command's Foreign Technology Division (FTD) at Wright-Patterson Air Force Base, Ohio. Operations at FTD have recently been the subject of a study by Arthur D. Little, Inc., and it is from this study that the following data have been taken:

1. The cost of machine translation (excluding overhead and equipment amortization) is about $36 per 1,000 Russian words.
2. FTD's in-house human-translation cost, excluding overhead, is about $40 per 1,000 Russian words.
3. FTD's contract translation cost is about $33 per 1,000 Russian words, including contractor's overhead.
4. Postediting (31 percent) and recomposition (40 percent) are the main cost components in the machine-translation process, accounting for over 70 percent of the total cost; input processing accounts for only 11 percent.
5. The average total machine-translation processing time is 109 days. The average for high-priority documents is 44 days.
6. During the period June-September 1964, the average output per working day was 103,146 Russian words translated into English. The average output per hour was 7,569 words. The average working day for the computer, therefore, amounts to 13 hours.
7. Input costs to the machine-translation system amount to $4.10 per 1,000 Russian words.

From the A. D. Little data and from the results of a comparison with the work done by the Joint Publications Research Service (see

Appendix 3), one sees that the FTD postedited machine translations are slow, expensive, of poor graphic arts quality, and not very good translations.

The FTD machine-translation facility currently has a staff of 43 persons, including the posteditors. Their final product is 100,000 words of poor translation per day. Since JPRS could do the same amount of translation faster and for less than half the price, the Committee is at a loss to understand why the FTD does not rely on the services of the JPRS.

Appendix 6

Journals Translated with National Science Foundation Support

ABBREVIATIONS USED IN THIS APPENDIX

AGI	American Geological Institute
AGS	American Geographical Society
AGU	American Geophysical Union
AIBS	American Institute of Biological Sciences
AIChE	American Institute of Chemical Engineers
AIP	American Institute of Physics
AMS	American Mathematical Society
ASME	American Society of Mechanical Engineers
CB	Consultants Bureau Enterprises, Inc.
ESA	Entomological Society of America
GChS	The Geochemical Society
IEEE	Institute of Electrical and Electronics Engineers
IJSM	International Journal of the Science of Metals
ISA	Instrument Society of America
OSA	Optical Society of America
SIAM	Society for Industrial and Applied Mathematics
SSSA	Soil Science Society of America
ST	Scripta Technica, Inc.

TABLE 1. Journals Translated with NSF Support

Sponsor	Title of Journal	Number of Subscribers			
		Fiscal Year 1961	Fiscal Year 1962	Fiscal Year 1963	Fiscal Year 1964
AGI	Izv. Acad. Sci. USSR, Geol. Ser.	136	130	Merged with Intern. Geol. Rev.[a]	
AGI	Dokl. Earth Sci. Sect.	224	312	353	360
AGI	Intern. Geol. Rev.[a]	400	564	625	655
AGS	Soviet Geogr.: Rev. Trans.[a]	540	750	760	750
AGU	Bull. Acad. Sci. USSR, Geophys. Ser.[b]	310	450	431	500
AGU	Geod. and Aerophotog.	100	135	150	150
AGU	Geomagnetism and Aeronomy	-	150	150	150
AIChE	Intern. Chem. Eng.[a]	125	1,500	1,800	1,541
AIP	Soviet Phys. - Solid State	500	1,038	1,025	990
AIP	Soviet Astron. - AJ	250	553	550	520
AIP	Soviet Phys. - Usp.	600	782	700	-
AIP	Soviet Phys. - Cryst.	400	742	750	710
AIP	Soviet Phys. - Acoust.	-	784	775	730
AIP	Soviet Phys. - Tech. Phys.	-	874	900	825
AIP	Soviet Phys. - JETP	-	1,241	1,275	-
AIP	Soviet Phys. - Dokl.	-	954	950	-
AMS	Soviet Math.	400	500	600	700
AMS	Acta Math. Sinica	-	-	58	200
ASME	Appl. Math. Mech.	138	165	165	500
IJSM	Phys. Metals Metallog.	542	618	700	700
IJSM	Metallurg.	128	220	240	275
IJSM	Metal Sci. Heat Treat. Metals	80	125	138	250
IJSM	Refractories	79	120	133	200
c	Dokl. - Biol. Sci. Sect.	284			
c	Dokl. - Biochem. Sect.	210	1,093	763	800
c	Plant Physiol.	336			
c	Microbiology	340			
IEEE	Telecommunications	176	355	480	
IEEE	Radio Eng. Electron. Phys.	254	445	735	2,600
IEEE	Radio Eng.	191	360	500	
GChS	Geochemistry[d]				260
ISA	Autom. Remote Control	657	731	609	682
ISA	Ind. Lab.	307	355	281	318
ISA	Instr. Exptl. Tech.	470	526	460	518
ISA	Meas. Tech.	373	414	346	381
SIAM	Theory Probability Appl.	700	590	590	700
e	Soviet Soil Sci.	168	267	394	500
f	Entomol. Rev.	126	141	300	500
OSA	Opt. Spectry.	Free of Charge	1,600	2,100	2,100
AGU	Soviet Oceanog.[a,g]	-	-	105	105
AGU	Soviet Hydrol.[a]	-	200	280	300
IEEE	Elect. Eng. Japan	-	-	213	375
IEEE	Electron. Commun. Japan	-	-	269	440
	Total	9,813	19,784	21,653	21,330

[a] Selected articles only. All others listed are cover-to-cover translations.
[b] Split into Izv. Acad. Sci. USSR, Atmos. Oceanic Phys. and Izv. Acad. Sci. USSR, Phys. Solid Earth.
[c] Sponsors: 1961-first half of 1962, AIBS; second half of 1962-1963, CB; 1964, CB self-supporting.
[d] Replaced by Geochem. Intern. (selected), AGI.
[e] Sponsors: 1961-first half of 1962, AIBS; second half of 1962-1963, ST; 1964, SSSA.
[f] Sponsors: 1961-first half of 1962, AIBS; second half of 1962-1963, ST; 1964, ESA.
[g] Replaced by Oceanology (cover-to-cover).

TABLE 2. Translation Journals That Achieved Self-Sufficiency

IN JANUARY 1964	
Soviet Phys. - JETP	AIP
Soviet Phys. - Dokl.	AIP
Soviet Phys. - Usp.	AIP
Soviet Phys. - Solid State	AIP
Soviet Phys. - Acoust.	AIP
Soviet Phys. - Cryst.	AIP
Soviet Phys. - AJ	AIP
Soviet Phys. - Tech. Phys.	AIP
Appl. Math. Mech.	ASME/Pergamon
Phys. Metals Metallog.	IJSM/Pergamon
Dokl. - Biol. Sci. Sect.	CB
Dokl. - Botan. Sci. Sect.	CB
Dokl. - Biochem. Sect.	CB
Plant Physiol.	CB
Microbiology	CB
IN JANUARY 1965	
Metal Sci. Heat Treat. Metals	IJSM/CB
Metallurg.	IJSM/CB
Refractories	IJSM/CB
Friction and Wear in Machinery	ASME

TABLE 3. Average Time Performance of One Journal Issue in Fiscal Year 1964 (in weeks)

Journal	Sponsor	Translation	Editing	Composition	Printing and Distribution	Total
Bull. Sov. Antarctic Expedition	AGU	4	3	4	4	15
Dokl., Earth Sci. Ser.	AGI	8	5	6	5	24
Elect. Eng. Japan	IEEE	7	6	5	4	22
Electron. Commun. Japan	IEEE	7	6	5	4	22
Eng. Cybernetics	IEEE	4	6	6	5	21
Entomol. Rev.	ESA	7	3	6	5	21
Geochem. Intern.	AGI	8	4	6	5	23
Geod. and Aerophotog.	AGU	4	3	4	4	15
Geomagnetism and Aeronomy	AGU	5	5	6	4	20
Radio Eng. Electron. Phys.	IEEE	10	5	6	5	26
Soviet Hydrol.	AGU	6	3	6	4	19
Soviet Oceanog.	AGU	4	5	4	4	17
Soviet Soil Sci.	SSSA	4	3	4	5	16
Telecommunications	IEEE	7	4	6	5	22
Soviet Phys. - Tech. Phys.	AIP	10	a	9	3	22
Soviet Phys. - Cryst.	AIP	11	a	9	3	23
Soviet Astron. - AJ	AIP	10	a	9	3	22
Soviet Phys. - Dokl.	AIP	9	a	8	3	20
Soviet Phys. - Solid State	AIP	10	a	9	3	22
Soviet Phys. - Acoust.	AIP	12	a	8	3	23
Soviet Phys. - JETP	AIP	14	a	4	3	21
Soviet Phys. - Usp.	AIP	18	a	5	3	26

[a]Editing time included in translation.

Appendix 7

Civil Service Commission Data on Federal Translators

TRANSLATORS AND CLERK TRANSLATORS

Total Translators in Each Division and Grade

UNITED STATES

Translators		Clerk Translators	
Number	Grade	Number	Grade
6	4	16	4
22	5	24	5
14	6	3	6
26	7	1	7
15	8		
40	9	1	9
10	10		
52	11		
23	12		
7	13		
2	14		
217		45	

Total U.S. Translators and Clerk Translators: 262

WORLDWIDE

Translators		Clerk Translators	
Number	Grade	Number	Grade
6	4	17	4
36	5	54	5
17	6	22	6
40	7	3	7
29	8		
71	9	1	9
16	10		
54	11		
26	12		

WORLDWIDE (Cont'd)

Number	Grade	Number	Grade
7	13		
3	14		
25	Not Graded*	26	Not Graded*
330		123	

Total Worldwide Translators and Clerk Translators: 453

*Employed by an agency that does not use the grading system.

Classification of Translators and Clerk Translators According to Representative Agency

Translators		Clerk Translators*		Agency
U.S.A.	Worldwide	U.S.A.	Worldwide	
17	17	5	5	Library of Congress
26	26	2	2	Dept. of State
3	5		1	Treasury Dept.
32	112	17	51	Dept. of the Army
11	13	2	6	Dept. of the Navy
22	37		34	Dept. of the Air Force
13	14	6	6	Dept. of Justice
9	9			Post Office Dept.
4	4			Dept. of the Interior
5	5	1	4	Dept. of Agriculture
18	18			Dept. of Commerce
36	36	1	1	Dept. of Health, Education and Welfare
1	1			Canal Zone Government
1	1			Federal Aviation Agency
		1	1	Federal Communications Commission
1	1			General Services Administration
	1			Housing and Home Finance Agency
9	17	9	9	U.S. Information Agency
2	2			National Aeronautics and Space Administration
	1			National Labor Relations Board
	2		2	Panama Canal Company
1	1			Railroad Retirement Board
6	7	1	1	Veterans' Administration

*A clerk translator primarily does clerical work and is required to have some familiarity with the language involved in his work. The bulk of clerk translators are located on the Mexican border, in Puerto Rico, and on Indian reservations.

Civil Service Salary Schedule, 1964

Grade	Minimum	Maximum	Mean
4	$ 4,480	$ 5,830	$ 5,155
5	5,000	6,485	5,743
6	5,505	7,170	6,338
7	6,050	7,850	6,950
8	6,630	8,610	7,620
9	7,220	9,425	8,323
10	7,900	10,330	9,115
11	8,650	11,305	9,978
12	10,250	13,445	11,848
13	12,075	15,855	13,965
14	14,170	18,580	16,375

CGS QUALIFICATION STANDARDS, TRANSLATOR SERIES (EFFECTIVE DECEMBER 1959)*

Translator GS-5/11

Category I positions require sufficient knowledge of the languages involved to render adequate translations of simple, uncomplicated, nontechnical material such as birth, marriage, and death certificates, proofs of residence, and correspondence dealing with relatively simple inquiries for information about benefits, services, etc. Positions in this category are found only at GS-5 and GS-7.

Category II positions require that the translator have a native ability† in the language into which the translation is made, and a comprehensive knowledge‡ of the language from which the translation is made. Translations cover a broad variety of subjects such as science, economics, legal, and diplomatic work, as well as any other type of technical or specialized subject-matter material that may require translation. The level of difficulty of positions in this category is determined not by degree of language proficiency alone but also by the knowledge and comprehension of the subject matter involved. Positions in this category are found at all levels between GS-5 and GS-12.

*Quoted from GS-031.

†Native ability in a language is the ability to speak or write a language so fluently that the expression of thought is structurally, grammatically, and idiomatically correct and reflects a range of vocabulary in the language commonly characteristic of a person who has received his education through the high-school level in a country of the language.

‡Comprehensive knowledge of a language means the ability to read the language easily. It represents an ability acquired usually acquired through academic study and is a lesser ability than "native ability" as defined here.

LANGUAGE AND EXPERIENCE REQUIREMENTS—CATEGORY I POSITIONS

Written Tests are Required for All Positions

Grade GS-5. Candidates must be able to translate from one foreign language into English or from English into one foreign language.

Grade GS-7. Candidates must be able to translate from two foreign languages into English, or from English and one foreign language into one other foreign language. In addition, candidates for grade GS-7 must have 1 year's specialized experience in preparing written translations of nontechnical material of routine or repetitive nature in the appropriate languages.

LANGUAGE AND EXPERIENCE REQUIREMENTS—CATEGORY II POSITIONS

Written Tests are Required for All Positions

Positions in this category require the ability to translate from at least two foreign languages into English or from English into a foreign language and from the same foreign language into English.

In addition to basic language ability, candidates must have the following number of years of specialized experience:

Grade	Total, yr
GS-5	0
GS-7	1
GS-9	2
GS-11	3

This work experience must demonstrate the ability to prepare written translations in the appropriate languages, involving technical material in one or more specialized subject-matter fields such as architecture, automotive mechanics, physics, biology, legal or judicial procedures, foreign affairs, statistics, etc.

This translation work must be of such a nature that the finished products appear to have been written by a native subject-matter specialist or technician in terms of sense, tone, style, and terminology. The degree of finish will depend upon the level of difficulty involved. For all levels above GS-7, 1 year of this specialized experience must be equivalent in scope and difficulty to that of the next lower level in this series.

Appendix 8

Demand for and Availability of Translators

A. GEOGRAPHICAL DEMAND

According to the U.S. Department of Labor, Bureau of Employment Security, the geographical demand for translators during calendar year 1964 was centered in Washington, D.C. (see below). The only other demand recorded on the bureau's interarea recruitment records was as follows:

Month, 1964	No. of Openings	Locations
January	4	Minn., Mo., Ark., Hawaii
February	5	N.J., Pa., Mo., Ark., Hawaii
March	2	Mo., Ark.
April	2	Mo., Ark.
May	3	N.J., Ohio, Mo.
June	3	N.J., Ohio, Mo.
July	2	Minn., Mo.
August	2	N.J., Mo.
September	2	N.J., Mo.
October	2	N.J., Mo.
November	2	N.J., Mo.
December	3	N.J., Ill., Mo.

Although New Jersey and Missouri each appear more frequently than do the other states, the Bureau feels that this repetitive requirement reflects difficulty in securing qualified persons rather than a turnover of translator personnel.

B. GOVERNMENT AGENCIES IN THE WASHINGTON AREA THAT ANNOUNCED VACANCIES IN FISCAL YEAR 1964

(Data supplied by the U.S. Employment Service, District of Columbia Professional Placement Center)

Agency	Language(s)
Central Intelligence Agency	Information not available
Department of State	Arabic, Persian, Turkish, Slavic
U.S. Information Agency	French
U.S. Joint Publications Research Service	All
Voice of America	Hindi
National Security Agency	Information not available

C. GOVERNMENT VACANCIES BY TYPE OF EMPLOYMENT

(Data supplied by United States Employment Service, District of Columbia Professional Placement Center)

I. Full-Time Translators

Note: The U.S. Employment Service defines full-time employment in the following categories:

(a) Permanent full-time—A position that lasts more than 30 days and has a 5-day, 40-hr week.

(b) Temporary full-time—A position that lasts 4 to 30 days and has a 5-day, 40-hr week.

(c) Short-time full-time—A position that lasts less than 4 days and has an 8-hr day.

The only agency that requested permanent full-time translators was the National Security Agency. No translators were requested under categories (b) and (c).

II. Part-Time Translators

Note: The U.S. Employment Service defines part-time employment in the following categories:

(a) Permanent part-time—A position that lasts more than 30 days and has less than an 8-hr day.

(b) Temporary part-time—A position that lasts 4 to 30 days and has less than an 8-hr day.

(c) Short-time part-time—A position that lasts less than 4 days and has less than an 8-hr day.

Permanent part-time translators (a) were requested by the U.S. Joint Publications Research Service. Temporary part-time translators (b) were requested by The U.S. Department of State Foreign Service Institute. No short-time part-time translators (c) were requested. It is interesting to note that the agency requesting category (b) translators did not request category (c) translators.

D. NUMBER OF AVAILABLE TRANSLATORS IN THE WASHINGTON AREA

The U.S. Employment Service, District of Columbia Professional Placement Center, has 523 translators registered. (The number

of available translators (826) exceeds the number of translators registered (523) because many translators indicated their ability to work in more than two languages). A sample of the number of translators available for work in some of the more exotic languages is shown below.

Language	No. of Available Translators
African Languages	
Akau	2
Amharic	4
Efik	1
Fante	2
Hausa	2
Ibo	3
Mandingo	1
Swahili	6
Twi	1
Yoruba	3
Chinese Languages	
Mandarin	21
Cantonese	3
Shanghai	3
Fukien	1
Indian Languages	
Bengali	6
Gujarati	4
Hindi	11
Malayalam	4
Tamil	5
Telugu	5
Urdu	4
Philippine Languages	
Bikol	1
Chabokano	1
Ermitano	1
Tagalog	5
Wraywaray	1

The Committee would like to express its appreciation to Miss E. Catherine Phelps, Manager of the U.S. Employment Service, District of Columbia Professional Placement Center, for her cooperation in providing these data for the Committee's use.

Appendix 9

Cost Estimates of Various Types of Translation

Before attempting to determine the costs of various types of translation, it might be instructive to see what the costs would be for an operation that made no use of translations, that is, a system that utilized subject specialists who were also skilled in a second language.

Let us assume that we have an agency that employs 100 analysts and let us further assume the following:

1. that 50 of the analysts are competent in Russian in their subject field,
2. that each analyst earns $12,000 per year,
3. that each analyst reads 1,000 words of Russian per day in his work,
4. that each analyst works 220 days per year, and
5. that, therefore, the agency consumes a total of 11,000,000 Russian words a year.

Since the major effort in past work on machine translation (MT) has been to develop a program to translate Russian into English, let us now restrict our discussion to the 50 analysts who are proficient in Russian. Salaries for these 50 would amount to $600,000 per year. Other costs such as Social Security, annual and sick leave, and retirement could be calculated at approximately 33 1/3 percent of their gross salaries. Thus the cost for these analysts would be approximately $800,000 per year. Obviously, no duplication checks would be necessary to determine whether a translation of any given work was already in existence.

The Committee has no figures on the cost of maintaining facilities necessary for the making of checks to prevent the duplication of translation. If these costs could be determined and if they proved to be substantial, it might be the case that it would be more economical not to make duplication checks of documents less than some specific number of pages in length. In any event, the duplication

checks would be superfluous for an agency employing persons proficient in a foreign language.

MAJOR COSTS OF ITEMS OF AN AGENCY UTILIZING 50 ANALYSTS PROFICIENT IN RUSSIAN

50 Analysts at $12,000 per annum	$600,000
Direct cost overhead at 33 1/3 percent of the above	200,000
Duplication checks	0
Total	$800,000

Figured at 220 working days per analyst the total volume of words of Russian read would amount to 11,000,000 or about $75 for each 1,000 words read.

Time lag after receipt of document	none
Total Cost of Translation	0

MONOLINGUALS

If the 50 analysts could not read Russian and had to rely on translation, a number of possibilities exist for providing them with English translation. The agency could

1. employ in-house translators in the conventional method,
2. employ translation using the dictation (or sight) method of translation,
3. employ contract translators,
4. utilize the services of JPRS,
5. provide the analysts with unedited "raw" (MT) output,
6. provide the analysts with postedited MT, or
7. use a system of machine-aided translation.

Throughout the subsequent discussion, the Committee has relied heavily on the cost figures developed by Arthur D. Little, Inc., and contained in An Evaluation of Machine-Aided Translation Activities at FTD [Contract AF 33(657)-13616, May 1, 1965]. References to this study are indicated below by (ADL) followed by the appropriate page number.

IN-HOUSE TRANSLATORS

At the Foreign Technology Division, the in-house translators work at a rate of about 240 Russian words per hour (ADL, p. 29), yielding a daily output of approximately 2,000 words. Thus one translator can produce enough to keep two analysts in translations.

Since ADL estimates (ADL, p. 21) that the cost for in-house translation is $22.97 per 1,000 Russian words, the cost for 11,000,000 Russian words would be $252,670. We assume that direct costs were included in this figure ($5.60 per hr) for translator time. Other costs that must be included in this type of operation are those of space, equipment, recomposition, and proofreading and review.

MAJOR COSTS FOR IN-HOUSE HUMAN TRANSLATION

25 Translators' salaries and direct cost overhead	$252,670
Recomposition ($14.15 per 1,000 words, ADL, p. 21)	155,650
Proofreading and review ($2.97 per 1,000 words, ADL, p. 21)	32,670
Duplication checks	?
Total	$432,990

IN-HOUSE TRANSLATION EMPLOYING DICTATION

The Committee's study described in Appendix 14 revealed that the average typing speed of the translator was only 18 words a minute and that typing took approximately 25 percent of the total time needed to produce the translation. It would seem then to be advantageous to use the translator for translating and to use trained typists to do the typing. One agency (see Appendix 1, page 35) found that on suitable texts (those with few graphics to be inserted), the daily output of the translator was doubled. A typist trained in the use of dictating equipment can type about 8,000 words of English per day. To convert this to the number of Russian words one must employ a factor of 1.35 English words per Russian word. Thus the 8,000 English words would represent 6,000 words of original Russian text. If the over-all output of the translator were to be increased by as little as 25 percent, his output would amount to 2,500 words per day. At this rate of output, only 20 translators would be needed instead of 25, and about eight typists would be needed to keep up with the output of the translators.

Although some savings are realized from this type of system, owing to the fact that typists are paid at about half the rate of translators, such savings are offset to some extent by the additional space and equipment required. It seems likely, however, that the use of this system would result in a more attractive product, the copy having been prepared by well-trained typists. Furthermore, an estimated increase of only 25 percent, upon which we have

based our computations, may be unduly conservative. If this is so—and the Committee would like to see studies made to determine more accurately the actual advantages of various systems—the dictation method would be even more attractive.

CONTRACT TRANSLATION

Since contract translation costs vary widely, we will once more base our computations on data in the Arthur D. Little, Inc., report. The ADL team found that the cost per 1,000 Russian words was $24.57 for the translation process, $5.40 for insertion of graphics, and $2.97 for proofreading and review, or a total of $32.94 (ADL, p. 21).

The Committee has been told by a reliable and knowledgeable individual connected with the translation at FTD that the proofreading and review procedure was unnecessary since the translations produced by the contractor were of excellent quality. Trusting this individual's judgment, but at the same time being aware that the ADL report is a careful study of what practices were in force (regardless of their necessity or degree of efficiency) at FTD, the Committee conjectured that $1.50 per 1,000 Russian words, rather than $2.97, might be a reasonable cost for the proofreading and review procedure; therefore, our computation differs from the ADL study. It is a fact that contractors have a lower overhead than in-house translators, and it is hoped that the significance of this item will not be overlooked by the reader.

An annual production of 11,000,000 Russian words by contract would cost the using agency

$270,270	for translation
59,400	for graphics
16,500	for proofreading and review
$346,170	Total

Since the average document to be translated is about 8,000 (Russian) words in length (ADL, p. A-8), our hypothetical agency would have to handle and control only six or seven documents a day, and few or no additional personnel would be needed for this task. Thus the $346,170 estimated above would approximate the total cost.

THE JOINT PUBLICATIONS RESEARCH SERVICE (JPRS)

The JPRS (Appendix 3) utilizes subject matter specialists who work at home on a part-time, contract basis. Thus, JPRS is able to

handle a large quantity of translations in many languages in many fields at low rates. Because it does handle a large quantity of translations, JPRS is able to charge the same price for all translations regardless of subject matter or language. The current price is $16 per 1,000 words of English. Applying the factor of 1.35 English words for each Russian word, one can see that 11,000,000 Russian words are the equivalent of 14,850,000 English words and that, therefore, the JPRS charge for such translation would amount to $237,600. Once again, as with any contract translation, the number of additional personnel would be minimal, and the cost above would be close to the true cost.

UNEDITED MACHINE TRANSLATION (MT)

The development of an MT program capable of producing translations of such a quality that they would be useful to the reader without requiring the intervention of a translator anywhere in the process has long been the goal of researchers in MT. As far as the Committee can determine, two attempts have been made to give analysts "raw" or unedited machine output. Neither proved to be satisfactory. The FTD experience is stated with admirable succinctness: "This [acceptance of postedited MT] marks a considerable change in attitude toward MT's which, in their earlier unedited form, were generally regarded as unsatisfactory" (ADL, p. F-5).

We have worked out a simple equation that shows how many dollars may be saved by using the unedited machine output.

Let

C_H = cost of human translation (dollars/1000 words),

C_M = cost of MT (dollars/1000 words),

W = loaded salary of user of the translation (dollars/hr),

T_H = reading time for human translation (hr/1000 words),

T_M = reading time for MT (hr/1000 words),

N = number of people who read the translation,

S = saving by MT (dollars/1000 words).

Then

$$S = C_H - C_M - WN\,(T_M - T_H).$$

Presumably the saving would be greatest if the reader merely read machine print-out, referring to the untranslated original for

figures and equations. Here the cost of machine output could best be compared, not with the cost of JPRS translations, but with the cost of dictated and uncorrected human translations, either voice on tape, or a typewritten transcription of the tape. As we have pointed out in Appendix 1, such translation can be carried out several times as fast as "full translation."

Unfortunately, we do not know what the costs are for translations that are dictated but not typed. It would seem likely, however, that savings would be substantial, since there would be no costs (a) for typist-transcriptionists or (b) for recomposition. Whether the savings involved would be offset by increased difficulty of use by the analyst is not known. Although the analyst would not be presented with a written translation, he would at least be assured of having all the words translated, unlike the raw MT output.

Most translations are apparently read by more than one reader. According to one agency, the preparation of 175 copies of a translation for distribution is standard for documents that appeared originally in the open literature and this distribution accounts for about 90 percent of the documents translated. For the remaining 10 percent (the classified documents) only one copy is prepared, but the requester has the privilege of making as many copies as he deems fit. Even more astonishing is the estimate of the Arthur D. Little, Inc., team that "about 615 members of the Air Force R & D community (40,000 members) would be expected to have a common interest in the average translated document" (ADL, p. F-9).

It was shown by John B. Carroll, in the study that he did for the Committee (see Appendix 10), that the average reader tested took twice as long to read raw MT as he did to read a human translation. The ADL team found that the average reading rate of those tested was 200 words per minute for well-written English (ADL, p. D-6) or 0.08 hr per 1,000 words. From these two studies we determined the reading rate for raw MT to be 100 words per minute or 0.16 hr per 1,000 words.

Raw MT should be compared, as has been mentioned, with an equally inelegant product. But the Committee has no idea of the cost of a comparable product or the time required to read (or listen to) it, and these factors are crucial in the calculation of savings according to our equation. Prudence demands that we compare raw MT with a product about which we have more certain knowledge concerning cost and reading rates even though such translations are of higher quality.

For the purposes of comparison, we have chosen the JPRS for the simple reasons that (1) it is relatively inexpensive and (2) the costs are known and stable. Applying our equation, we have

C_H = \$21.60 (the JPRS cost per 1,000 Russian words, the conversion factor of 1.35 being applied to \$16.00, the cost per 1,000 English words),

C_M = \$7.63 [input typing \$4.09, machine costs \$3.21, output typing \$0.33 (ADL, p. 20)],

W = \$10.00 [\$12,000 salary per annum ÷ 220 working days = \$60.00, \$60.00 + (60/3) (direct costs) = \$80.00 loaded salary per day, \$80.00 ÷ 8 = \$10.00 (loaded salary per hour)],

T_H = 0.08,

T_M = 0.16.

Utilizing the figures above, but varying N (the number of readers), we arrive at the savings made by the use of raw output.

If the number of readers is 1:
S = \$21.60 - 7.63 - [(10 × 1) (0.16 - 0.08)],
S = \$21.60 - 7.63 - 0.80,
S = \$13.17.

If the number of readers is 10:
S = \$5.97.

If the number of readers is 15:
S = \$1.97.

If the number of readers is 17:
S = \$0.37.

If the number of readers is 18:
S = -\$0.43.

If the number of readers is 20:
S = -\$2.03.

If the number of readers is 80:
S = -\$40.13.

If the number of readers is 175:
S = -\$127.03.

If the number of readers is 615:
S = -\$478.13.

Obviously, the break-even point occurs between 17 and 18 readers. But we have seen that, in one agency at least, about 90 percent of the translations are distributed to 175 readers, whereas only 10 percent are prepared for a single reader. By simple computation it can be determined that whereas the use of JPRS for all translation would result in a loss of \$14,487, the use of MT for all translation would result in a loss of \$1,257,597. It might be argued that MT is still economical when used to provide translations that

are user-limited; but, since relatively few translations seem to be destined for use by less than 18 readers, the volume would probably be too small to warrant the maintenance of an elaborate computer facility with its attendant personnel.

To the Committee, machine output (such as that shown on pages 20-23) seems very unattractive. We believe that the only valid argument for its use would be a compelling economic argument. If it can be shown that the use of unedited machine output, taking proper account of increased reading time on the part of the readers, would result in worthwhile savings over efficient human translation of the most nearly comparable kind, then there is a cogent reason for using unedited MT. But, unless such a worthwhile saving can be convincingly demonstrated, we regard the use of unedited machine output as regressive and unkind to readers.

In considering the cost of producing unedited machine output we must use the real current cost. It is nice to think that savings may be made someday by using automatic character recognition, but actual savings should be demonstrated conclusively before machine output is inflicted on users in any operational manner.

POSTEDITED MACHINE TRANSLATION (MT)

To provide 11,000,000 words of postedited Russian-to-English MT per year would cost $397,980 [$36.18 per 1,000 Russian words (ADL, p. B-7)]. This estimate should be regarded as a very low one, since the ADL team did not include overhead costs (ADL, p. 3). ADL figures (ADL, p. E-5) that for 100,000 words per day, 44 individuals would be required; for input typing, 14; for machine operation, 1.6; for output typing, 1.4; and for postediting, 28. Since we are assuming a 50,000-word-per-day consumption, we will halve this estimate, giving a total of 22 personnel. The point the Committee would like to make in this connection is that since 22 personnel would be required, 14 of whom (the posteditors) have to be proficient in Russian, one might as well hire a few more translators and have the translations done by humans. Another, perhaps better, alternative would be to take part of the money spent on MT and use it either (1) to raise salaries in order to hire bilingual analysts—thus avoiding translation altogether—or, (2) to use the money to teach the analysts Russian.

MACHINE-AIDED TRANSLATION (M-AT)

We will call M-AT any system of human translation that utilizes the computer to assist the translator and that was designed originally

for such a purpose. A system such as that at the FTD might properly be called human-aided machine translation, since the postediting process was added after it became apparent that raw output was unsatisfactory and since humans are employed essentially to make up for the deficiencies of the computer output.

Specific costs for the two types of M-AT systems in operation (see Appendixes 12 and 13) are not known to the Committee, but from the given figures that show the proportion of translator time saved, it is possible to make some rough estimates. Both the Federal Armed Forces Translation Agency and the European Coal and Steel Community indicate that a saving of about 50 percent of the translator's time could be expected by the use of a machine-aided system. Since translators' salaries constitute the largest item in the budget for a human-translation facility, such savings would probably be substantial. Input typing costs would not be as great as those at FTD, where the entire document to be translated is keypunched, since only the individual words or sentences with which the translator desires help are keypunched. Furthermore, the programming involved is relatively simple and small, and inexpensive computers are adequate.

The relatively modest increases in staff, equipment, and money necessary for the production of translator aids are likely to be offset by the increase in quality of the product. It is possible, therefore, that the savings of an M-AT system might approach 50 percent of the cost of translator salaries in a conventional human-translation system. If this estimate is sound, then the cost for an M-AT system to produce 11,000,000 words of Russian-to-English translation would be $314,655 ($126,335 for salaries, $155,650 for recomposition, $32,670 for proofreading and review).

SUMMARY

Throughout our discussion of costs, we have been conscious of the fact that we were not in possession of all the necessary data. We present the following estimates with diffidence and would welcome any studies that would more precisely determine actual translation costs and quality, whether they affirm or deny the validity of our estimate.

ESTIMATES OF COSTS AND QUALITY FOR VARIOUS TYPES OF TRANSLATION

Type	Quality	Cost for 11,000,000 Russian Words
In-house (conventional translation)	Good	$ 440,000
In-house (dictation)	Good	440,000 -
Contract	Fair to good	350,000
JPRS	Fair	240,000
Raw MT	Unsatisfactory	80,000+
Postedited MT	Fair	400,000
M-AT	Excellent	310,000
Analysts proficient in Russian	-	0

CONCLUSION

Since no one can be proficient in all languages, there will always be a need for translation. Yet, publication is not evenly distributed among the some 4,000 languages of the world, and this is especially so in the areas of science and technology. Russian-to-English translation constitutes a large part of the total translation done in the United States, and there are no signs that this situation is likely to change radically in the foreseeable future. This being the case, the present policy of using monolingual analysts and providing them with translations year after year seems lacking in foresight, particularly since the time required for a scientist to learn a foreign language well enough to read an article in his own field of specialization is not very long, and since the facilities are available to train him.

In our hypothetical agency, the costs of providing fair and good translations were from 30 to 55 percent greater than the estimated costs of a facility using analysts proficient in Russian. To allow heavy users of Soviet literature to continue to rely on translations seems unwise.

Appendix 10

An Experiment in Evaluating the Quality of Translations

This experiment* was designed to lay the foundations for a standard procedure for measuring the quality of scientific translations, whether human or mechanical. There have been other experiments on this problem [e.g., G. A. Miller and J. G. Beebe-Center, Mechan. Transl. 3, 73 (1958); S. M. Pfafflin, Mechan. Transl. 8, 2 (1965)], but their methods for evaluating translations have been too laborious, too subject to arbitrariness in standards, or too lacking in reliability and/or validity to become generally accepted. The measurement procedure developed here gives promise of being amenable to refinement to the point where it will meet the requirements of relative simplicity and feasibility, fixed standards of evaluation, and high validity and reliability.

A detailed report of this experiment will be submitted for publication elsewhere; the present brief report will serve to indicate the general nature of the measurement procedure and some of the chief results.

THE MEASUREMENT PROCEDURE

It was reasoned that the two major characteristics of a translation are (a) its intelligibility, and (b) its fidelity to the sense of the original text. Conceptually, these characteristics are independent; that is, a translation could be highly intelligible and yet lacking in fidelity or accuracy. Conversely, a translation could be highly accurate and yet lacking in intelligibility; this would be likely to occur, however, only in cases where the original had low intelligibility.

Essentially, the method for evaluating translations employed in this experiment involved obtaining subjective ratings for these two characteristics—intelligibility and fidelity—of sentences selected

* Conducted by John B. Carroll with funds provided by the Automatic Language Processing Advisory Committee.

randomly from a translation and interspersed in random order among other sentences from the same translation and also among sentences selected at random from other translations of varying quality. When a translation sentence was being rated for intelligibility, it was rated without reference to the original. "Fidelity" was measured indirectly: the rater was asked to gather whatever meaning he could from the translation sentence and then evaluate the original sentence for its "informativeness" in relation to what he had understood from the translation sentence. Thus, a rating of the original sentence as "highly informative" relative to the translation sentence would imply that the latter was lacking in fidelity.

All ratings were made by persons who were specially selected and trained for this purpose. There were two sets of raters. The first set of raters (called here "monolinguals" for convenience) consisted of 18 native speakers of English who had no knowledge of the language of the original (Russian, in this case). They were all Harvard undergraduates with high tested verbal intelligence and with good backgrounds in science. In rating "informativeness" these raters were provided with carefully prepared English translations of the original sentences, so that in effect they were comparing two sentences in English—one the sentence from the translation being evaluated, and the other the carefully prepared translation of the original.

The second set of raters ("bilinguals") consisted of 18 native speakers of English who had a high degree of competence in the comprehension of scientific Russian. Their ratings of the intelligibility of the translation sentences may well have been influenced by their knowledge of the vocabulary and syntax of Russian; at any rate, no attempt was made to prevent them from using such knowledge. To rate "informativeness," they made a direct comparison between the translation sentence (in English) and the original version.

All ratings were made on nine-point scales that had been established by the writer prior to the experiment by an adaptation of a psychometric technique known as the method of equal-appearing intervals. Thus, points on these scales could be assumed to be equally spaced in terms of subjectively observed differences. In the case of the intelligibility scale, each of the nine points on the scale had a verbal description (see Table 4). The same was true of the "informativeness" scale except that verbal descriptions were omitted for a few of the points (see Table 5). In this way each degree on the scales could be characterized in a meaningful way. For example, point 9 on the intelligibility scale was described

TABLE 4. Scale of Intelligibility

9—Perfectly clear and intelligible. Reads like ordinary text; has no stylistic infelicities.
8—Perfectly or almost clear and intelligible, but contains minor grammatical or stylistic infelicities, and/or midly unusual word usage that could, nevertheless, be easily "corrected."
7—Generally clear and intelligible, but style and word choice and/or syntactical arrangement are somewhat poorer than in category 8.
6—The general idea is almost immediately intelligible, but full comprehension is distinctly interfered with by poor style, poor word choice, alternative expressions, untranslated words, and incorrect grammatical arrangements. Postediting could leave this in nearly acceptable form.
5—The general idea is intelligible only after considerable study, but after this study one is fairly confident that he understands. Poor word choice, grotesque syntactic arrangement, untranslated words, and similar phenomena are present, but constitute mainly "noise" through which the main idea is still perceptible.
4—Masquerades as an intelligible sentence, but actually it is more unintelligible than intelligible. Nevertheless, the idea can still be vaguely apprehended. Word choice, syntactic arrangement, and/or alternative expressions are generally bizarre, and there may be critical words untranslated.
3—Generally unintelligible; it tends to read like nonsense but, with a considerable amount of reflection and study, one can at least hypothesize the idea intended by the sentence.
2—Almost hopelessly unintelligible even after reflection and study. Nevertheless, it does not seem completely nonsensical.
1—Hopelessly unintelligible. It appears that no amount of study and reflection would reveal the thought of the sentence.

as follows: "Perfectly clear and intelligible. Reads like ordinary text; has no stylistic infelicities." Point 5 (the midpoint of the scale): "The general idea is intelligible only after considerable study, but after this study one is fairly confident that he understands. Poor word choice, grotesque syntactic arrangement, untranslated words, and similar phenomena are present, but constitute mainly 'noise' through which the main idea is still perceptible."

PREPARATION OF TEST MATERIALS AND COLLECTION OF DATA

The measurement procedure was tested by applying it to six varied English translations—three human and three mechanical—

TABLE 5. Scale of Informativeness

(This pertains to how informative the original version is perceived to be after the translation has been seen and studied. If the translation already conveys a great deal of information, it may be that the original can be said to be low in informativeness relative to the translation being evaluated. But if the translation conveys only a certain amount of information, it may be that the original conveys a great deal more, in which case the original is high in informativeness relative to the translation being evaluated.)

9—Extremely informative. Makes "all the difference in the world" in comprehending the meaning intended. (A rating of 9 should always be assigned when the original completely changes or reverses the meaning conveyed by the translation.)

8—Very informative. Contributes a great deal to the clarification of the meaning intended. By correcting sentence structure, words, and phrases, it makes a great change in the reader's impression of the meaning intended, although not so much as to change or reverse the meaning completely.

7—(Between 6 and 8.)

6—Clearly informative. Adds considerable information about the sentence structure and individual words, putting the reader "on the right track" as to the meaning intended.

5—(Between 4 and 6.)

4—In contrast to 3, adds a certain amount of information about the sentence structure and syntactical relationships; it may also correct minor misapprehensions about the general meaning of the sentence or the meaning of individual words.

3—By correcting one or two possibly critical meanings, chiefly on the word level, it gives a slightly different "twist" to the meaning conveyed by the translation. It adds no new information about sentence structure, however.

2—No really new meaning is added by the original, either at the word level or the grammatical level, but the reader is somewhat more confident that he apprehends the meaning intended.

1—Not informative at all; no new meaning is added, nor is the reader's confidence in his understanding increased or enhanced.

0—The original contains, if anything, less information than the translation. The translator has added certain meanings, apparently to make the passage more understandable.

of a Russian work entitled Mashina i Mysl' (Machine and Thought), by Z. Rovenskii, A. Uemov, and E. Uemova (Moscow, 1960). These translations were of five passages varying considerably in type of content. (All the passages selected for this experiment, with the original Russian versions, have now been published by the Office of Technical Services, U.S. Department of Commerce, Technical

Translation TT 65-60307.) The materials associated with one of these passages were used for pilot studies and rater practice sessions; the experiment proper used the remaining four passages.

In preparing materials for the rating task, 36 sentences were selected at random from each of the four passages under study. Since six different translations were being evaluated, six different sets of materials were prepared (in two forms, one for the monolinguals and one for the bilinguals) in such a way that each set contained a different translation of a given sentence. In this way no rater evaluated more than one translation of a given sentence. Each set of materials was given to three monolinguals and to three bilinguals; thus, there were 18 monolinguals and 18 bilinguals. Each rater had 144 sentences to evaluate first for intelligibility and then for the informativeness of the original (or the standard translation of it) after the translation had been seen. The raters required three 90-min sessions to complete this task, dealing with 48 sentences in each session. The raters were not informed as to the source of the translations they were rating, although they were told that some had been made by machine.

Before undertaking this task, the raters attended a 1-hr session in which they were given instruction in the rating procedures and required to work through a 30-sentence practice set.

During the rendering of ratings for intelligibility, the raters held stopwatches on themselves to record the number of seconds it took them to read and rate each sentence.

RESULTS

The results of the experiment can be considered under two headings: (a) the average scores of the various translations, and (b) the variation in the scores as a function of differences in sentences, passages, and raters.

Table 6 gives the over-all mean ratings and time scores for the six translations, arranged in order of general excellence according to our data.

Consider first the mean ratings for intelligibility by the monolinguals. Translation 1, a published human translation that had presumably been carefully done, received the highest mean rating, 8.30, on the scale established in Table 4. But 8.30 is still appreciably different from the maximum possible mean rating of 9.00, and it is evident that not even this "careful" human translation was as good as one might have expected. Furthermore, the mean rating of Translation 1 is not significantly different from that of Translation 4 (8.21), a "quick" human translation made by rapid dictation

procedures. The mean ratings of Translations 1 and 4 do, however, differ significantly from the mean rating (7.36) of Translation 2, another "quick" human translation. It may be concluded that the measurement procedure studied here is sensitive enough to differentiate among human translations.

A similar remark may be made about the sensitivity of this procedure to differences in the intelligibility of machine translations. Translations 7 and 5 were shown to be significantly more intelligible, on the average, than Translation 9.

Of most current interest, however, are the results having to do with the comparison of the human and the machine translations. Machine translations 7, 5, and 9 received mean ratings, respectively, of 5.72, 5.50, and 4.73. A scale value of 5 refers to a translation in which "the general idea is intelligible only after considerable study, but after this study one is fairly confident that he understands . . ." All these machine translations are significantly less intelligible, on the average, than any of the three human translations. As machine translations improve, it should be possible to scale them by the present rating procedure to determine how nearly they approach human translations in intelligibility.

The monolinguals' mean ratings on "informativeness" (reflecting the lack of fidelity of the translations) show an almost perfect inverse relationship to the mean ratings on intelligibility, and they differentiate the various translations in the same way and to the same extent. This result means that in practice, when ratings are averaged over sentences, passages, and raters, "intelligibility" and "fidelity" are very highly correlated. The detailed results of this study show that only in the case of a few particular sentences do the mean ratings of intelligibility and informativeness convey different information.

Furthermore, the mean reading times per sentence show almost precisely the same pattern of results as the ratings. In fact, the mean reading times are linearly related to the mean ratings, a result that supports the conclusion that the points on the rating scales are evenly spaced.

The results from the ratings by bilinguals contribute nothing more to the differentiation of the translations than is obtainable with the monolinguals' ratings. Bilinguals' intelligibility ratings of the translations are slightly (and significantly) higher, on the average, than those of the monolinguals, and correspondingly, their informativeness ratings are slightly lower. Yet, they took significantly longer to read and rate the sentences. Apparently their knowledge of Russian caused them to work harder on trying to understand the translations. One is inclined to give more credence to the results

from the monolinguals because monolinguals are more representative of potential users of translations and are not influenced by knowledge of the source language. It is also to be noted that the data from the monolinguals differentiate the translations to a somewhat greater extent than do the data from the bilinguals.

The results concerning the differences in ratings due to differences in sentences, passages, and raters can now be considered. (The detailed tables of these results are omitted here to save space.) The more important results may be summarized as follows:

1. The results do not differ significantly from passage to passage; that is, on the average the various passages from a given translation receive highly similar ratings. For intelligibility ratings, however, there is a small but significant interaction between translation and passage, indicating that translations are to some extent differentially effective for different types of content. (This interaction effect is present both for human and for machine translations.)

2. There is a marked variation among the sentences. In fact, as may be seen from Figure 1, there is some overlap between sentences from human translations and from mechanical translations; or, in other words, there are some sentences translated by machine that have higher ratings than some other sentences translated by human translators, even though, on the average, the human-translated sentences are better than the machine-translated ones. These results imply that in order to obtain reliable mean ratings for translations, a fairly large sample of sentences must be rated.

3. Variation among raters is relatively small, but it is large enough to suggest that ratings should always be obtained from several raters—say at least three or four.

CONCLUSION

This experiment has established the fact that highly reliable assessments can be made of the quality of human and machine translations. In the case of the six particular translations investigated in the study, all the human translations were clearly superior to the machine translations; further, some human translations were significantly superior to other human translations, and some machine translations were significantly superior to other machine translations. On the whole, the machine translations were found to fall about at the midpoint of a scale ranging from the best possible to the poorest possible translation.

What is still needed, however, is a system whereby any translation can be easily and reliably assessed. The present experiment has determined the necessary parameters of such a system.

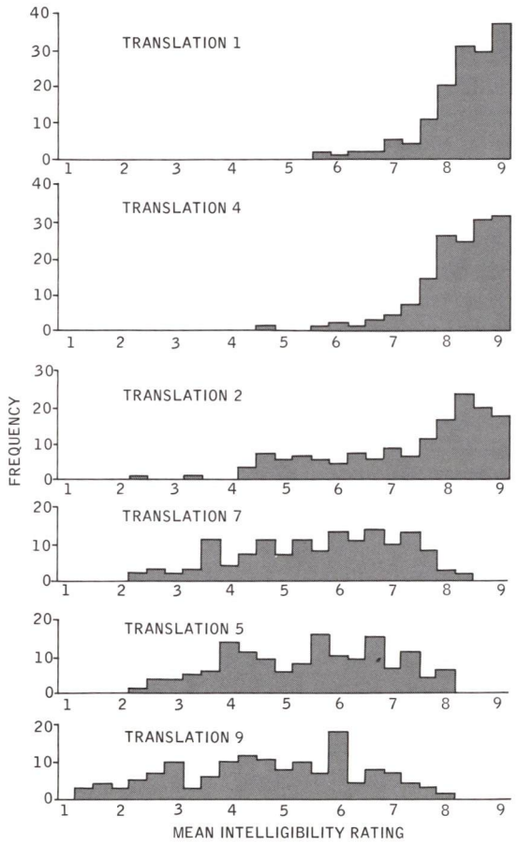


FIGURE 1. Frequency distribution of monolinguals' mean intelligibility ratings of the 144 sentences in each of six translations. Translations 1, 4, and 2 are human translations; Translations 7, 5, and 9 are machine translations.

TABLE 6. Evaluation of Translations: Over-all Mean Ratings and Time Scores from "Monolingual" (M) and "Bilingual" (B) Raters[a] (3 raters × 4 passages = 432 observations underlying each mean)

Translation Number	Description	Mean Ratings Intelligibility M	Mean Ratings Intelligibility B	Informativeness M	Informativeness B	Mean Reading Times per Sentence (sec) M	Mean Reading Times per Sentence (sec) B
1	"Careful," published human translation	8.30	8.37	1.95	1.72	9.13	10.09
4	"Quick" human translation	8.21	8.25	1.85	1.47	9.21	11.54
2	"Quick" human translation	7.36	7.67	3.03	2.43	12.59	13.53
7	Machine translation, Program B 2nd Pass	5.72	5.86	4.28	4.19	18.89	20.50
5	Machine translation, Program A	5.50	5.59	4.41	3.88	18.98	20.42
9	Machine translation, Program C 1st Pass	4.73	5.14	5.34	5.09	23.96	23.75

[a]The translations are listed in order of decreasing general excellence according to the results presented here. The brackets indicate results of the application of the Newman-Keuls multiple-range test of the significance of the differences of the rank-ordered means in each column. Any two means embraced within a given bracket are not significantly different at the 0.01 level. There are several cases in which the above listing entails reversals of the order of means, but in no case are the means involved significantly different from each other. Any two means not embraced within one bracket are significantly different at the 0.01 level; any two means

Appendix 11

Types of Errors Common in Machine Translation

Two studies have recently been made of the types of errors made in mechanical translation. The first study was very kindly made available to the Committee by the IBM Thomas J. Watson Research Center, Yorktown Heights, New York. By counting and classifying the corrections made by posteditors, this study determined the types and frequency of errors found in the output of four machine translations (Russian to English).

GENERAL CLASSIFICATION AND PERCENTAGE OF ERRORS OF ARTICLE I

Total number of words:	Approximately 1,200	
	No.	%
Transliterated words	—	—
Multiple meanings and ambiguities	96	8.0
Word order rearranged	23	2.0
Miscellaneous insertions and corrections	45	3.6
Total	164	13.6

GENERAL CLASSIFICATION AND PERCENTAGE OF ERRORS OF ARTICLE II

Total number of words:	Approximately 1,200	
	No.	%
Transliterated words	6	0.5
Multiple meanings and ambiguities	132	11.0
Word order rearranged	17	1.4
Miscellaneous insertions and corrections	77	6.4
Total	232	19.3

GENERAL CLASSIFICATION AND PERCENTAGE OF ERRORS OF ARTICLE III

Total number of words:	Approximately 1,700	
	No.	%
Transliterated words	17	1
Multiple meanings and ambiguities	143	9
Word order rearranged	36	2
Miscellaneous insertions and corrections	122	7
Total	318	19

GENERAL CLASSIFICATION AND PERCENTAGE OF ERRORS OF ARTICLE IV

Total number of words (including individual digits and symbols in all formulas):	Approximately 1,600	
	No.	%
Transliterated words	1	—
Multiple meanings and ambiguities	87	5.8
Word order rearranged	14	0.9
Miscellaneous insertions and corrections	436	29.0
Total	538	35.7

The second study was made by Arthur D. Little, Inc., and was done in a manner similar to the IBM study. That is, machine translation output was postedited and the errors classified and counted. From the study, the A. D. Little group was able to tell the percentage of total corrections made in each category. The original consisted of approximately 200 pages of scientific Russian. One set of approximately 100 pages was edited by two different editors. The second set contained "approximately 100 pages from seven MT articles edited by at least four different editors."*

*An Evaluation of Machine-Aided Translation Activities at F.T.D., Contract AF 33(657)-13616, Case 66556, May 1, 1965, p. G-10.

PERCENTAGE OF TOTAL CORRECTIONS COUNTED*

Error	%
Word omission	
A. Articles	18.76
B. Others	15.98
	34.74
Wrong words	
A. Prepositions	3.78
B. Verb tense, voice, suffix	5.56
C. Others	16.24
	25.58
Russian left in	4.48
Choice	
A. Choice of two	8.17
B. Choice of two, both wrong	3.57
	11.74
Unnecessary word	3.09
Symbol	4.5
Phrase not interpreted	3.14
Word order	12.73

Total Number of Corrections: 7,573

Appendix 12

Machine-Aided Translation at the Federal Armed Forces Translation Agency, Mannheim, Germany

SEMIAUTOMATIC TRANSLATION AID SYSTEM (STAGE 1)

Translated from German by the Federal Armed Forces Translation Agency, Annex to Report MÜV - Az.: 55-05 (30) dated, February 18, 1965.

Report on Sixth Test Run On TR4 Computer Facility

I. GENERAL

During the week of February 8 to 12, 1965, a second improved model test run was conducted using the TR4 computer facility of the Telefunken Company, Konstanz. The test run was designed to test as an integral system all routines and subroutines developed so far. The test, which represents the culmination of the development work done in Stage I of the semiautomatic translation aid system, can be regarded as quite successful: it confirmed the soundness of the approach. Practical application of the procedure (Stage I) now depends on when the Federal Armed Forces Computer Center is operational so that the entire body of linguistic information now stored on punched cards can be transferred to magnetic tape. Optimization of the program will be effected on the basis of practical experience.

II. DESCRIPTION OF TEST RUN

The testing material consisted of three English-language texts (so-called partial interrogation batches). The texts bore different job numbers and were assigned to different translators who underscored in the text those terms with which the machine was to be presented. Double or triple underscorings of compounds meant that in addition to the translation of the compound itself the

translation of one or more of its elements was desired in order to utilize optimally the information stored in the machine dictionary. Where appropriate, the underscored expressions were reduced to the reference form (nominative singular, infinitive, etc.). The terms were then punched on cards and read into the computer in the sequence of their occurrence in the text. Read-in of the three partial interrogation batches was in the sequence of ascending job numbers. The dictionary used in this text did not contain the entire A-to-Z stock of vocabulary but was a micro-glossary specially compiled for the purposes of this test. This fact already points to the model character of the test. The output units were printed out by an OFF-LINE high-speed printer. This second model test run differed from the first model test run [cf. Report ÜDBw - MÜV - Az.: 55-05 (30) dtd 14 Oct. 1964] in that it presupposed large quantities of data. While in the first test sorting had been circumvented, the second test included a sorting (SORT-2) program using four magnetic tapes. Since the sorting procedure has already been discussed in Report ÜDBw - MÜV - Az.: 55-05 (30) of 10 Dec. 1964, it need not be described here.

III. FORMAT OF OUTPUT LISTS

What has been said about the format of the output lists in Reports ÜDBw - MÜV - Az.: 55-05 (30) of 14 Oct. and 10 Dec. 1964 is true also for the output lists produced in the present test with the exceptions that in the present test the lists have a title line and each partial interrogation batch begins on a new page. Print-out of more than one partial batch is in the sequence of the alphabetical order of the abbreviated names of the translators.

IV. INTERPRETATION OF SOME "MISSING" NOTATIONS

1. The missing notations, some of which were introduced intentionally for reasons of illustration, are attributable to the following causes:

a. Interrogation of compounds with variable context-related elements

Examples:	freak midget craft	(GRE 8969 034)
	midget-type submarine	(GRE 8969 043)
	cyclic control system	(HER 8970 029)
	low-power gain recovery	(MUL 8968 038)

In some cases interrogation without the variable elements was successful.

b. Interrogation of words and word compounds which occur as "quasi-technical terms" in certain contexts and which because of their elusive character are not contained in the dictionary.

Examples:	ASW package	(GRE 8969 025)
	oscillatory mode	(HER 8970 005)
	hydraulically boosted	(HER 8970 037)
	distributed fashion	(MUL 8968 030)

c. Spelling variants

Examples:	antisubmarine air barrier	(GRE 8969 047)
	travelling-wave maser	(MUL 8968 012)

Interrogation of the alternative spellings (anti-submarine air barrier; traveling-wave maser) was successful.

d. Interrogation of expressions which, strictly speaking, cannot be regarded as technical terms

Examples:	porpoise	(GRE 8969 036)
	ocean passage	(GRE 8969 049)
	stocking	(HER 8970 024)

e. Uncorrected punching errors

Examples:	artifical feedback	(HER 8970 040)
	artifical feel	(HER 8970 042)

f. Inaccuracies in the original text

In text 64/18968, line 23, the letters "bL" were interpreted as an abbreviation. However, they are not an abbreviation but the product of the two quantities "b" and "L." For the sake of clarity the product should have been written "b $\times$ L."

g. All other "missing" notations may be interpreted as blanks in the dictionary

Examples:	advance radar picket	(GRE 8969 019)
	missile-launcher	(GRE 8969 045)
	stability augmentation	(HER 8970 002)
	artificial feedback feel	(HER 8970 039)
	maser line	(MUL 8968 013)
	gain recovery	(MUL 8968 039)

In many cases, however, the missing equivalents could have been derived from the information actually printed out.

2. The justification of the warning to the translator not to accept blindly everything printed out by the machine is demonstrated by the following examples:

a. Text 64/18969, line 12: "weather beacon." The German equivalents "Wetterboje" and "Wetterbake" (GRE 8969 021) printed out by the nachine are not very meaningful in this particular context. A destroyer may rather serve as a "Wetterstation (weather station)" or "Wetterschiff (weather ship)."

b. Text 64/18970, line 18: "loop." What is meant here is a "servo loop" ("Regelkreis"); the word "loop" without a qualifying addition is not specific enough. The equivalents under "loop" (HER 8970 028), therefore, are not applicable.

c. Text 64/18970, line 28: "displacement." The equivalents printed out under HER 8970 038 are wrong in this context.
The weaknesses pointed up above are not to be blamed on the machine or the procedure but are inherent in the language.

V. OUTLOOK

Practical application of the procedure developed so far, a procedure proven in a second successful model test run, now depends on when the Federal Armed Forces computer can be used in order to transfer the entire punch-card information onto magnetic tape. Organizational and programming preparatory work for this significant step are already under way. In addition, work on the new complex "processing of vocabulary passed by the terminology boards" has been initiated.

TEXT-RELATED GLOSSARIES AND MACHINE-PRODUCED ENGLISH-LANGUAGE TECHNICAL TEXTS

(1) One common practice is to credit any ship with a hull number starting with D as being per se an ASW ship. To be sure, destroyers (DD), escorts (DE), and frigates (DL) all have ASW capabilities. So do all other types of ships. The bow of
(5) an ocean liner, if it rammed a submarine, would be a mighty ASW weapon. This does not make merchant ships into an ASW force. Is a guided missile destroyer (DDG), or a radar escort picket (DER), any more an ASW craft?
Ships are inherently multi-purpose, even when efforts are made
(10) to specialize their functions. The versatile destroyer, our traditional ASW surface craft, can and does serve as anti-air screen, advance radar picket, torpedo boat, weather beacon, and even as an emergency power plant for a good-sized city. It even makes an effective transport and cargo ship.
(15) Into the "ASW package" (lately broadened into something called undersea warfare, or USW) have gone a hodge-podge of ships. And a potpourri of projects have been labelled ASW, including such things as mines and mine detectors, noisemakers and deception devices, submarine machinery, test barges and
(20) calibration ranges, hydrographic and oceanographic surveys, long-range basic programs . . . , bathyscaphs, freak midget craft, and studies of the vocabulary of porpoises.
War will demand several rather different ASW missions. The tactics of convoy protection differ from those of a hunter-killer
(25) group free to pursue subs wherever they may be found. The problem of guarding an amphibious landing perimeter against coastal or midget-type submarines has little in common with the hunting down of silent missile-launchers hovering deep in unfrequented waters. Maintaining an antisubmarine air barrier across critical
(30) ocean passages differs markedly from all these.


```
GRE 8969 000  ********************************  TEXTBEZOGENE FACHWORTLISTE - UEBERSETZERDIENST DER BUNDESWEHR  ********************************
GRE 8969 001 0 HULL NUMBER                      AR30  1          SCHIFFSNUMMER
GRE 8969 001 1                                  AR30  1          BOOTSNUMMER
GRE 8969 001 2                                  AR30  1          OPTISCHES RUFZEICHEN
GRE 8969 002 0 HULL                             AL50  1          SCHIFFSRUMPF
GRE 8969 002 1                                  AL50  1          BOOTSRUMPF
GRE 8969 002 2                                  AL50  1          SCHIFFSKOERPER
GRE 8969 002 3                                  AL90  1          BOOTSKOERPER
GRE 8969 003 0 ASW SHIP                         AR30  1          UJAGDSCHIFF
GRE 8969 003 1                                  AL50  1          UJAGDSCHIFF
GRE 8969 003 2                                  AR30  1          U-ABWEHR-SCHIFF
GRE 8969 003 3                                  AL50  1          U-ABWEHR-SCHIFF
GRE 8969 004 0 ASW                              AR30 +1          UBOOTHEKAEMPFUNG          /ALLGEMEIN/
GRE 8969 004 1                                  AR30 +1          U-ABWEHR          /PASSIV/
GRE 8969 004 2                                  AR30 +1          UJAGD  /AKTIV/
GRE 8969 005 0 ESCORT                           AR30  1          GELEIT
GRE 8969 005 1                                  AL50* 1          GELEITBOOT
GRE 8969 005 2                                  AR30* 2          GELEITFAHRZEUG
GRE 8969 005 3                                  AR10  1          BEGLEITSCHUTZ
GRE 8969 005 4                                  AR10  1          ESKORTE
GRE 8969 005 5                                  AR10  2          EHRENGELEIT
GRE 8969 005 6                                  AR20  1          BEGLEITMANNSCHAFT
GRE 8969 005 7                                  AR30* 1          GELEITBOOT
GRE 8969 006 0 FRIGATE                          AR30* 2 /DL/     FREGATTE
GRE 8969 006 1                                  AL50* 2 /DL/     FREGATTE
GRE 8969 007 0 ASW CAPABILITY                                    F E H L T
GRE 8969 008 0 ASW WEAPON                       AR30  1          UJAGDWAFFE
GRE 8969 008 1                                  AR30  1          U-ABWEHR-WAFFE
GRE 8969 009 0 ASW FORCE                        AR30  1          UJAGDSTREITKRAFT
GRE 8969 009 1                                  AR30  1          UJAGDVERBAND
GRE 8969 009 2                                  AR30  1          U-ABWEHR-STREITKRAFT
GRE 8969 009 3                                  AR30  1          U-ABWEHR-VERBAND
GRE 8969 010 0 GUIDED MISSILE DESTROYER         AR30*+2 /DDG/    LENKFLUGKOERPERZERSTOERER
GRE 8969 010 1                                  AL50*+2 /DDG/    LENKFLUGKOERPERZERSTOERER
```

GRE 8969 011 0	RADAR ESCORT PICKET	AR30**2 /DER/	RADARPICKETGELEITBOOT
GRE 8969 011 1		AL50**2 /DER/	RADARPICKETGELEITBOOT
GRE 8969 012 0	PICKET	AR10 1	PICKET
GRE 8969 012 1		AR10 0	VORPOSTEN
GRE 8969 012 2		AR10 0	POSTEN
GRE 8969 013 0	ASW CRAFT	AR30 1	UJAGDFAHRZEUG
GRE 8969 013 1		AR30 2	UJAGDSCHIFF
GRE 8969 013 2		AL50 2	UJAGDSCHIFF
GRE 8969 013 3		AR30 1	U-JAEGER
GRE 8969 013 4		AR30 1	U-ABWEHR-SCHIFF
GRE 8969 013 5		AL50 1	U-ABWEHR-SCHIFF
GRE 8969 013 6		AR30 1	U-ABWEHR-FAHRZEUG
GRE 8969 014 0	VERSATILE DESTROYER		F E H L T
GRE 8969 015 0	ASW SURFACE CRAFT		F E H L T
GRE 8969 016 0	SURFACE CRAFT	AL50 +2	UEBERWASSERFAHRZEUG
GRE 8969 017 0	ANTI AIR SCREEN	AR50 1	FLUGABWEHRSICHERUNG
GRE 8969 017 1		AR50 1	LUFTABWEHRSICHERUNG
GRE 8969 018 0	SCREEN	AR10 1	SICHERUNG
GRE 8969 018 1		AH48 +2	BILDSCHIRM
GRE 8969 018 2		AH50 +2	BILDSCHIRM
GRE 8969 018 3		AH30 2	LEUCHTSCHIRM
GRE 8969 018 4		AJ20 2	SCHUTZGITTER /I LUFTEINTRITTSKANAL/
GRE 8969 018 5		AF30 0	FILTER
GRE 8969 018 6		AF87 3	RASTER /DRUCKTECHNIK/
GRE 8969 018 7		AQ40 1	VAU-NULL-GITTERRAHMEN
GRE 8969 019 0	ADVANCE RADAR PICKET		F E H L T
GRE 8969 020 0	RADAR PICKET	AH50 +1	RADAR-PICKET
GRE 8969 021 0	WEATHER BEACON	AE57 1	WETTERBOJE
GRE 8969 021 1		AE57 1	WETTERBAKE
GRE 8969 022 0	EMERGENCY POWER PLANT	AJ00 1	HILFSTRIEBWERK
GRE 8969 022 1		AH00 1	HILFSKRAFTWERK
GRE 8969 022 2		AH00 1	NOTSTROMAGGREGAT
GRE 8969 022 3		AH00 1	HILFSKRAFTANLAGE
GRE 8969 023 0	TRANSPORT SHIP		F E H L T
GRE 8969 024 0	TRANSPORT	AK10 3	TRANSPORTMITTEL
GRE 8969 024 1		AK10 3	TRANSPORTER

GRE 8969 024 2		AK10 3	TRANSPORT
GRE 8969 024 3		AR30 1	TRUPPENTRANSPORTER
GRE 8969 025 0	ASW PACKAGE		F E H L T
GRE 8969 026 0	UNDERSEA WARFARE	AR30 1	UNTERWASSERKRIEGFUEHRUNG
GRE 8969 027 0	MINE DETECTOR	AQ66 1	MINENDETEKTOR
GRE 8969 027 1		AQ66 1	MINENORTUNGSGERAET
GRE 8969 027 2		AQ66 1	MINENSPUERGERAET
GRE 8969 028 0	NOISEMAKER	AA10 1	GERAEUSCHERZEUGER
GRE 8969 028 1		AQ60 -1	KNALLKOERPER
GRE 8969 029 0	DECEPTION DEVICE	AR10 -1	TAEUSCHUNGSVORRICHTUNG
GRE 8969 029 1		AR10 1	TAEUSCHUNGSGERAET
GRE 8969 029 2		AR10 1	TAEUSCHUNGSEINRICHTUNG
GRE 8969 029 3		AR10 1	BOLD
GRE 8969 030 0	TEST BARGE	AL50 1	PRUEFPRAHM
GRE 8969 030 1		AL50 1	VERSUCHSPRAHM
GRE 8969 030 2		AL50 1	ERPROBUNGSPRAHM
GRE 8969 031 0	CALIBRATION RANGE	AF03 +1	MESSSTELLE /MES/
GRE 8969 031 1		AF03 1	EICHSTELLE
GRE 8969 031 2		AF03 2	EICHANLAGE
GRE 8969 031 3		AF03 2	EICHSTRECKE
GRE 8969 031 4		AF03 1	EICHENTFERNUNG
GRE 8969 032 0	OCEANOGRAPHIC SURVEY	AE55 1	OZEANOGRAPHISCHE VERMESSUNG
GRE 8969 033 0	BATHYSCAPH	AE55 1	BATHYSKAPH
GRE 8969 033 1		AE55 1	TIEFSEETAUCHGERAET
GRE 8969 034 0	FREAK MIDGET CRAFT		F E H L T
GRE 8969 035 0	MIDGET CRAFT	AL50 1	ZWERGFAHRZEUG
GRE 8969 035 1		AL50 1	KLEINSTFAHRZEUG
GRE 8969 036 0	PORPOISE		F E H L T
GRE 8969 037 0	CONVOY PROTECTION	AR30 0	GELEITZUGSICHERUNG
GRE 8969 037 1		AR10* 1	GELEITSCHUTZ
GRE 8969 037 2		AR20 1	MARSCHSICHERUNG
GRE 8969 038 0	CONVOY	AR30 *0	KONVOI /OHNE SICHERUNG/
GRE 8969 038 1		AR30 *1	GELEITZUG /MIT SICHERUNG/
GRE 8969 038 2		AR20 *0	FAHRZEUGKOLONNE
GRE 8969 038 3		AR20 1	MARSCHKOLONNE
GRE 8969 039 0	HUNTER KILLER GROUP	AR30* 0	GEMISCHTER U-ABWEHRVERBAND

GRE 8969 039 1		AR30* 1	UJAGD-TRAEGERGRUPPE
GRE 8969 039 2		AR30**1	HUNTER/KILLER-GRUPPE
GRE 8969 040 0	AMPHIBIOUS LANDING PERIMETER		F E H L T
GRE 8969 041 0	AMPHIBIOUS LANDING	AR39 1	LANDUNGSUNTERNEHMEN
GRE 8969 041 1		AR39 1	LANDUNG
GRE 8969 041 2		AR39 1	AMPHIBISCHE OPERATION
GRE 8969 042 0	COASTAL SUBMARINE	AL50 -2	KUESTEN-UBOOT
GRE 8969 042 1		AR30 -2	KUESTEN-UBOOT
GRE 8969 043 0	MIDGET TYPE SUBMARINE		F E H L T
GRE 8969 044 0	MIDGET SUBMARINE	AL50 2	ZWERG-UBOOT
GRE 8969 044 1		AR30 2	ZWERG-UBOOT
GRE 8969 044 2		AL50 1	KLEINST-UBOOT
GRE 8969 044 3		AR30 1	KLEINST-UBOOT
GRE 8969 044 4		AL50 1	EIN-MANN-UBOOT
GRE 8969 044 5		AR30 1	EIN-MANN-UBOOT
GRE 8969 045 0	MISSILE LAUNCHER		F E H L T
GRE 8969 046 0	LAUNCHER	A030 1	STARTGESTELL
GRE 8969 046 1		A030 +0	ABSCHUSSRAMPE
GRE 8969 046 2		A030 1	ABSCHUSSGESTELL
GRE 8969 046 3		A030 2	ABSCHUSSGERUEST
GRE 8969 046 4		A030 1	STARTGERUEST
GRE 8969 046 5		A030 1	ABSCHUSSVORRICHTUNG
GRE 8969 046 6		A030 +1	STARTGERAET
GRE 8969 047 0	ANTISUBMARINE AIR BARRIER		F E H L T
GRE 8969 048 0	ANTI SUBMARINE AIR BARRIER	AR30 1	UJAGD-LUFTSPERRE
GRE 8969 049 0	OCEAN PASSAGE		F E H L T

Appendix 13

Machine-Aided Translation at the European Coal and Steel Community, Luxembourg

```
      1
JETEE POUR LES CHARGEMENTS DE PETROLIERS

    JETEE D ACCES AVEC PLATE-FORME POUR CHARGEMENT ET DECHARGEMENT DE PETROLEERS        TRB2
        PIER WITH PLATFORM FOR LOADING AND UNLOADING OF TANKERS

      2
CARACTERISTIQUES PHYSIQUES DES ACIERS DE CONSTRUCTION

    EVOLUTION DES CARACTERISTIQUES DE L ACIER DESTINE A LA CONSTRUCTION METALLIQUE     INA5
        IMPROVEMENTS IN THE PROPERTIES OF STEEL USED IN BUILDING AND CONSTRUCTION
    CARACTERISTIQUES PHYSIQUES OU MECANIQUES                                           INH5
        PHYSICAL OR MECHANICAL PROPERTIES

      3
PROFILS D ACIERS SPECIAUX FILES A CHAUD

    PROFILS D ACIER SPECIAUX EXTRUDES A CHAUD                                          SI19
        HOT-EXTRUDED SPECIAL STEEL SECTIONS

      4
APTITUDE AU FORMAGE A FROID

    APTITUDE A LA DEFORMATION A FROID                                                  INC5
        COLD DRAWING QUALITY

      5
PLANCHERS EN BETON TRAVAILLANT AU CISAILLEMENT

    CHAPE FLOTTANTE EN BETON                                                           INO5
        FLOATING CONCRETE LAYER
    RESISTANCE DU CISAILLEMENT DE PLANCHERS EN BETON PREFABRIQUE                       INC5
        SHEAR RESISTANCE OF PRECAST CONCRETE FLOORS
    LONGUEUR REELLE DES MEMBRURES TUBULAIRES TRAVAILLANT A LA COMPRESSION              INA5
        EFFECTIVE LENGTH OF TUBULAR COMPRESSION MEMBERS
```

```
      6
POSE DES PANNEAUX DE FACADE SUR LA CHARPENTE

    POSE DES PANNEAUX DE REMPLISSAGE DE LA CHARPENTE                                   INA5
        FIXING OF WALL CLADDING PANELS ON STEEL FRAME
    PANNEAUX DE FACADE COURANTS                                                        INO5
        ORDINARY FRONT PANELS

      7
TUBES POUR INSTALLATIONS DE CHAUFFAGE PAR RAYONNEMENT

    LOGEMENTS POUR LE PASSAGE DES TUBES DE L INSTALLATION DE CHAUFFAGE                 INO5
    SERPENTINS TUBULAIRES POUR INSTALLATIONS DE CHAUFFAGE A PANNEAUX A RAYONNEMENT     SI18
        TUBULAR COILS FOR RADIATING PANELS OF HEATING PLANTS

      8
ACIERS FAIBLEMENT ALLIES QUI SONT TRAITES THERMIQUEMENT

    ACIER D ALLIAGE.,ACIER ALLIE                                                       SI19
        ALLOY STEEL
    ACIER ELECTRIQUE.,ACIER TRAITE AU FOUR ELECTRIQUE                                  SI19
        ELECTRIC STEEL

      9
ASSEMBLAGES PAR BOULONS A HAUTE RESISTANCE OU PAR SOUDURE

    SOUDURE PAR RESISTANCE                                                             INC5
        RESISTANCE WELDING
    ASSEMBLAGE PAR SOUDURE OU PAR BRIDES MOBILES                                       IND5
        CONNECTION BY WELDING OR BY LOSE FLANGES
    LE SOUDAGE ET L EMPLOI DE BOULONS A HAUTE RESISTANCE SE SUBSTITUENT AU RIVETAGE    INB5
        WELDING AND THE USE OF HIGH-STRENGTH BOLTS REPLACE RIVETING

     10
ACIERS ADOUCIS RESISTANT A LA CORROSION , EXPOSES AUX PHENOMENES ATMOSPHERIQUES

    ACIER RESISTANT A LA CORROSION                                                     SI19
        CORROSION-RESISTING STEEL
    LA CORROSION ATMOS2PHERIQUE EST EXOMORPHE,C EST-A-DIRE PROVOQUEE PAR LES DISCONTINUITES DU MILIEU AMBIANT   INH5
    ACIER A ADOUCIR                                                                    SI19
        TEMPERSTEEL
    COMPORTEMENT EN PRESENCE DE PHENOMENES SISMIQUES                                   ING5
```

CONGRES SUR L'UTILISATION DE L'ACIER
KONGRESS ÜBER STAHLVERWENDUNG
CONGRESSO SULL'UTILIZZAZIONE DELL'ACCIAIO
CONGRES OVER DE TOEPASSING VAN STAAL
STEEL UTILIZATION CONGRESS

TERMES TECHNIQUES
FACHWÖRTER
TERMINI TECNICI
VAKTERMEN
TECHNICAL TERMS

EUROPEAN COAL AND STEEL COMMUNITY
HIGH AUTHORITY
Terminological bureau

FOREWORD

This glossary has been compiled by the High Authority's Terminological Bureau for the Congress on Steel Utilization scheduled to meet in Luxembourg from October 28 to 30, 1964.

Use has been made of modern data-processing techniques *), which have enabled the difficulties of assembling and analysing material from a variety of countries in a bare three months to be successfully overcome, though, needless to say, in the circumstances the five-language glossary can make no claim to be exhaustive.

In an effort to make for easier consultation, the terms have been grouped under headings corresponding to the items of the Congress programme. A somewhat arbitrary classification,has, however, resulted, so that users not finding a term under one heading are recommended to try under a related one. In each case the key word is immediately followed by the esearch argument (i.e. key word plus any qualifying matter), and then by the whole phrase from which the term is taken, with the equivalent phrases in the other languages; the search argument is, however, of minor importance to the user.

In the assembly of the material the Bureau received most valuable assistance from various information centres in the countries approached, the documentation supplied by whom is listed in the accompanying bibliography. Special thanks for assistance with terminological problems are due to the library of the Technische Hogeschool, Delft, and the Centre Belgo-Luxembourgeois d'Information de l'Acier, Brussels.

Altough initially intended as an aid for the numerous interpreters and translators who will be called upon to grapple with the highly-specialized Congress papers and discussions, the glossary may well prove of interest to wider circles. It is issued in five versions, German, French, Italian, Dutch and English, and will be supplied on request.

Queries and suggestions will be welcomed, and should be addressed to Mr. J.A. BACHRACH, Head of the High Authority Terminological Bureau.

Luxembourg, October 5, 1964

T.F. NOYON
Director of Internal Affairs

*) Offset reproduction of listings obtained from a KWIC-programmed IBM 1410 computer.

CONTENTS

```
                                                                IN05 00092
FACADE
     FACADE ..
      NON-LOADBEARING FRONT
          NON-LOADBEARING FACADE..
          NON-LOADBEARING FRONT
               FACADE NON PORTEUSE
               NICHTTRAGENDE WANDVERKLEIDUNGEN
               PARETE VERTICALE ESTERNA NON PORTANTE
               NIET-DRAGENDE GEVEL
                                                                IN05 01039
FACEWORKS
     FACEWORKS FOR CEILINGS
          SPECIAL FACEWORKS FOR CEILINGS
               MATERIAUX D ETAYAGE,DE TYPE SPECIAL,DESTINES A L ETAIEMENT
               PROVISOIRE DES PLANCHERS
               SPEZIELLE PROVISORISCHE DECKENSTUETZEN
               MATERIALI DI PUNTELLAZIONE E DI ARMAMENTO PROVVISORIO DEI SOLAI
               SPECIAAL MATERIAAL VOOR DE VOORLOPIGE ONDERSTEUNING VAN VLOEREN
                                                                IN05 00755
FALSEWORK
     FALSEWORK
          SLIDING FALSEWORK
               COFFRAGES GLISSANTS
               GLEITSCHALUNGEN
               ARMATURE SCORREVOLI
               GLIJBEKISTING
                                                                IN05 00180
FINISH
     FINISH HARDWARE
          HARDWARE..
          FINISH HARDWARE
               QUINCAILLERIE
               EISENTEILE
               MINUTERIE METALLICHE
               IJZERWERK
                                                                IN05 01209
FINISHING
     FINISHING
          EXTERIOR WOOD FINISHING
               MENUISERIES EXTERIEURES
               BAUTISCHLEREI (AUSSENARBEITEN)
               INFISSI ESTERNI
               BUITENBETIMMERING
                                                                IN05 01212
     FINISHING
          INTERIOR WOOD FINISHING
               MENUISERIES INTERIEURES
               INNENAUSBAU
               INFISSI INTERNI
               BINNENBETIMMERING
                                                                IN05 01160
```

```
RESONANCE
     RESONANCE PERIODS OF THE GROUND
          DOMINANT OR RESONANCE PERIODS OF THE GROUND
               PERIODES DOMINANTES OU DE RESONNANCE DU SOL
               GRUND- ODER RESONANZPERIODEN DES BODENS
               PERIODI DOMINANTI O DI RISONANZA DEL SUOLO
               DOMINERENDE OF RESONANTIEPERIODEN VAN DE BODEM
                                                                ING5 01229
RESPONSE
     RESPONSE OF THE ENVIRONMENTAL FORCES
          RESPONSE OF THE ENVIRONMENTAL FORCES
               REACTION DES FACTEURS DE MILIEU
               AUSWIRKUNG DER NATURGEGEBENEN KRAEFTE
               REAZIONE DELLE FORZE AMBIENTALI SISMICHE
               UITWERKING VAN DE OMGEVENDE NATUURKRACHTEN
                                                                ING5 01224
SCALE
     SCALE
          PASS SATISFACTORILY EARTHQUAKES UP TO SEVEN OF THE MODIFIED MERCALLI
          SCALE
               RESISTER DE MANIERE SATISFAISANTE A DES TREMBLEMENTS DE TERRE D
               INTENSITE SEPT SELON L ECHELLE MODIFIEE DE MERCALLI
               AUSREICHENDER WIDERSTAND GEGEN ERDBEBEN BIS ZU STUFE SIEBEN DER
               MODIFIZIERTEN SKALA VON MERCALLI
               RESISTERE IN MODO SODDISFACENTE A TERREMOTI FINO AL NUMERO SETTE
               DELLA SCALA MERCALLI MODIFICATA
               BEVREDIGENDE WEERSTAND AAN AARDBEVINGEN VAN INTENSITEIT ZEVEN DER
                SCHAAL VAN MERCALLI
                                                                ING5 01227
SECTIONS
     SECTIONS
          STEEL PLATES AND ANGLES RIVETED TOGETHER TO FORM LARGE HOLLOW SECTIONS
               TOLES ET CORNIERES EN ACIER REUNIES PAR RIVETAGE DE MANIERE A
               FORMER DE GRANDS CADRES CREUX
               STAHLPLATTEN UND -WINKEL,DIE ZU GROSSEN HOHLFELDERN VERNIETET
               SIND
               LAMIERE ED ANGOLARI DI ACCIAIO UNITI A RIBADITURA PER FORMARE
               GRANDI PROFILATI CAVI
               STALEN PLATEN EN HOEKEN ZODANIG VASTGEKLONKEN DAT ZIJ GROTE OPEN
               VAKKEN VORMEN
                                                                ING5 01228
     SECTIONS AND SPECIAL SPLIT BEAM CONNECTIONS
          ROLLED STRUCTURAL STEEL SECTIONS AND SPECIAL SPLIT BEAM CONNECTIONS
               PROFILES DE CONSTRUCTION LAMINES EN ACIER ET ASSEMBLAGES FOURCHUS
               GEWALZTE BAUSTAHLPROFILE UND TRAEGER MIT SPALT-VERBINDUNGEN
               PROFILATI PER COSTRUZIONI LAMINATI IN ACCIAIO E SPECIALI
               COLLEGAMENTI A TRAVE SPACCATA
               GEWALSTE CONSTRUCTIESTAALPROFIELEN EN SPECIALE GESPLETEN
               BALKVERBINDINGEN
                                                                ING5 01226
```

Appendix 14

Translation Versus Postediting of Machine Translation

This study reports the results of a small experiment done for the purpose of obtaining some facts regarding the process of postediting machine-translation output as compared with the process of ordinary translation. In particular, information was desired concerning the relative speed and ease (or difficulty) of postediting as compared with those of translation.

A variety of translators (i.e., commercial free-lance translators, government in-house translators, government contract translators, and bilingual persons who did not ordinarily engage in translation work) were sent a packet containing (1) a 1,135-word excerpt from a Russian book on cybernetics, Machina i Mysl', which they were to translate and provide typed copy of their translations; (2) a 765-word excerpt from the same book; (3) a print-out of the machine translation of (2), which was to be postedited and typed; and (4) a questionnaire (Exhibit 1, page 99).

The translators were to keep a careful record of time spent in translating, editing, postediting, and (for some) typing.

Those responding were:

(a) three translators employed by commercial translation agencies (Numbers 2, 14, and 23);

(b) eleven translators who held contracts with the U.S. Joint Publications Research Service (Numbers 1, 3, 6, 7, 11, 13, 15, 16, 17, 18, and 22);

(c) six full-time translators employed, in-house, by an agency of the U.S. Government (Numbers 4, 9, 10, 12, 19, and 21); and

(d) three members of the faculty of the Russian department at the Defense Language Institute (Numbers 5, 8, and 20). These three are language instructors and not primarily translators.

EASE OF POSTEDITING

Eight translators found postediting to be more difficult than ordinary translation. Six found it to be about the same, and eight found

it easier. (One translator indicated that he found the degree of difficulty to lie between "easier" and "the same.")

Thus, from the answers received, it can be seen that the translators were almost evenly divided in their opinions on the difficulty of postediting.

The point of interest is that the more adept (rapid) translators found postediting more difficult than did the slower translators (see Exhibit 2, page 100). The apparent paradox that those people who thought postediting was more difficult were more proficient at it than those who found it to be "the same" or "easier" is explained by the fact that those who found it more difficult are the same people who are the most adept at translation.

From Exhibit 2 one may see that six of the eight translators who found postediting to be more difficult than translating were among the faster half, and that six of the eight translators who found postediting to be easier than translating were in the slower half.

The average translation speeds of translators were as follows: those who found postediting more difficult, 11.9 wpm; those who found postediting easier, 6.5 wpm; and those who found postediting about the same, 7.9 wpm.

The average postediting speeds of translators were as follows: those who found postediting more difficult, 9.4 wpm; those who found postediting easier, 8.6 wpm; and those who found postediting about the same, 8.0 wpm.

RELIANCE ON THE ORIGINAL

Only one translator (number 2) indicated that he seldom had to refer to the original (8a) in order to postedit machine translation. Eight translators indicated that it was almost necessary to translate the original (8b), and 14 translators answered that the degree of reliance fell between answers (8a) and (8b). It is of interest to note that most of those who said they had to translate the original were the fastest translators (and perhaps the best at translation).

POSTEDITING AND TRANSLATION SPEED

Translation Speed

The fastest translation speed was 19.5 wpm by translator number 1 and the slowest was 4.2 wpm by translator number 23. The difference between the translation rates of the fastest and slowest was 15.3 wpm; the mean speed was 8.7 wpm; the median was 7.6 wpm; the mode was 6.3 wpm (Figure 2).

Postediting Speed

The fastest posteditor was translator number 5, with a rate of 12.7 wpm. The slowest was translator number 23, with a rate of 3.9 wpm. The difference between the postediting rates of the fastest and slowest translators was 8.8 wpm; the mean postediting speed was 8.7 wpm; the median postediting speed was 9.2 wpm; the mode was 10.2 wpm (Figure 2).

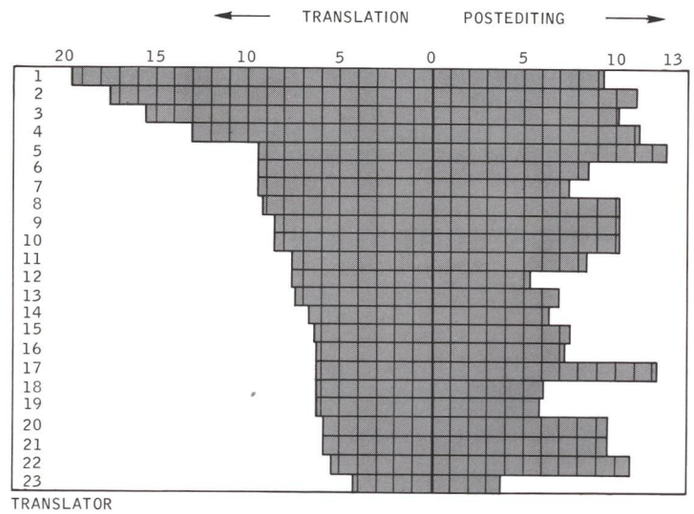


FIGURE 2. Speed (in words per minute) of translation and postediting.

OBSERVATIONS

(a) The mean speed for both translation and postediting was 8.7 wpm.

(b) Although the fastest translator could translate almost five times as fast as the slowest translator, the fastest translator could postedit only about three times as fast as the slowest posteditor.

(c) Of the 23 respondents, ten (3, 6, 7, 11, 13, 14, 15, 16, 17, and 22) indicated that they had had previous experience at postediting machine-translation output (one translator said that he had postedited 93,000 words). Of this group, half had slower rates for postediting than for ordinary translation. Almost exactly the same ratio (number slower:number faster) held overall (11/23 slower: 12/23 faster).

(d) The mean postediting speed of the experienced posteditors was 8.6 wpm. The mean postediting speed of those who did not indicate having experience at postediting was 8.8 wpm.

(e) 1. The four fastest posteditors had an average postediting rate of 11.8 and an average translation rate of 11.5.

2. The four slowest posteditors had an average postediting rate of 5.3 and an average translation rate of 6.1.

3. The four fastest translators had an average postediting rate of 10.4 and an average translation rate of 16.3.

4. The four slowest translators had an average postediting rate of 8.5 and an average translation rate of 5.3. Thus the difference between the faster and slower of these two groups was only 1.9 wpm for postediting but 11 wpm for translation.

5. The fastest translator's postediting rate was the median for postediting (9.2 wpm).

6. The slowest translator was also the slowest posteditor.

IMPACT OF POSTEDITING ON OUTPUT RATES

Figure 3 indicates for each translator his speeds for postediting and translation. It is fairly obvious from a glance at this chart that fast translators will lose productivity if given postediting to do, whereas slow translators will gain.

If translators are given postediting to do, then, contrasted with their translation rates:

Translators 1-4 will show an aggregate loss of 23.6 wpm or 34 percent in output.

Translators 5-8 will show an aggregate gain of 1.7 wpm or 5 percent in output.

Translators 9-12 will show an aggregate gain of 2.1 wpm or 3 percent in output.

Translators 13-15 will show an aggregate gain of 0.6 wpm or 3 percent in output.

Translators 16-19 will show an aggregate gain of 6.3 wpm or 20 percent in output.

Translators 20-23 will show an aggregate gain of 12.6 wpm or 37 percent in output.

Thus, it may be seen that postediting machine translation tends to impede the rapid translators and assist the slow translators.

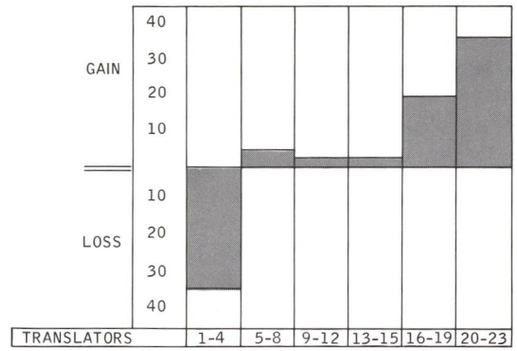


FIGURE 3. Percentage gain or loss in output from postediting.

TIME SPENT PREPARING THE COPY

Practice varied in producing typed translations. Some respondents combined various processes. Ten translators performed translation, editing, and typing as separate operations. The total amount of time these 10 spent on the various processes was as follows:

Translation	1,697	min or 63 percent
Editing	365	min or 13 percent
Typing	645	min or 24 percent

Average typing speed of translators was only 18 wpm. Not all translators produced a typed copy.

WILLINGNESS TO POSTEDIT MACHINE TRANSLATION

Twenty translators answered question 9a. Of the 20 replies, eight were negative, 11 were affirmative, and one was a qualified affirmative (yes, only if straight translation is not available). Of those who would do postediting at a lower rate than that received for translation, over half (6/11) would be willing to postedit for one half or less than the rate paid for translation.

No. of Translators	Rate
1	1/3
1	1/3 - 1/2
4	1/2
1	2/3
1	2/3 - 3/4
1	3/4
2	4/5

It is of considerable interest (especially in a society that is allegedly materialistic) to compare the willingness to postedit at reduced rates with the respondents' speeds of translation and postediting (see Exhibit 2). For example, although translator number 13 indicated that he would accept a rate of 1/3 for postediting, his postediting speed (7.0 wpm) is actually lower than his translation speed (7.3 wpm). Only one translator, number 22, would have broken even. The other 10 would be willing in effect, to do the same number of hours of work for less pay.

Of those translators who indicated their willingness to postedit at reduced rates, one out of three were commercial translators, three out of six were government in-house translators. Seven out of 11 were government-contract translators (an eighth gave a qualified "yes").

TRANSLATORS' REACTIONS TO POSTEDITING

Twenty respondents took the time to give their reactions to the process of postediting machine-translation output. Although their remarks make interesting reading, for the purpose of this study we will only summarize some of the opinions expressed:

Most of the translators found postediting tedious and even frustrating. In particular, they complained of the contorted syntax produced by the machine. Other complaints concerned the excessive number of lexical alternatives provided and the amount of time required to make purely mechanical revisions. A number of the experienced posteditors remarked that, although the material in this study had been carefully keypunched, they had found in their previous experience that careless keypunching was a considerable detriment.

Although no translator commented that he really liked to work with the machine output, a number stated that they found the output

served as an aid in the translation process, particularly with regard to technical terms.

(The difficulty in trying to reflect accurately the opinions of the translators may be appreciated when one reads the following comment made by translator number 23): "In conclusion, the MT was an aid and made translation easier, but when all the time used is figured up, was not as fast or profitable."

TRANSLATORS' RECOMMENDATIONS

Several of the respondents were moved to suggest possible improvements in the machine output:

Number 21

"I believe it might do well to scan the copy to be translated and provide a translator with a vocabulary and then allow him to translate it directly."

Number 15

"Syntax-wise, some time in postediting might be reduced if the editor has knowledge of the degree of dissemination to be given the end product."

Number 3

"A major improvement would be a much bolder programming of word-blocks which have a single or at most dual word English equivalent."

Number 9

"More space for corrections would be a welcome format modification and would, incidently, help assure accuracy if the text is to be retyped after editing."

CONCLUSIONS

In view of the small sample that formed the basis for this study, any conclusions must be tentative. With this in mind, one might draw the following conclusions from this study:

1. An adept translator's skills will probably be wasted on postediting.
2. The slower the translator, the greater the likelihood that his output can be increased by having him postedit machine translation.

3. Machine translation is not yet of such quality as to allow postediting to be done without a copy of the original in the hands of the translator.

4. Translators are apt to be rather mediocre typists.

5. Either translators do not consider their time and effort to be overly dear, or our respondents were exaggerating the time necessary to perform postediting, since half indicated their willingness to do the same work for less pay.

Exhibit 1.

QUESTIONNAIRE

1. Exactly how much time (hours and minutes) was required to translate document number 2?

2. Exactly how much time (hours and minutes) was required to edit the translation?

3. Exactly how much time (hours and minutes) was required to type this translation?

4. How much time was required to edit document number 3?

5. How much time was required to edit the edited copy (if this was necessary)?

6. How much time was required to type document number 3?

7. How did you find the postediting process to be compared to the process of full translation from the original?

   Easier? ☐

   More Difficult? ☐

   About the Same? ☐

8. Check the appropriate box:

   ☐ a. "It was necessary almost to translate the original in order to properly edit the machine output."

   ☐ b. "I seldom had to refer to the original."

   ☐ c. "I placed not so great reliance on the original as question number 8, but greater than indicated by question number 9."

9.a. Would you be willing to regularly postedit similar machine-translation output if you were to be paid at a lower rate than you earn for translating from a document in the original language?

   Yes ☐ No ☐

9.b. If yes, what is the lowest rate you would accept? Circle.

   4/5 2/3 3/4 1/2 1/3 1/4 1/5 of the conventional translation rate.

10. Your candid comments and your reactions to the experience of postediting the machine output are invited below.

Exhibit 2. Data Compiled from Questionnaires

Translator Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
I. Time (minutes) required to translate	58	65	73	87	120	120	120	125	134	135	150	150	155	170	177	180	180	180	180	190	190	210	270
II. Time (minutes) required to postedit	83	180	75	68	60	90	100	75	75	75	90	140	110	120	100	105	60	125	130	80		70	195
III. Postediting was found to be more difficult (MD) than translation, about the same (S), or easier (E)	MD	MD	MD	MD	S	S	MD	E	E	MD	S	S	S	E[b]	E	E	E	S	MD	MD	E[d]	E	E
IV. For postediting (A) it was necessary to translate, (B) seldom had to refer to the original, or (C) between (A) and (B)	C	B	A	A	A	A	C	C	C	A	C	A	C	C	C	C	C	C	A	C	C	C	A
V. Willingness to regularly postedit MT output if paid at lower rate	No	No	Yes	No	—	Yes[a]	No	—	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	No	Yes	No
VI. Amount lower			2/3						1/2			3/4	1/3	2/3-3/4[c]		1/2	1/3-1/2	4/5	4/5			1/2	
VII. Translation speed (wpm)	19.5	17.4	15.5	13.0	9.4	9.4	9.4	9.1	8.5	8.5	7.6	7.6	7.3	6.7	6.4	6.3	6.3	6.3	6.3	5.9	5.9	5.4	4.2
VIII. Postediting speed (wpm)	9.2	11.1	10.2	11.3	12.7	8.5	7.6	10.2	10.2	10.2	8.5	5.4	7.0	6.4	7.6	7.3	12.2	6.1	5.9	9.6	9.6	10.9	3.9
IX. Editing speed (wpm)	Com	25	Com	227	ND	19	56	ND	113	ND	Com	28	56	37	37	74	113	74	74	ND	56	32	15
X. Typing speed (wpm)	Com	19	Com	ND	ND	19	19	ND	ND	ND	10	37	17	15	15	23	Com	14	ND	ND	ND	16	14

Com: Done in combination with other processes.
ND: Not done.

[a] Yes, only if straight translation is not available.

[b] Easier, but not much.

[c] 1/2 if typed copy not required, otherwise 3/4 to 4/5.

[d] Between easier and same.

Appendix 15

Evaluation by Science Editors of Joint Publications Research Service and Foreign Technology Division Translations

Five Joint Publications Research Service (JPRS) translations and five Foreign Technology Division (FTD) translations (four post-edited machine translations and one unedited rough-draft human translation) were sent to six science editors of the American Association for the Advancement of Science and to one translation-agency owner. The translations were ranked according to their quality as scientific writings. The JPRS translations were, in general, ranked higher than the FTD translations. The agreement was almost unanimous that the worst translation of all was the FTD unedited rough-draft human translation.

We requested that the Clearinghouse for Federal Scientific and Technical Information provide us with the six most recently acquired Russian-to-English translations from JPRS and FTD. When these arrived, we eliminated three translations—two because of length and one because we wanted to include an unedited rough-draft translation in the sample. The ten translations that formed the sample were keyed as follows:

(A) Absorption of Radio Waves by Air Behind a Shock Wave, FTD AD605883, FTD-MT-63-74, by T. V. Bazhenova and Yu. S. Lobastov 9/62

(B) Translations on Soviet Construction and Building Materials Industry No. 65, USSR (Large-Scale Building Activity in Process Throughout the Soviet Union) JPRS: 27,267, TT: 64-51522 11/6/64

(C) USSR Industrial Development, Soviet Chemical Industry, No. 188 JPRS: 27,271, TT: 64-51526 11/6/64

(D) Research on Heat Exchange in Vacuum by A. N. Devoyno, FTD-MT-63-09 Edited Machine Translation, 20 Feb. 1964

(E) Testing and Ozokerite Bacillus Culture Liquid for Toxicity by Ch. B. Bayriyev - USSR - JPRS: 27,268, TT: 64-51523 11/6/64

(F) There is Such a Machine by Ye. Temchin, FTD-TT-64-1170/1 27 Oct. 1964

(G) Method of Detection and Identification of Remote Explosions by V. S. Voyutskiy, FTD-MT-64-407, Edited Machine Translation, 6 Oct. 1964

(H) Prevention of Brucellosis by I. N. Ivashurova - USSR - JPRS: 27, 269 TT: 64-51524 11/6/64

(I) Investigation of Optical Oscillator on Ruby at Liquid Nitrogen Temperature by V. K. Konyukhov, L. A. Kulevskiy, and A. M. Prokhorov, FTD-MT-63-100, 21 Oct. 1963

(J) Translations on Soviet Agriculture No. 44, JPRS: 27,272, TT: 64-51527 6 November 1964

The translations were then stripped of any identifying markers and photoreproduced.

The samples were then sent to the science editors at the American Association for the Advancement of Science and to the owner of a commercial translation agency who did not read Russian but was experienced in the editing of translations. These editors were given the following instructions:

> What is needed is a rank-ordering of the enclosed materials with the best document being given the number "1" and the worst document number "10." The basis for judgement would be the standards which you as a scientific editor normally apply. What we are after is your rating of excellence or lack of excellence of the writing in these documents. In other words, how does the stuff read?
>
> In addition to your rank-ordering of these items (which thus shows their standing relative to each other), we would welcome your comments as to how they impress you on an absolute scale. That is, although number "1" will be the best of the total group, it still may be an example of poor scientific writing.

TABLE 7. Ranking of FTD (letters in parentheses) and JPRS Translations

	Best ← Rating → Worst									
Editor Number	1	2	3	4	5	6	7	8	9	10
1 (Commercial firm)	H	(G)	(D)	C	(I)	E	(A)	B	(F)	J
2	C	H	J	(G)	E	(I)	(D)	B	(A)	(F)
3	E	H	C	(G)	(D)	B	(A)	(I)	J	(F)
4	E	H	C	B	J	(G)	(A)	(I)	(D)	(F)
5	(G)	C	H	E	(A)	(D)	(I)	J	B	(F)
6	C	H	E	(G)	B	J	(D)	(I)	(A)	(F)
7	H	E	(G)	(D)	C	B	(A)	(I)	(J)	(F)

Results of the editors' ranking are given in Table 7. In order to obtain a numerical rating of the translations, those appearing in column 1 were given a score of 100; each column was scored 10 points lower so that those in column 10 were given a rating of 10. On this basis the numerical scores of the translations are as follows:

Translation	Score	Translating Agency
H	640	JPRS
C	580	JPRS
E	550	JPRS
G	530	FTD
D	360	FTD
B	310	JPRS
I	270	FTD
J	270	JPRS
A	260	FTD
F	80	FTD

If both FTD and JPRS had had equal numbers of translations on either side of the median (55), their scores would each have been 1,925 (half of the total 3,850 points possible). Actually the JPRS translations scored 2,350 points and the FTD translations scored 1,500 points.

Concerning the absolute merit of these translations, some comments of editors might be informative:

Number 4. "I consider this (E-JPRS) a paper of average merit, which, from the standpoint of style and clarity, would be acceptable for publication in a technical scientific journal."

Number 4. "'What is it all about?' says paper F. What indeed! This one is hopeless."

Number 3. "(E and H) could be published as is or with very little rephrasing."

Number 2. "As scientific writing, C is acceptable, H,J,G, and E are fair and could be fixed up with a little editing. The rest go from poor to very poor."

Although the sample was too small to allow one to generalize with a great deal of confidence, the consensus of the editors concerning the relative worth (or worthlessness) of some of the translations (e.g., H and F) tends to increase one's confidence

in the findings of this study; i.e., the JPRS translations are somewhat better than the postedited machine translation, and the unedited rough-draft human translation is the worst of all.

This conclusion, when coupled with the report from the Government Printing Office (Exhibit 1) concerning the graphic arts quality of these samples, would tend to indicate that JPRS translations are superior to FTD translations.

Statistical reliability figures based on these ratings have been computed by Professor J. B. Carroll. They are as follows:

Kendall's W., a coefficient of concordance, based on the JPRS-FTD comparison ratings, is 0.724, well beyond the 0.001 level, but not as high as 1.00, the figure indicating perfect reliability.

The application of the Mann-Whitney U-test to the summed ratings gives a value of U=4.5. For the case where 5 values are being compared with 5 values, this is significant only with a probability between 0.096 and 0.15. This is not sufficiently significant to reject with any confidence the null hypothesis that the two sets of translation are drawn from the same population.

The summed ranks on which the Mann-Whitney test was based are as follows:

JPRS	FTD
H 13	(G) 24
C 19	(D) 41
E 22	(I) 50
B 46	(A) 51
J 50	(F) 69

EXHIBIT 1.

March 24, 1965

Dr. A. Hood Roberts, Executive Secretary
National Academy of Sciences
National Research Council
2101 Constitution Avenue
Washington, D.C. 20418

Dear Dr. Roberts:

In answer to your request for an evaluation of the quality of the printing of the translated material which you left with me, we have arrived at the following breakdown:

		Rating
1.	F	Satisfactory
2.	B,C,H,J	Fair
3.	G,E,D,A,I	Poor

Group 1: This is adequate perhaps only because it is double spaced and seems to be blacker than the rest of the submissions.

Group 2: The printing of these is very poor, although not so bad but what the text can be read. The difficulty here seems to be that there has been no attempt to maintain good ink coverage, or good quality camera work and platemaking. The presswork is particularly bad where smudges are permitted to appear across the printing.

Group 3: This group contains the illustrations. Most of them are evidently too many times removed from the original, or they were made from duplicator copies (Xerox, Ozalid, etc.) which always lose much of the detail. If the original copy had been used as camera copy, I am sure much better results could have been obtained. If the original copy was used, then the results are simply bad handling or inexperienced personnel. There seems to be little reason for reproductions as poor as this last group.

Sincerely yours,

JAMES L. HARRISON
Public Printer
By: Frank H. Mortimer
Typography and Design Manager
United States Government
Printing Office

Appendix 16

Government Support of Machine-Translation Research

NATIONAL SCIENCE FOUNDATION

Office of Science Information Services, Information Systems Program

1. Cambridge Language Research Unit

Grant Number	Date	NSF	Transferred	Total
GN 3398	3-29-57	$ 7,100	$ 20,000 (RADC)	$ 27,100
GN 4788	12-31-57	13,000	20,000 (RADC)	33,000
GN 8212	4-3-59	15,650	20,000 (RADC)	35,650
GN 8212.1	5-6-60	—	5,500 (RADC)	5,500
		$ 35,750	$ 65,500	$ 101,250

2. Georgetown University

Grant Number	Date	NSF	Transferred	Total
G 2723	6-29-56	$ 35,000	$ 65,000 (CIA)	$ 100,000
G 3867	6-6-57	35,000	90,000 (CIA)	125,000
G 5513	6-6-58	36,600	150,000 (CIA)	186,600
		$ 106,600	$305,000	$ 411,600

3. Harvard University

Grant Number	Date	NSF	Transferred	Total
GN 4982	1-31-58	$ 14,150	$ 15,000 (RADC)	$ 29,150
G 5514	6-6-58	26,200		26,200
G 6400	9-23-58	150,000	70,000 (RADC)	220,000
G 10636	12-11-59	100,000	100,000 (RADC)	200,000
G 15924	12-29-60	128,500	21,500 (RADC)	150,000
G 24833	6-30-62	160,160		160,160
GN 162	6-29-63	235,450		235,450
GN 329	6-25-64	240,500		240,500
		$1,054,960	$206,500	$1,261,460

4. Massachusetts Institute of Technology

Grant Number	Date	NSF	Total
G 1210	10-28-54	$ 18,700	$ 18,700
G 2044	10-25-55	24,800	24,800
G 3031	10-23-56	35,200	35,200
G 4378	9-30-57	41,400	41,400
G 6537	11-3-58	90,600	90,600
G 10130	10-26-59	126,000	126,000
G 16843	3-3-61	150,000	150,000
G 24047	6-6-62	225,000	225,000
GN 244	1-22-64	200,000	200,000
		$911,700	$911,700

5. University of California, Berkeley

Grant Number	Date	NSF	Total
G 6399	9-30-58	$ 40,500	$ 40,500
G 8737	6-12-59	57,600	57,600
G 14147	8-15-60	208,000	208,000
GN 92	2-1-63	249,000	249,000
GN 306	6-8-64	167,300	167,300
		$722,400	$722,400

6. Ohio State University

Grant Number	Date	NSF	Total
G 18609	6-16-61	$ 14,700	$ 14,700
G 25055	6-30-62	40,000	40,000
GN 174	6-24-63	100,000	100,000
		$154,700	$154,700

7. Wayne State University

Grant Number	Date	NSF	Total
GN 159	6-15-63	$200,000	$200,000
GN 430	6-11-65	244,000	244,000
		$444,000	$444,000

8. Ramo-Wooldridge

Contract Number	Date	NSF	Total
C 233	10-2-61	$119,477	$119,477

Thompson Ramo-Wooldridge

C 233 (Amend)	3-1-63	152,084	152,084
C 320	8-20-63	50,223	50,223

Bunker-Ramo Corp.

C 372	6-30-64	$240,000	$240,000
			$561,784

9. University of Texas

Grant Number	Date	NSF	Total
G 19277	8-18-61	$ 95,000	$ 95,000
GN 54	9-27-62	200,000	200,000
GN 208	10-24-63	150,000	150,000
GN 308	6-18-64	168,200	168,200
		$613,200	$613,200

10. University of Pennsylvania

Grant Number	Date	NSF	Total
G 3027	10-16-56	$ 1,950	$ 1,950
G 3397	2-1-57	24,300	24,300
G 4981	2-15-58	42,300	42,300
G 6538	10-24-58	31,450	31,450
G 8217	6-15-59	321,800	321,800
G 17446	4-28-61	180,400	180,400
G 24340	6-5-62	346,000	346,000
GN 311	6-11-64	414,000	414,000
		$1,362,200	$1,362,200

11. National Bureau of Standards

Grant Number	Date	NSF	Total
G 17815	6-7-61	$ 15,000	$ 15,000
G 19659	10-3-61	73,000	73,000
GN 107	3-26-63	75,000	75,000
GN 320	6-29-64	58,200	58,200
		$221,200	$221,200

12. University of Chicago (Yngve)

Grant Number	Date	NSF	Total
GN 412	5-22-65	$294,000	$294,000

13. National Academy of Sciences, Automatic Language Processing Advisory Committee

Contract Number	Date	NSF	Transferred	Total
C 310	4-20-64	$19,000	$20,000 (CIA)	$59,000
T. O. 80			20,000 (RADC)	
		$19,000	$40,000	$59,000

14. Linguistic Society of America, MIT (Conference)

Grant Number	Date	NSF	Total
G 11302	2-8-60	$15,000	$15,000

15. Wayne State University (Conference)

Grant Number	Date	NSF	Transferred	Total
G 12887	5-12-60	$3,938	$1,000 (ONR)	$ 4,938
G 15859	12-16-60	3,328		3,328
G 22890	3-27-62	357	5,000 (RADC)	5,357
		$7,623	$6,000	$13,623

16. Massachusetts Institute of Technology (Conference)

Grant Number	Date	NSF	Total
G 2337	5-1956	$1,059	$1,059
G 2888	10-1956	5,351	5,351
		$6,410	$6,410

17. University of Washington

Grant Number	Date	NSF	Total
G 13579.1	FY-62	$ 1,000	$ 1,000
G 13579	FY-60	53,700	53,700
		$54,700	$54,700

TOTAL NSF SUPPORT: $6,585,227

TOTAL TRANSFERRED FUNDS: $623,000

CENTRAL INTELLIGENCE AGENCY

Georgetown University

Grant Number	Date	Total
NSF G 5513	6-6-58	$ 9,890
Supplement		
XG 2230	7-1-59	24,979
XG 2239	7-16-59	153,000
XG 2312	7-1-60	439,000
XG 2427	9-1-61	438,000
Supplement to 3-31-63		250,000
		$1,314,869

Note: Other CIA funds in support of the Georgetown machine-translation project (amounting to $205,000) were transferred to NSF. See above.

DEPARTMENT OF DEFENSE

1. United States Air Force

Fiscal Year	
1956	$ 400,000
1957	700,000
1958	800,000
1959	1,500,000
1960	1,400,000
1961	927,000
1962	561,000
1963	600,000
1964	2,045,000
1965	680,000
Total	$9,613,000

2. United States Navy

Fiscal Year	
1953-1960	$ 416,600
1961	50,000
1962	75,000
1963	130,000
1964	150,000
1965	150,000
Total	$ 971,600

3. United States Army

Fiscal Year	
1958-1959	$ 184,000
1960	223,000
1961	225,000
1962	110,000
1963	175,000
1964	230,000
1965	175,000
Total	$1,322,000

TOTAL DEPARTMENT OF DEFENSE SUPPORT: $11,906,600

DOD	$11,906,600
CIA	1,314,869
NSF	6,585,227
GRAND TOTAL	$19,806,696

The Committee feels that these data form the best estimate now available of government expenditures in support of machine-translation research. Other estimates could be obtained, however, depending on the extent to which one would include or exclude funds for the support of work in related areas of data processing and information technology and the costs of the operation of the Foreign Technology Division mechanical translation facility. Criteria for what constituted support of mechanical translation research were determined by the individual sponsors.

Appendix 17

Computerized Publishing

In the past 3 years, since the first, and unsuccessful, attempt to use computerized typesetting in newspaper production, the advances in this technology have been such that about 200 computers are now in use in or on order by the printing business throughout the world. Nearly all the major U.S. computer manufacturers have entered this field, and competition for the market is keen.

Although newspapers have been the primary practitioners of computerized printing, book manufacturers and government agencies have also begun computerized operations. In its newspaper application, a typical system would consist of the following operations:

1. The reporter types his copy in the customary way except that in certain systems the output consists of a punched paper tape in addition to the usual hard copy.
2. The editor indicates on the hard copy what changes he desires to be made.
3. If the reporter's output was a punched tape, only the necessary corrections are punched up. If only the hard copy exists, it is punched up incorporating the editor's corrections.
4. The edited punched paper tape is fed into the computer, where words are hyphenated and lines are justified automatically.
5. The punched tape (sometimes magnetic tape) output from the computer is then used to operate linecasting or photocomposition machines.
6. Subsequent operations are essentially no different from those in the conventional printing process.

LINE JUSTIFICATION

The computer is well adapted for the type of computation needed for the justification of printed lines. By simply adding the width of the characters and spaces in each line and comparing the sum with the column width, the computer is able to apply the

proper spacing techniques (e.g., insertion of thin spaces, ens, ems, or hyphenation) for justification.

WORD DIVISION

Word division still poses a problem in that the two most widely used methods ("logic" and "dictionary look-up") each have certain disadvantages. The logical method, owing to the completely arbitrary nature of English syllabification rules, cannot attain 100 percent accuracy. The dictionary look-up method requires a much larger computer memory than the logical method. Since it is unlikely that the disadvantages of either method can be completely overcome, an entirely different approach has gained the favor of some. This system, to be in operation next year at the CIA's Printing Services Division, justifies without word division hyphenation by using a photocomposer to vary the set size of the type. Exhibit 1 shows an 80 percent reduction of the standard Government Printing Office format, which in its original form is 20 picas wide and set in 10 point Modern at 10 1/2 set. It contains 15 hyphens. Exhibit 2 is the same job reset using a choice of set sizes. No word division hyphenation has been necessary. Exhibit 3 is the same as Exhibit 2 with bullets next to the lines where alternate set sizes were used.

ADVANTAGES OF COMPUTERIZED PRINTING

Some of the advantages that have been mentioned by the users of this method of printing are:

1. improved output by typists resulting from elimination of the spacing and hyphenation decisions,
2. reduction of time needed to train new perforator operators,
3. more efficient use of linecasting machines,
4. the ability to set closer deadlines, and
5. increase in production.

PHOTOCOMPOSITION

In the future, photocomposing machines will have to be used in order to take full advantage of the computer. The fastest linecasting machines are capable of an output of only 15 newspaper lines a minute, whereas the newest photocomposing machines are capable of printing 1,000-2,000 lines a minute.

EXHIBIT 1

Section II. COMBAT SUPPORT

46. General

This section generally covers organic and normal supporting units of mechanized infantry and armored brigades. Nonorganic combat support units available to brigades in the support role include tactical air support; Army aviation; and artillery, chemical, engineer, and ground transportation units. An appropriate number of mechanized infantry battalions and tank battalions are attached to the brigade headquarters according to the operation plan.

47. Tactical Air Support

a. General. The flexibility and long-range striking power of tactical air makes it an important means of destroying the enemy. Superiority in the air, or at least relative freedom of action, is a predominant factor in securing success in desert operations. Tactical air power has three general missions: gaining air superiority, interdicting the battle area, and providing close support. These are inherent in joint air-ground operations and apply equally to desert operations. Since desert areas produce little upon which a military force can survive, extensive supply transportation is necessary. The entire enemy transport network is analyzed as a target system and attacked accordingly. Attacks are directed against rail centers, locomotive repair installations, and ports, if they exist. When the function of these transportation facilities is reduced, and the flexibility of the system is thus impaired, attacks are made on the means of transport such as locomotives (with rolling stock) and surface shipping. Then attention is directed to the last link of the transport system—motor convoys and transshipment installations.

b. Close Support Operations. The lack of concealment, great distances involved, and mobility of forces—each characteristic of desert operations—necessitate increased emphasis on the employment of tactical air in close support of ground operations. The lack of natural cover and concealment makes for ease of target location and provides better than normal conditions for high-level bombing. Installations stand out due to the contrast between regularly shaped objects and the open barrenness of the desert. Movement is readily apparent from the air because of the dust created and the prominence of shadows. Low-level attacks are handicapped by lack of covered approaches; however, this is offset by the increased visibility which enables aircraft to initiate their firing runs from a greater distance. This improved visibility, coupled with the rapid movement, lack of prominent terrain features, and the fluid situations characteristic of desert operations, necessitates positive action to identify friendly

EXHIBIT 2

Section II. COMBAT SUPPORT

46. General

This section generally covers organic and normal supporting units of mechanized infantry and armored brigades. Nonorganic combat support units available to brigades in the support role include tactical air support; Army aviation; and artillery, chemical, engineer, and ground transportation units. An appropriate number of mechanized infantry battalions and tank battalions are attached to the brigade headquarters according to the operation plan.

47. Tactical Air Support

a. General. The flexibility and long-range striking power of tactical air makes it an important means of destroying the enemy. Superiority in the air, or at least relative freedom of action, is a predominant factor in securing success in desert operations. Tactical air power has three general missions: gaining air superiority, interdicting the battle area, and providing close support. These are inherent in joint air-ground operations and apply equally to desert operations. Since desert areas produce little upon which a military force can survive, extensive supply transportation is necessary. The entire enemy transport network is analyzed as a target system and attacked accordingly. Attacks are directed against rail centers, locomotive repair installations, and ports, if they exist. When the function of these transportation facilities is reduced, and the flexibility of the system is thus impaired, attacks are made on the means of transport such as locomotives (with rolling stock) and surface shipping. Then attention is directed to the last link of the transport system—motor convoys and transshipment installations.

b. Close Support Operations. The lack of concealment, great distances involved, and mobility of forces—each characteristic of desert operations—necessitate increased emphasis on the employment of tactical air in close support of ground operations. The lack of natural cover and concealment makes for ease of target location and provides better than normal conditions for high-level bombing. Installations stand out due to the contrast between regularly shaped objects and the open barrenness of the desert. Movement is readily apparent from the air because of the dust created and the prominence of shadows. Lowlevel attacks are handicapped by lack of covered approaches; however, this is offset by the increased visibility which enables aircraft to initiate their firing runs from a greater distance. This improved visibility, coupled with the rapid movement, lack of prominent terrain features, and the fluid situations characteristic of desert operations, necessitates positive action to identify friendly.

EXHIBIT 3

Section II. COMBAT SUPPORT

46. General

10—● This section generally covers organic and normal supporting units of mechanized infantry and armored brigades. Nonorganic combat support units available to brigades in the support role include tactical air support; Army aviation; and
11—● artillery, chemical, engineer, and ground transportation units. An appropriate number of
10—● mechanized infantry battalions and tank battalions are attached to the brigade headquarters according to the operation plan.

47. Tactical Air Support

a. General. The flexibility and long-range
10—● striking power of tactical air makes it an important means of destroying the enemy. Superiority in the air, or at least relative freedom of action, is a predominant factor in securing success in desert operations. Tactical air power has three general missions: gaining air superiority, interdicting the battle area, and providing close support. These are inherent in joint air-ground operations and apply equally to desert operations. Since desert areas produce little upon which a military force can survive, extensive supply transportation is necessary. The entire enemy transport network is
11—● analyzed as a target system and attacked accordingly. Attacks are directed against rail centers, locomotive repair installations, and ports, if they exist. When the function of these ●—11 transportation facilities is reduced, and the flexibility of the system is thus impaired, attacks are made on the means of transport such as locomotives (with rolling stock) and surface shipping. Then attention is directed to the last link of the transport system—motor convoys and transshipment installations.

b. Close Support Operations. The lack of ●—10 concealment, great distances involved, and mobility ●—10 of forces—each characteristic of desert operations— necessitate increased emphasis on the employment ●—10 of tactical air in close support of ground operations. The lack of natural cover and concealment makes for ease of target location and provides better than ●—11 normal conditions for high-level bombing. Installations stand out due to the contrast between ●—10 regularly shaped objects and the open barrenness of the desert. Movement is readily apparent from the air because of the dust created and the prominence of shadows. Lowlevel attacks are handicapped by lack of covered approaches; however, this is offset by the increased visibility which enables aircraft to initiate their firing runs from a greater distance. This improved visibility, coupled with the rapid movement, lack of ●—11 prominent terrain features, and the fluid situations characteristic of desert operations, necessitates positive action to identify friendly.

Appendix 18

Relation Between Programming Languages and Linguistics

EFFECT OF LINGUISTICS ON PROGRAMMING

This effect varies from period to period of programming history (which is very short). In pre-Fortran times the effect was almost nil since all programming was in machine language and almost all computation was scientific.

In the period from Fortran to ALGOL (1956-1960) the connection was almost totally terminological: words and definitions, but not theory and technique, were borrowed from linguistics, for example, grammar and syntax. The real link was between programming and mathematical logic, as witness the development of ADES language[1] based on recursive functions and the development of several Polish prefix-oriented languages. Syntax analysis during this period was a collection of ad hoc techniques. Thus the paper by Sheridan on Fortran[2] is enormously complex. Descriptions of even more complex grammars are much more clearly understandable today.

The period from ALGOL to the present shows intense borrowing of current mathematical linguistic theory, technique, and notation. The source of this dependency can be traced to the definition of ALGOL 60 syntax production notation. The similarity between this notation and the rewriting rules of some linguistic models caused this theory to be rapidly employed in programming. Still, it is important to note that the definition of the ALGOL language was totally inspired by programming considerations (Fortran, LISP), and not linguistic ones.

The effect of this syntax formalism has been enormous and all to the good. Thus ALGOL syntax is "essentially" of Type 2. Hence, parsing mechanisms for Type 2 languages can be applied in the construction of ALGOL translators. Many of the parsing techniques employed were, however, discovered by programmers operating in parallel to, but independent of, similar developments in mathematical linguistics.

The existence of a theory has made it possible to define variations on a given grammar that permit the same task specification but in a grammar more efficiently parsed (one push-down stack instead of many, no retracing of paths in a tree of syntax choices), for example, precedence grammars.

Certainly it is now the case that the design of programming languages follows a more rational procedure than before because of mathematical linguistics, and proceeds in the following steps:

A. A set of tasks is isolated and their informal algorithmic descriptions are specified.

B. The data structures inherent in this class of problems are isolated and appropriate computer representations are defined.

C. The natural operators on the data are isolated.

D. A grammar of increasingly complex units is specified, e.g., atoms, expressions, statements, and programs.

E. A parser-recognizer is constructed for the grammar.

F. The steps D and E are iterated until a reasonable mixture of flexibility and efficiency is attained.

G. A semiformal statement of the evaluation of algorithms described in this language is given, which becomes the basis for a translation process taking this language into some other given language (usually machine code).

It is now possible to teach syntax analysis of programming languages, i.e., the basic knowledge is now available in an organized form.

It is now possible to construct programs that are general-purpose syntax analysers in the sense that they parse any programming language of a given type.

EFFECT OF PROGRAMMING ON LINGUISTICS

Since programming is an "applied" activity and linguistics a more abstract one, programming has provided linguistics with "real" models that are sufficiently complicated to permit the development of diverse theories.

Programming has also led to the definition of linguistic models possessing a theory of their own[3] and specifically tailored for use as programming languages.[4]

The existence of a body of technique in programming has made it possible to develop special programming languages for solving certain linguistic problems, e.g., SNOBOL[5] and COMIT.[6]

Similarly, programming, being concerned with a growing set of demands, provides a pressure on linguistic theory directing it toward problems particularly relevant to computation, e.g., problems of efficiency of representation and speed of computation.

FUTURE RELATIONSHIP BETWEEN PROGRAMMING AND LINGUISTICS

In programming there will be concentration on developing theories of evaluation, i.e., what is meant by the execution of a program written in language $\mathcal{L}$? We may call this the sematics of $\mathcal{L}$. Such studies will replace the present ad hoc development of compiler-compilers with a theory of their properties and more insight into the design of computing machines. This is the translation problem for computer languages.

These languages will become sufficiently complex so that a theory of their semantics or evaluation will be a sufficiently interesting model for the equivalent problems arising in natural language translation.

Similarly, there will be a reverse flow from the development of semantic theories within natural linguistics into mathematical linguistic models, which, in turn, will influence programming.

REFERENCES

1. E. K. Blum, "Automatic Digital Encoding System," NAVORD Rep. 4411 (1956).
2. P. B. Sheridan, "The Arithmetic Translator-Compiler of the IBM Fortran Automatic Coding System," Commun. Assoc. Computing Mach. 2, 9 (1959).
3. S. Ginsburg and R. H. Gordon, "Two Families of Languages Related to ALGOL," J. Assoc. Computing Mach. 9, 350 (1962).
4. R. W. Floyd, "Syntactic Analysis and Operator Precedence," J. Assoc. Computing Mach. 10, 316 (1964).
5. D. J. Farber, R. E. Griswold, and I. P. Polonsky, "SNOBOL, A String Manipulation Language," J. Assoc. Computing Mach. 11, 21 (1964).
6. The Research Laboratory of Electronics and the Computation Center, COMIT Programmers Reference Manual, 2nd ed., The M.I.T. Press, Cambridge, Mass. (1962).

BIBLIOGRAPHY

1. R. W. Floyd, IEEE Trans. Electron. Computers 13, 346 (1964). This bibliography includes subjects related to the syntax of programming languages insofar as they illuminate the problems of analysis and synthesis of formally defined programming languages.

Appendix 19

Machine Translation and Linguistics

The advent of computational linguistics promises to work a revolution in the study of natural languages. Hockett is fond of the appellation "computer revolution" or "third human revolution" for the events that are engulfing us [see C. F. Hockett and R. Ascher, "The Human Revolution," Current Anthropol. 5, 135 (1964)]. There was speech, making the aggregate of codwelling animals a conglomerate tribe. There was the tool, the lever with which mankind moved the world. And now there is the computer, the first powerful manipulator of symbols outside the human head. Whether the computer is as great an invention as the first artefact, or only the first intellectual tool, its potential for linguistics is already profound. It can change the level of analysis of natural languages, as the microscope changed biology. It facilitates mathematization as it has aided physics. And it has linked theory, empirical studies, and, perhaps, practical application. Mel'chuk says that computational linguistics is not a field of linguistics, a subspecialty for those who like computation; it is a technique inescapable for any linguist who honors his discipline. In O. S. Akhmanova, I. A. Mel'chuk, R. M. Frumkina, and E. V. Paducheva, Exact Methods in Linguistic Research, University of California Press, Berkeley (1963), p. 46 we read, "MT is simultaneously both a workshop, where the methods of precise linguistic research are perfected independently of the concrete sphere of application of these methods, and an experimental field, where the results are verified by experience."

Much of the recent change in linguistics has come from clarification gained through formalizing disciplines, and these changes are surely connected with the developments underlying computer studies, as well as with trends in the growth of contemporary logic and philosophy. Though it seems clear that the computer was not at the center of most of this in a direct causal fashion, it has surely played a significant role, both of interplay and as a tool for validation.

Surely the most dramatic recent changes have been caused by Chomsky [see, for example, Proc. 9th Internatl. Cong. of Linguistics, Cambridge, Mass., 1962, Mouton and Company, The Hague Netherlands (1964)] and similar thinkers, and they have explicitly had little to do directly with computers (see page 922 of the above-mentioned Proceedings). The fundamental changes that they have brought to linguistics inhere rather in an altered view taken by linguistics of the nature of science, of a scientific theory, and of the relation of empiricism to science. But these changes have been brought about and spurred on not by scholars who live and work in vacuo, but with a good deal of cross-fertilization from areas in close touch with computational activities, and even with machine translation.

Moreover, the depth of syntactic analysis has changed. A decade ago, most linguists believed that syntax had to do with word order, inflection, function words (e.g., prepositions and conjunctions), and intonation or punctuation. They also believed that most sentences uttered by native speakers in ordinary contexts were syntactically, even if not semantically, unambiguous. The important difference in their belief of that time was that they thought syntax related only to the surface structure, the visible or audible configurations of the output, and they denied by and large that process-type statements relating to rules that worked on underlying abstract expressions were properly a part of grammar. There can be no doubt that experiments in computer parsing of ordinary sentences, using reasonable grammars as hitherto conceived and programs that expose all ambiguities, have greatly helped many linguists to abandon their earlier inadequate syntactic views. A recent and accessible account of these ambiguities is that of R. A. Langevin and M. F. Owens ["Computer Analysis of the Nuclear Test Ban Treaty," Science 146, 1186 (1964)]. They use the Kuno-Oettinger parser.

While it is true that a very new view of syntax has grown up, the interesting result has been that within the last 3 years or so, interest among generative grammarians has been perhaps as lively on questions of phonology as it has come to be on syntax. In fact, this is a natural consequence if one views a grammar as a total set of ordered rules, with components (e.g., phrase-structure and transformational) simply differentiated by type of rule, rather than a set of levels differentiated by the phenomena to which they severally apply, and from which one can then make a choice for the application of one's analytic efforts based on taste.

Mathematical linguistics would have had no significance in 1686, if Newton had invented it. The slide rule was the perfect mathematical machine for mechanics and many other branches of

physics; with pencil and paper and a slide rule, general theories could be solved abstractly for special cases, and specific examples worked out for observed or proposed parameters. Of course, other branches of physics could not progress far without massive digital calculations: the study of nuclear reactions, for example, or of crystal structure. All of linguistics falls in the latter category. When a mathematical structure is promulgated as a linguistic model, its specific correspondence with any one natural language can be tested, in a serious way, only by the examination of many strings that it generates as sentences [several transformationalists have tried this technique, but the only publications known to use are by V. H. Yngve and his students; e.g., his Random Generation of English Sentences," in 1961 International Conference on Machine Translation of Languages and Applied Language Analysis, H.M. Stationery Office, London (1962), pp. 65-82], or, conversely, by the study of the structures that it assigns to naturally occurring sentences. This plan has been tried many times. The situation is reviewed by D. G. Bobrow, in his paper "Syntactic Analysis of English by Computer—A Survey," in AFIPS Conference Proceedings, Spartan Books, Baltimore, Md. (1963), Vol. 24. Only a high-speed automatic computer (i.e., symbol manipulator) can serve adequately in empirical tests of such theories.

Even today there are linguistic theoreticians who take no interest in empirical studies or in computation. There are also empirical linguists who are not excited by the theoretical advances of the decade—or by computers. But more linguists than ever before are attempting to bring subtler theories into confrontation with richer bodies of data, and virtually all of them, in every country, are eager for computational support.

If ever a machine-aided simulation of total linguistic analysis-synthesis (or voice-to-ear-to-voice translation) becomes possible, it will not be because of adherence to the type of linguistic theory widely current around 1950.

There can be no doubt that the disappointingly slender computer results realized on the basis of such theory must have been important in shaking at least some inquisitive linguists out of their contentment. If machine translation had various negative results, this was one that was potent in a singularly fruitful way.

Appendix 20

Persons Who Appeared Before the Committee

June 2-3, 1964

Edmund Glenn, Department of State
Jules Mersel, Bunker-Ramo Corporation

September 30 - October 1, 1964

Franklin Clark, President, Language Service Bureau, Inc.
Theodore Schaeffer, Free-lance translator
Kurt Gingold, President, American Translators Association
Howard Steensen, Translation Director, F. W. Dodge Company
Thomas Miller, Director, Joint Publications Research Service
Charles Zalar, National Science Foundation

December 9-10, 1964

Vincent Giuliano, Arthur D. Little, Inc.
Stephen Pollock, Arthur D. Little, Inc.
Ernest R. Sohns, National Science Foundation

March 17-18, 1965

Paul L. Garvin, Bunker-Ramo Corporation
Gilbert King, The Itek Corporation
J. C. R. Licklider, The IBM Corporation
David Lieberman, The IBM Corporation
Warren Strohm, The IBM Corporation
Winfred P. Lehmann, The University of Texas

OFFICIAL USE ONLY

AGENDA
PRESIDENT'S SCIENCE ADVISORY COMMITTEE
Room 208, Old Executive Office Building
October 16-17, 1972

Monday, October 16

Item 1
9:30 - 12:00 — Energy Policy Issues - R. Balzhiser

Lunch
12:00 - 1:00 — Executive Dining Room
Room 22 EOB

Item 2
1:00 - 3:00 — PSAC Panel Activities and Status Reports on Selected Panels

Educational Research and Development - J. Truxal
Training for Research in Biomedical Sciences -
L. H. Smith, Jr.
Space Science and Technology - H. Friedman
Strategic Military Panel - V. Fitch

Item 3
3:00 - 5:30 — Chairman's Report

a. Status of Preparations for Meeting of the US-USSR Joint Commission on Scientific and Technical Cooperation

b. Further Discussions of Federal Science and Technology Organization

c. The Federal Advisory Committee Act (H. R. 4383)

Tuesday, October 17

Item 4
9:00 - Russian Language Machine Translation - Representatives of the Foreign Technology Division, Air Force Systems Command, Wright Patterson AFB, et al.

Lunch
12:00 - 1:00

Item 1 (Continued)
1:00 - 3:30 — Chairman's Report

a. Further Discussion of Agenda Items
b. PSAC Membership
c. PSAC Future Work Program