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96-79 **AUTHORIZATIONS FOR NBS**

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HEARING
BEFORE THE
SUBCOMMITTEE ON
SCIENCE, TECHNOLOGY, AND SPACE
OF THE
COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE
NINETY-SIXTH CONGRESS



SECOND SESSION

ON

S. 2320

TO AUTHORIZE APPROPRIATIONS TO THE SECRETARY OF COMMERCE
FOR THE PROGRAMS OF THE NATIONAL BUREAU OF STANDARDS,
INCLUDING CERTAIN SPECIAL STATUTORY PROGRAMS, AND
FOR OTHER PURPOSES

MARCH 12, 1980

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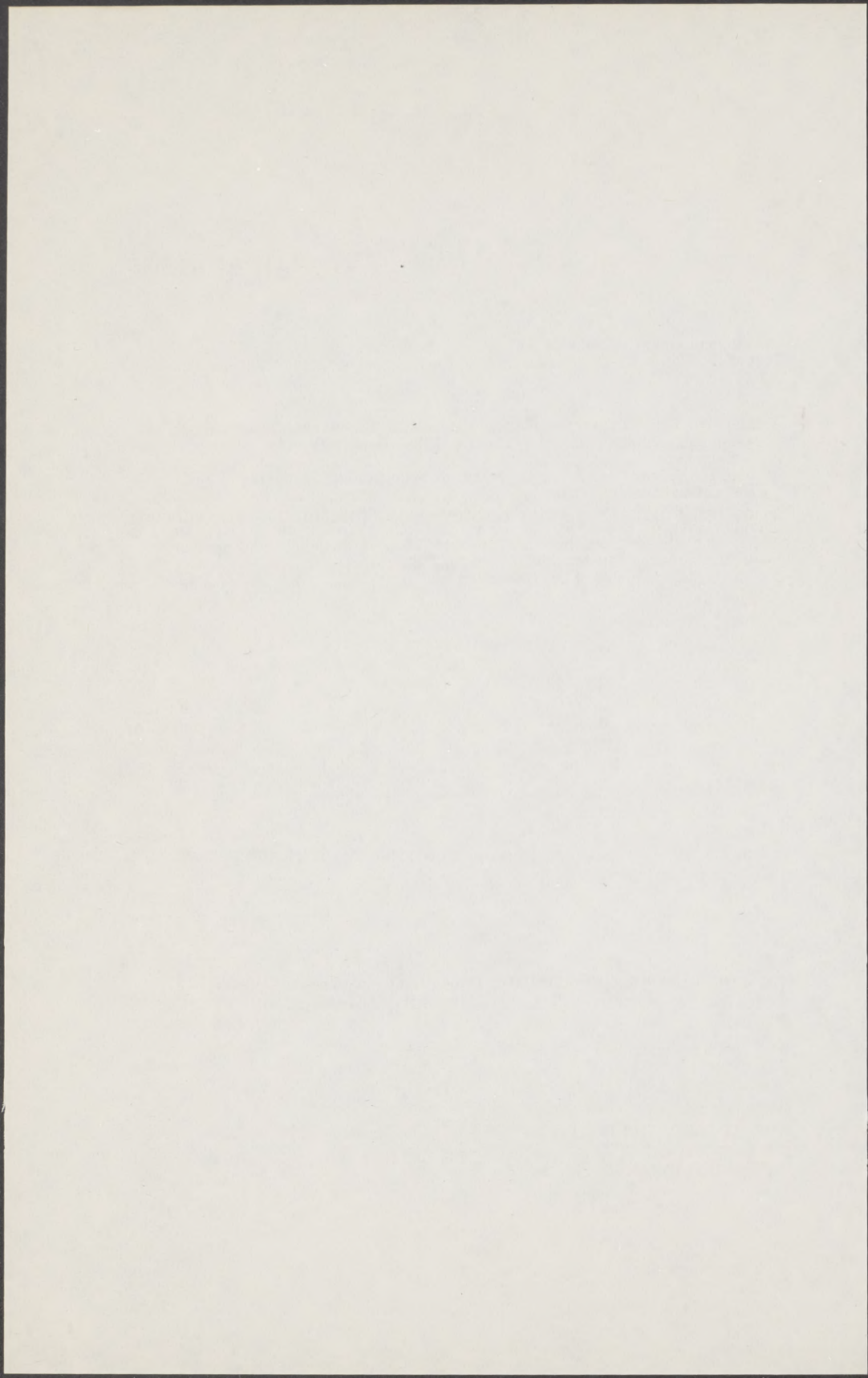
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(III)



AUTHORIZATIONS FOR THE NATIONAL BUREAU OF STANDARDS—FISCAL YEARS 1981 AND 1982

WEDNESDAY, MARCH 12, 1980

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND SPACE,
Washington, D.C.

The subcommittee met at 9:40 a.m., in room 235, Russell Senate Office Building, Hon. Adlai E. Stevenson (chairman of the subcommittee) presiding.

OPENING STATEMENT BY SENATOR SCHMITT

Senator SCHMITT [presiding]. The hearing will come to order. Senator Stevenson will be here shortly. He asked me to begin this morning. The subcommittee will examine the fiscal year 1981 authorization request for the National Bureau of Standards.

Our witnesses are Dr. Jordan Baruch, Assistant Secretary for Science and Technology, the Department of Commerce; Dr. Ernest Ambler, Director, National Bureau of Standards, Department of Commerce; Dr. W. Dale Compton, vice president, research, Ford Motor Co.; and Dr. Mildred S. Dresselhaus, director, center for materials science and engineering at MIT.

The National Bureau of Standards is the Nation's oldest national laboratory, and it is always a privilege to review the health and status of the Bureau and its contributions to our national scientific and technological base.

I think there are concerns that we must have about the Bureau. I have stated before my concerns in the past about reports of low morale, for a variety of purposes in some areas, insufficient funding for the purposes for which it is chartered, possibly some declining capability in the scientific base of the Bureau, claims that the scientific reputation is deteriorating in the Bureau, and insufficient attention to long-term research. I might add to that list a concern that the Department of Energy and possibly other agencies don't pay any attention to the Bureau when they make recommendations on scientific or technical work of various proposals put before them. I suspect that is more of a problem of the Department of Energy than it is the Bureau of Standards, but nevertheless I think it's something we need to address.

[The bill follows:]

96TH CONGRESS
2D SESSION

S. 2320

To authorize appropriations to the Secretary of Commerce for the programs of the National Bureau of Standards, including certain special statutory programs, and for other purposes.

IN THE SENATE OF THE UNITED STATES

FEBRUARY 20 (legislative day, JANUARY 3), 1980

Mr. CANNON (by request) introduced the following bill; which was read twice and referred to the Committee on Commerce, Science, and Transportation

A BILL

To authorize appropriations to the Secretary of Commerce for the programs of the National Bureau of Standards, including certain special statutory programs, and for other purposes.

1 *Be it enacted by the Senate and House of Representa-*
2 *tives of the United States of America in Congress assembled,*
3 That this Act may be cited as the "National Bureau of
4 Standards Authorizations of Appropriations Act for Fiscal
5 Years 1981 and 1982".

1 AUTHORIZATIONS FOR ACTIVITIES UNDER THE ACT OF
2 MARCH 3, 1901

3 SEC. 2. (a) There are hereby authorized to be appropri-
4 ated to the Secretary of Commerce to carry out activities
5 performed by the Bureau under the Act of March 3, 1901, as
6 amended (15 U.S.C. 271-278h), except section 16 thereof
7 (15 U.S.C. 278f), \$87,733,000 together with such sums as
8 may be necessary for increases resulting from adjustments in
9 salary, pay, retirement, other employee benefits required by
10 law, and for other nondiscretionary costs for fiscal year 1981,
11 and such sums as may be necessary for fiscal year 1982.

12 (b) Section 16 of the Act of March 3, 1901, as amended
13 (15 U.S.C. 278f), is further amended by adding at the end
14 thereof a subsection (c) to read as follows: "(c) For the pur-
15 poses of this section, there are authorized to be appropriated
16 to the Secretary of Commerce \$1,253,000 together with
17 such sums as may be necessary for increases resulting from
18 adjustments in salary, pay, retirement, other employee bene-
19 fits required by law, and for other nondiscretionary costs for
20 fiscal year 1981, and such sums as may be necessary for
21 fiscal year 1982."

22 (c) Section 18 of the Act of March 3, 1901, as amended
23 (15 U.S.C. 278h), is further amended by: (1) repealing sub-
24 section (b); and (2) removing the designation "(a)" from the
25 remaining paragraph.

1 AUTHORIZATIONS FOR ACTIVITIES UNDER OTHER
2 STATUTES

3 SEC. 3. (a) There are authorized to be appropriated to
4 the Secretary of Commerce \$15,390,000 together with such
5 sums as may be necessary for increases resulting from adjust-
6 ments in salary, pay, retirement, other employee benefits re-
7 quired by law, and for other nondiscretionary costs for fiscal
8 year 1981, and such sums as may be necessary for fiscal year
9 1982 to carry out the activities specified for performance by
10 the Secretary or the Bureau in:

11 (1) section 111(f) of the Federal Property and Ad-
12 ministrative Services Act of 1949, as amended (40
13 U.S.C. 759(f));

(2) sections 5 (d) and (e), 8 and 9(a) of the Fair Packaging and Labeling Act (15 U.S.C. 1454 (d) and (e), 1457 and 1458(a));

(3) section 383(c) of the Energy Policy and Conservation Act, as amended (42 U.S.C. 6363(c));

19 (4) section 5002 of the Solid Waste Disposal Act,
20 as amended (42 U.S.C. 6952);

(5) section 5(d) of the Earthquake Hazards Re-
duction Act of 1977 (42 U.S.C. 7704(d)); and

23 (6) title IV of the Trade Agreements Act of 1979
24 (19 U.S.C. 2531-2573).

1 (b) There are authorized to be appropriated to the Sec-
2 retary of Commerce to carry out research by the Bureau in
3 the area of environmental measurement sciences \$245,000
4 together with such sums as may be necessary for increases
5 resulting from adjustments in salary, pay, retirement, other
6 employee benefits required by law, and for other nondiscre-
7 tionary costs for fiscal year 1981, and such sums as may be
8 necessary for fiscal year 1982.

9 (c) There are authorized to be appropriated to the Sec-
10 retary of Commerce to carry out the purposes of the Stand-
11 ard Reference Data Act (15 U.S.C. 290-290f) such sums as
12 may be necessary for fiscal year 1982.

13 FACILITIES IMPROVEMENT

14 SEC. 4. The Act of March 3, 1901, as amended (15
15 U.S.C. 271-278h), is further amended by striking the figure
16 "\$75,000" in section 14 of such Act (15 U.S.C. 278d) and
17 inserting in lieu thereof the figure "\$250,000".

18 INTERNATIONAL ACTIVITIES

19 SEC. 5. In order to develop and strengthen the Depart-
20 ment of Commerce's expertise in science and engineering, to
21 enhance the Secretary's ability to maintain the Department's
22 programs at the forefront of worldwide developments in sci-
23 ence and engineering, and to cooperate in international scien-
24 tific activities, the Act of March 3, 1901, as amended (15
25 U.S.C. 271-278h), is further amended by adding immedi-

1 ately after section 16 (15 U.S.C. 278f) a new section 17 to
2 read as follows:

3 “SEC. 17. (a) The Secretary is authorized, notwith-
4 standing any other provision of law, to expend such sums,
5 within the limit of appropriated funds, as the Secretary may
6 deem desirable, through the grant of fellowships or any other
7 form of financial assistance, to defray the expenses of foreign
8 nationals not in service to the Government of the United
9 States while they are performing scientific or engineering
10 work at agencies of the Department of Commerce or partici-
11 pating in the exchange of scientific or technical information
12 at agencies of the Department of the Commerce.

13 “(b) The Congress consents to the acceptance by an
14 employee of the Department of Commerce of fellowships,
15 lectureships, or other positions for the performance of scien-
16 tific or engineering activities or for the exchange of scientific
17 or technical information, offered by a foreign government,
18 and to the acceptance and retention by an employee of the
19 Department of Commerce of any form of financial or other
20 assistance provided by a foreign government as compensation
21 for and/or to defray the expenses associated with performing
22 scientific or engineering activities or exchanging scientific or
23 technical information, when the acceptance of such fellow-
24 ship, lectureship, or position or the acceptance and retention
25 by an employee of such assistance is determined by the Sec-

1 retary to be appropriate and consistent with the interests of
2 the United States. For the purposes of this subsection, the
3 definitions appearing in subsection 7342(a) of title 5 of the
4 United States Code apply. Civil actions may be brought and
5 penalties assessed against any employee who knowingly ac-
6 cepts and retains assistance from a foreign government not
7 consented to by this subsection in the same manner as pre-
8 scribed by subsection 7342(h) of title 5 of the United States
9 Code.

10 “(c) Provisions of law prohibiting the use of any part of
11 any appropriation for the payment of compensation to any
12 employee or officer of the Government of the United States
13 who is not a citizen of the United States, shall not apply to
14 the payment of compensation to scientific or engineering per-
15 sonnel of the Department of Commerce.”.

16 ACTIVITIES PERFORMED FOR OTHER AGENCIES

17 SEC. 6. The Secretary of Commerce shall charge for
18 any service performed by the Bureau, at the request of an-
19 other Government agency, in compliance with any statute,
20 enacted before, on, or after the date of enactment of this Act,
21 which names the Secretary or the Bureau as a consultant to
22 another Government agency, or calls upon the Secretary or
23 the Bureau to support or perform any activity for or on behalf
24 of another Government agency, or to cooperate with any
25 Government agency in the performance by that agency of

1 any activity, regardless of whether the statute specifically
2 requires reimbursement to the Secretary or the Bureau by
3 such other Government agency for such service, unless funds
4 are specifically appropriated to the Secretary or the Bureau
5 to perform such service. The Secretary may, however, waive
6 any charge where the service rendered by the Bureau is such
7 that the Bureau will incur only nominal costs in performing
8 it. Costs shall be determined in accordance with section 12(e)
9 of the Act of March 3, 1901, as amended (15 U.S.C.
10 278b(e)).

Senator SCHMITT. From my review of the statements submitted by today's witnesses, I am encouraged by the optimism in those statements. Hopefully it is well based, and, Dr. Baruch, if you would like to convince me that it's well based, I would like to hear from you. Please proceed. You may summarize, as you desire, and your complete statement will be part of the record.

**STATEMENT OF DR. JORDAN BARUCH, ASSISTANT SECRETARY
FOR SCIENCE AND TECHNOLOGY, DEPARTMENT OF COM-
MERCE**

Dr. BARUCH. Thank you, Senator Schmitt. I would like to submit my statement for the record, and indeed summarize it.

You mentioned optimism, and this year I am pleased to testify before you in a spirit of optimism. That is rare in this period of budget restraint. I am particularly pleased to speak on behalf of the Bureau. It has applied its expertise in science and engineering to the pursuit of innovation, productivity, equitable regulatory decisionmaking, equity in commerce, and accuracy and compatibility in science and science measurement.

I would like to start my testimony by expressing my support for S. 2320 as introduced by Senator Cannon, a bill which would reauthorize the Bureau's programs for fiscal years 1981 and 1982.

The Department of Commerce, as you know, is concerned with the overall industrial health of the country, and in one of my earliest appearances before this committee, Senator Stevenson asked me how I would feel about periodic reauthorization hearings for the Bureau. He was surprised when I said I would welcome them.

I welcomed them then, I welcome them now. The reason for that welcome is the fact that the role of the National Bureau of Standards is changing because of our economic situation and because of the rate of development of technology in the United States.

Mr. Chairman, if you will permit me, I would like to let Dr. Ambler address the details of the bill, and I would like to try to establish the context in the Department of Commerce in which the Bureau will be functioning over the coming years.

The Secretary of Commerce, with the approval and the encouragement of the President, is in the process of establishing an Office of Productivity, Technology, and Innovation (OPTI). It is a less comfortable name than was the Office of Science and Technology, but there is a reason for the name change that is far more than cosmetic.

The principal purpose of OPTI will be to enhance the productivity and development of U.S. industry through the strategic application of science and technology. The name OPTI reflects that our efforts will concentrate on the task we are intending to accomplish, rather than the tools, science and technology, that we use to attack that task.

The primary market for our services is the U.S. private sector where and when it lacks either the ability or incentives to do the job itself.

Our secondary market is those foreign nations whose industrialization is important to U.S. foreign policy.

Senator SCHMITT. Doctor, excuse me for interrupting. Is this new office going to be located within the Bureau of Standards?

Dr. BARUCH. No, sir. It's an office that will be adjacent to the Bureau of Standards. The Assistant Secretary of Science and Technology will be renamed the Assistant Secretary for Productivity, Technology, and Innovation, and the Bureau of Standards will report to that Assistant Secretary. Currently I will be that Assistant Secretary if Congress approves.

Senator SCHMITT. And what will be the relationship between this new office and the Bureau of Standards?

Dr. BARUCH. The same relationship that the Bureau has had with the Office of Science and Technology. Technically, it will not be part of the new office, it will remain part of the Office of the Assistant Secretary, and its relationship to the Assistant Secretary will not change.

Senator SCHMITT. OK. Please proceed.

Dr. BARUCH. In my definition of the role of OPTI to enhance the productivity and development of U.S. industry through the strategic application of science and technology, I used the word "strategy." The development of these strategies and the analysis on which we will base the priorities for our programs will be the responsibility of a new Office of Strategy and Evaluation.

The last page of my written testimony, Senator, has a chart which I prefer to call a functional organization rather than an operating organization, and it shows, incidentally, the relationship of the National Bureau of Standards to the material enclosed in the dashed line, which is the Office of Productivity, Technology and Innovation.

In the upper left corner, we find the Office of Strategy and Evaluation which will be responsible for the development of strategies for our programs. Two other blocks up there, the Commerce Technical Advisory Board and the Office of Product Standards Policy help the Assistant Secretary to develop policies for recommendation to the Secretary and to the President for the removal of disincentives or the establishment of new incentives for the enhancement of industrial development.

The program activities lie below that, and deal with the commodity that we are concerned with, science and technology.

Senator SCHMITT. Please continue, doctor.

We welcome Senator Stevenson.

Senator STEVENSON [presiding]. Thank you.

Dr. BARUCH. We recognize that modern U.S. industry is based on and paced by knowledge. Our programmatic task is to improve availability of that knowledge and its utility to U.S. industry.

There are three tasks we have to do and do well in order to increase the availability and utility of knowledge to industry:

First, where that knowledge already exists, our job is to collect it, evaluate it, organize it, and make it readily accessible to industry. If you look at the organizational chart, you will see that the National Technical Information Service, the second column from the left, is the central organization for gathering, organizing and making existing information available. It has been primarily a document distribution system. Its Federal information until recently has been concerned only with completed reports of Federal

agencies. It will, with the incorporation of the Smithsonian Science Information Exchange, be dealing also with reports of research in progress.

It has several other functions. Under Federal information, you will see the Center for the Utilization of Federal Technology, CUFT, which is modeled on the technology utilization program of NASA, but which has a broader mandate. Its task is to help match technologies that develop in the Federal laboratories to the needs of industry.

It will work through seminars, conferences, and a program we expect to initiate of CUFT fellows, who will actually come from industry to the Federal laboratories to participate along with their Federal peers.

Where a technology utilization group exists, as it does in NASA, it will work very closely with that group, not to supplant its activities, but to extend its reach to industries with which it is not normally in communication.

The NTIS will also be taking over much of the patent information activity of the U.S. Patent and Trademark Office. The Patent and Trademark Office will continue to maintain its files for the use of lawyers, patent searchers, examiners, and so forth, but to make those files accessible and useful to engineers requires that they be catalogued and organized somewhat differently, and that will be a task undertaken by NTIS.

Information knowledge that industry needs frequently does not exist, however. Where it doesn't, our next job is to create it. That brings us to the National Bureau of Standards. The National Bureau of Standards has some 200 programs engaged in developing the basic infrastructural knowledge for industry on which industry can base and reference its technical activities.

The Bureau has been in existence for some 79 years. It has had an exemplary record in the past. As you mentioned, Senator Schmitt, it has had some difficulties in the more recent past, difficulties to which the administration is paying hard and detailed attention to.

The National Bureau of Standards will continue to function as the Nation's central reference laboratory and as the laboratory on which much of industry depends for the traceability of its measurements, for the ability to check out standard reference materials from which to gather standard data, and to get the very basic knowledge of which they build their technology.

Within the dashed lines defining OPTI is a new group—the Office of Productivity and Product Technology. The President has proposed in his budget the formation of a cooperative generic technology program to establish centers to work in close liaison with the industry on the developments of process technologies that are applicable to a wide range of our industries, particularly those industries on whom we depend for our exports and for our lead position in world commerce.

The cooperative generic technology program will be part of that Office of Productivity and Product Technology, as will our work in the positive adjustment programs where we guide the expenditure of funds from the Economic Development Administration that are

used to help industries develop and adapt technologies that will restore their competitive position.

Exploratory technology is meant to manage those programs generally mandated by Congress to explore new areas that they see as important to the country, such as resource recovery and the recovery of native latex from guayale.

The Patent and Trademark Office which I have already mentioned, provides the asset value that gives the incentive to investors to engage in the expensive development programs necessary to bring new inventions to fruition.

Within the dashed lines which define OPTI, is another new group—the Productivity Reference Service. It is there because there needs to be an outreach agency to keep the public informed of productivity and an agency where industry can come in order to get the kinds of productivity data and productivity impact analyses that they need in management.

The last column on the right, the last box on the right, is the Office of Reimbursable Foreign Programs. It will manage the kinds of programs that we now have underway with China, Israel, Egypt and potential programs with South and Central America.

Senator SCHMITT. Doctor, you snuck the guayale plant by me. I thought that was a Department of Agriculture program.

Dr. BARUCH. It's a joint program, sir. The Department of Agriculture is concerned with how you grow guayale, and the Department of Commerce is concerned with what you do with it after you grow it. Postharvest processing—

Senator SCHMITT. The specific funding has been coming through the Department of Agriculture.

Dr. BARUCH. The Native Latex Commercialization and Economic Development Act authorizes money for both the Department of Agriculture and the Department of Commerce.

Senator SCHMITT. Thank you. That's all.

Dr. BARUCH. I'd like to return now, if I may, to the National Bureau of Standards, because that's what we're really here for today, and I merely wanted to give a context for it.

I don't need to convince this committee that the National Bureau of Standards is a major national resource. For 79 years, NBS has played a key role in the maturation of U.S. industry and has learned how to work effectively at the interface between industry and government. Would that the relationship between industry and government were as comfortable every place else as it is at the Bureau of Standards.

The Bureau has a unique role. Knowledge is best disseminated on a person-to-person basis. During the Bureau's life, more than 1,000 engineers and scientists have been formally supported by some 450 industrial organizations to do extended research at the National Bureau of Standards labs.

Currently there are 99 research associates from 31 industrial organizations in the NBS labs gaining expertise and extending their organizations' research horizons. This year, 150 university professors and students will collaborate on NBS work. Over 16,000 engineers and scientists will participate in NBS specialized work shops and conferences.

NBS' 22 standard reference data centers for technical data exchange have provided 50,000 replies each year to requests from the public for information.

I should mention that those are not freedom of information requests, but requests for technical assistance.

We have 37,000 standard reference materials distributed each year to 10,000 users, and participate in the calibration of 3,000 instruments for some 1,000 organizations to insure that our Nation's measurements are traceable to the standards of the National Bureau of Standards.

Almost every Government agency concerned with science or technology from the Department of Agriculture to the Department of Defense works with the National Bureau of Standards, coming to them for the kind of specialized knowledge and competence available no place else.

In my new role, I shall continue to use NBS both as a reference for assessing the status of science and technology, for institutional guidance, and for its contacts with universities and industry, but also as a working model for how a government agency can develop programs and operate them in collaboration with industry in pursuit of national goals.

When I made the presentation on the new organization to the Secretary, I got a little difficulty because of the acronym OPTI. Secretary Klutznick, who has a wit that I appreciate, said, "I like it. It's the first two syllables of optimism." And we are taking an optimistic view of the role that Government can play in working with industry to advance our economic development.

But if we don't take an optimistic view, there is almost no other view we can take at the present time.

Gentlemen, thank you for your interest. I would be pleased to answer any questions about the new office or about the Bureau of Standards that I am competent to answer.

Senator STEVENSON. Thank you, sir. I think you have done a very good job in your difficult and important position. That goes for Dr. Ambler, too.

Well, I do have some questions, and if they reflect some skepticism, it's not for any lack of confidence in you.

The Bureau requested \$18 million for research in industrial productivity and innovation. That was not approved at the department level, I understand. This is for the fiscal 1981 budget. Why not?

Dr. BARUCH. I need a moment to get the details of that.

Senator STEVENSON. Well, all right.

Dr. BARUCH. Unless you have them there.

Senator STEVENSON. Well, that's all I have. I'd like to get the details, but I'm not looking so much at the detail as why, with all the rhetoric and the reorganization intended to support productivity—I wish I saw more references to innovation—a budget request by a competent agency for the purpose of improving productivity and innovation wasn't approved.

It looks like we're getting a lot of organization and a lot of words, but not so much action.

Dr. BARUCH. In the \$18 million that you mentioned, two parts were present:

One was a proposal on automation, and one was a proposal on automated testing. We did get a significant portion of the request we made, but I ought to mention some of the reasons why we have problems.

Senator STEVENSON. I'm not talking about your request. This is a request from NBS, as I understand it. It was turned down within the Department. It is not an OMB denial.

Dr. BARUCH. That's what I'm referring to, Senator. For example, in the very large scale integrated circuit work, we did get approval from OMB for \$3.3 million. In the automation activities, however, as you may know, the visiting committee has scheduled its review of the NBS' role in automation for its next meeting, and NBS didn't—we in the Department did not feel it was appropriate to go ahead with a major expansion in that area until the visiting committee had had a chance to report.

Senator STEVENSON. Is that because such activities are now intended for the Department outside of the Bureau in one of these many boxes?

Dr. BARUCH. One of the suggested areas for work, Senator, in automation is in the cooperative generic technology center, where there has been a great deal of interest in the area of flexible manufacturing.

Senator STEVENSON. Well, I think that's a prime candidate for a generic technology center. The Japanese are way ahead of us. They've got about 15,000 robots on line. The Datsun assembly plant has 67 employees producing—I think it's 1,300 cars a day. But how much money have we got for cooperative generic technology?

Dr. BARUCH. The President's request was for \$5.2 million.

Senator STEVENSON. And what's going to happen to that in this current round of budget slashing?

Dr. BARUCH. I don't know for sure, naturally, but the indications that I have gotten so far are that the productivity and innovation efforts are not going to suffer in the budget cuts; but nobody can guarantee that.

Senator STEVENSON. Well, I hope that's so, because it would be ironic, to say the least, if these feeble efforts to control inflation were the victims of the conventional wisdom which suggests that you can control it by indiscriminately cutting the budget except, of course, for the military.

Positive adjustment programs. That sounds like Chrysler. Is this for managing bailouts? I mean Chrysler is our big adjustment program at the moment, isn't it?

Senator SCHMITT. It sounds like an afterwork discussion at a local bar.

Dr. BARUCH. Senator, there are two ways that the Government can help industry. The addition of money, as in the case of Chrysler, was one. It's not the kind of program in which we are involved. We will be involved in those programs where we see some technological opportunity to restore the competitive position of an American industry, and we think that's a very productive use of Government talent.

Senator STEVENSON. How much is budgeted for those activities, that box?

Dr. BARUCH. That budget comes out of the Economic Development Administration funds, and their technical assistance program is the order of \$30 million—I'm not quite sure—

Senator STEVENSON. \$30 million?

Dr. BARUCH. I'm not quite sure what size it is.

Senator STEVENSON. EDA already has a positive adjustment mandate in its authorization. I don't know about the appropriations this year. It's going up to a—it's a very large figure. It's about \$1.3 billion, as I recall.

Dr. BARUCH. One small part of that is the technical assistance program, and that's the part that they have called on us to help them manage so that we can get technology applied to those industries.

Senator STEVENSON. It sounds like a very tiny part for positive adjustment, and the rest for negative adjustment. That's what EDA has historically done, it's been income maintenance. It hasn't been positive adjustment.

You said \$30 million for the positive part?

Well, I'm going to turn to Senator Schmitt in one second, and I will have a few more questions, but I heard from somebody at a rather high level in the Department the other day, not in your part of the Department, that the Department was literally collapsing under the weight of this overhead, and all of these new boxes.

He said that to get the simplest decision, the clearance process now required some 26 different checkoffs in boxes that the decisions had to go through.

How do you respond to that complaint from within your own Department?

Dr. BARUCH. Well, it hasn't been a complaint within our office, for the simple reason that this is not an organizational chart in the sense of how clearance must take place. This is a chart that shows the functions that we do. We have put them in boxes. Perhaps we would have been smarter to put them just as a list, but we wanted to clarify for this committee the kind of functions in which we are engaged.

We do not have a high overhead in our office. You should be aware that the total overhead section of our office is 11 people, including me and the secretaries and my Deputy.

Senator STEVENSON. How will the Office for Productivity, Technology, and Innovation relate to the Office of Industrial Technology proposed in S. 1250? Now we plan to get that bill out. It's very consistent, I think, with your own ideas of what needs to be done.

Dr. BARUCH. It's certainly consistent with the functional organization I have given here. It would provide a structural organization that's somewhat different than I use, but the tasks we are addressing are very, very similar.

Senator STEVENSON. Well, we'd better figure out how to relate that Office of Industrial Technology to this chart, or your chart, to here.

Dr. BARUCH. I would be glad to work with your staff to do just that.

Senator STEVENSON. Thank you.

Senator Schmitt?

Senator SCHMITT. Thank you, Mr. Chairman.

Dr. Baruch, I have a great interest in the structural organization of bureaucracy, and at various times I have traded philosophy with members of the bureaucracy.

For example, in discussing the 2 to the n th factor, are you familiar with that?

Dr. BARUCH. Yes, sir.

Senator SCHMITT. The number of interactions that one must have to make a decision a function of 2 to the n th. N is the number of people at the level that have to interact. What is N in your case?

Dr. BARUCH. One.

Senator SCHMITT. You interact with no one in your staff on a daily basis for each decision?

Dr. BARUCH. No. It's just that much of the decisionmaking has been delegated to the competent members of the staff.

For example, the Director of the National Bureau of Standards makes a wide range of decisions without ever referring to me, as does the Director of—

Senator SCHMITT. Then you're not very busy during the day; is that correct?

Dr. BARUCH. No, I'm busy as hell during the day.

Senator SCHMITT. Well, who are you interacting with?

Dr. BARUCH. I interact with all of them, in part to make decisions, although those are rare. They are decisions where the leaders of these groups come and ask me for help. Much of my work, however, is working with people like the Director of the Bureau to establish the basic policies under which the Bureau will run.

Senator SCHMITT. Well, Doctor, I suspect that many of your decisions impact on everything on the major boxes on this chart, which means that there probably are a large number of decisions that require from 5 to 10 interactions for you to finally come up with the Department level or the Assistant Secretary level of recommendation to the Secretary.

Dr. BARUCH. I can't think of many, and the main reason is that 2 to the N th—

Senator SCHMITT. Well, I don't know what you're doing. You're at the top of the pyramid.

Dr. BARUCH. And the 2 to the n th paradigm is related to a star organization where each member communicates with all other members.

Senator SCHMITT. Don't you do that with these 10 boxes that are here at the top of the chart?

Dr. BARUCH. But an easy way to do that is to bring the interested group of people together with me, talk it out, and reach a decision. That's not quite the same as requiring 2 to the N th sequential decisions. We can work in parallel frequently, and do.

Senator SCHMITT. But it still takes time for each of those interactions, even working in parallel.

Dr. BARUCH. Yes.

Senator SCHMITT. Ten is a pretty large number; 2 to the 10th is a pretty large number.

Dr. BARUCH. The operational activities here, I am very sensitive to maintaining a moderate span of control, Senator, and if you will look at the operational activities other than the staff ones, which

are not the decisionmaking, they are policy advisory primarily, you find that there are six.

Senator SCHMITT. Well, but they're all interrelated, or should be. Most of the technology innovation decisions you make could fruitfully gain from interaction with each one of those boxes.

Dr. BARUCH. Oh, yes. And frequently the interactions take place at very low levels. For example, when we work with the Chinese on their work in manufacturing, the people in that office will go directly to the people at the Bureau of Standards, not to reach a decision, but for consultative assistance.

This is a very close-knit group, and these people work together very comfortably.

Senator SCHMITT. Then couldn't it all be done under the National Bureau of Standards? Why do you need all these other offices?

Dr. BARUCH. There are various kinds of activities that would dilute the efforts of the National Bureau of Standards. Take the policy area, for example. We have in the upper right-hand corner the Office of Product Standards Policy.

Senator SCHMITT. I'm not arguing you shouldn't have some staff for those boxes, but these others below that, it seems to me, would fit very logically within the National Bureau of Standards' history, tradition and capability.

Dr. BARUCH. Many of them would. If you look at something like cooperative generic technology, which is probably the closest to the activity in the National Bureau of Standards, that's where we started it, and the reason for separating it out is that it gets a feel for the main scientific and technical thrust of the Bureau, and that was not a decision that was imposed on the Bureau, but rather one that the Bureau participated in fully.

Senator SCHMITT. Well, I can't help but believe that part of it is just the realization that you're not going to be able to talk the administration in to many more bucks, and so you can say you're doing something because you created a new office.

Dr. BARUCH. Sir, we have talked them into more dollars, as you put it, but we feel it is important that the various activities have a home and have an idea of their mission and know what they are intended to do.

Senator SCHMITT. I think that can happen with less overhead. That's all I'm getting at.

Well, obviously we will take a while to agree on that. I still have the strong impression that there is a tendency to reorganize and create new offices to help business and industry, rather than looking at some of the generic problems of why isn't it being done naturally? Such as tax law and regulatory law. But I don't think that we are going to solve that disagreement this morning.

Dr. BARUCH. But, Senator, I will mention that part of my new policy responsibilities are to advise the Secretary on the impact of various tax laws on technology, on innovation, and on industrial development.

Senator SCHMITT. Well, your advice, if it's what I hope it would be, is not being heeded; at least it hasn't worked its way to the White House.

You mentioned that you look at the National Bureau of Standards as a model of a way. Government and industry can work

together. Why do you pick that model and not one like the NACA and its derivatives within NASA? There is certainly a much stronger cooperative relationship there.

Dr. BARUCH. The generic technology program is modeled as closely as humanly possible on the old NACA to which I was consultant for many years. There you had the research strategy developed primarily by industry. You had a distribution of responsibilities that was agreed to between Government and industry. You had work that was clearly focused on the capability needs—the capability requirements of the aircraft industry, and it was probably the most successful joint Government-industrial activity that ever took place.

Senator SCHMITT. One of the reasons it was successful is it was bounded and focused.

Dr. BARUCH. That's right.

Senator SCHMITT. It was the National Advisory Committee on Aeronautics.

Dr. BARUCH. Yes, sir.

Senator SCHMITT. Not a generic technology office.

Dr. BARUCH. Right. But the question is if you want several of those, and if you want them to learn from each other, it seems appropriate to put them into one place where they have easy communication with the people who are developing their roles who have to argue with the Justice Department, for example, whether there would be an antitrust violation.

We are not going to have a generic technology program that has got a characteristic. We are going to have a program that establishes several generic technology activities.

For example, if we went into flexible manufacturing, we would have a flexible manufacturing activity that would look very much like NACA. It would have a somewhat smaller budget, but it would look in its intent and in its activities very much like NACA.

Senator SCHMITT. Except that it is not perceived as a bounded, independent problem, as NACA was.

Dr. BARUCH. If we do our job properly, I think it will be perceived that way.

Senator SCHMITT. Well, not if it's lost in this maze. Why don't we just establish a small independent agency, a National Advisory Committee on Flexible Manufacturing, or National Advisory Committee on—whatever is appropriate, and bound that problem and go to work on it, and beat the Japanese and others at their own game? That's what we did in aeronautics. Why do we keep ignoring that lesson?

Dr. BARUCH. There is a policy question of whether you want to have a proliferation of independent committees and agencies.

Senator SCHMITT. If you can bound them so their charter and purpose is clear, there is absolutely no reason not to have those kinds of agencies. The problem is what we have come up with are these massive bureaucracies, and you are adding to the complexity of the Department of Commerce by this organization which can never get anything done. They are too big. It is beyond the capacity of an individual, I don't care who he is, to manage too many variables, too many people, to keep his eye on all those balls that are down below him.

That's why you need problems bounded within the realm that they can be solved, and we are not doing that any more. The whole tendency of this administration is to aggregate things, make it tougher on the guy at the top rather than easier. And that's what you're doing to yourself here by this proliferation of boxes.

Dr. Baruch, it's my understanding that within the Bureau, there is an Office of Energy-Related Inventions, which continuously reviews inventions with potential energy applications. Could you describe briefly the function and operation of that office?

Dr. BARUCH. Yes, sir. The Department of Energy has requested of the Bureau that we review those energy inventions that are submitted largely by small inventors, to determine whether they are feasible, to do a small amount of economic analysis of them, where that's possible, and the Department of Energy provides \$2½ million to the Bureau of Standards to do that kind of review.

Senator SCHMITT. Do you make specific recommendations?

Dr. BARUCH. Yes; we do.

Senator SCHMITT. Could you supply the committee with a record of projects evaluated over a reasonable period of time and the recommendations you have made, and what the Energy Department has decided to do with those projects?

Dr. BARUCH. We can supply you with the some 100 projects that we have recommended to DOE for further financing, and 50 of those have already been funded by the DOE. I will be happy to provide a list.

Senator SCHMITT. Do you know why the other 50 are not?

Dr. BARUCH. Presumably because it takes time for the Department of Energy to review them for funding purposes.

Senator SCHMITT. It is my understanding that in at least one case related to us in the Small Business Committee, that office's recommendation was overruled by the Department of Energy, and there was no funding.

Dr. BARUCH. It's highly possible.

Senator SCHMITT. It had to do with a lift translator.

Dr. BARUCH. It's highly possible. The Department of Energy, of course, has final say on what it funds and what it does not fund. We are advisers to the Department of Energy on the projects submitted to us.

Senator SCHMITT. Well, if you would provide us with some information so we can evaluate how that interrelationship is working between the two groups.

Dr. BARUCH. I will do that.

[The following information was subsequently received for the record:]

The most recent semi-annual status reporting on the Energy-Related Inventions Program (copy attached) contains the information requested by the Committee. The report shows that as of December 31, 1979, 13,215 inventions had been submitted to the National Bureau of Standards (NBS) for evaluation; review had been completed on 12,431; and 128 had been recommended to DOE. The attachments to the report include brief descriptions of those recommended inventions and the actions taken by DOE. As of the date of the report, the DOE had awarded 61 grants or contracts totaling \$4,114,134.

The attachments also explain the current status of the other recommended inventions. The expectation on recommendations is that support will be provided. However, the recommendations are understood by both NBS and DOE not to be binding on DOE.

While support was not provided on ten recommendations, we are unaware of any conflict between a recommendation by NBS and a decision by DOE. The working relationship between NBS and DOE on the Inventions Program is considered extremely good.

As evidenced by the joint status report there is very close cooperation and mutual support between DOE and NBS at the policy level, but the evaluation process is managed and implemented solely by NBS. The separation of the evaluation program (NBS) from the support program (DOE) seems to be working well. The objectives and policies of other DOE programs are not a factor in NBS' decision on evaluation. The existence of DOE sponsored research and development is taken into account in reviewing the state-of-the-art in various technologies to see if the invention is new. Most of the recommendations from NBS under the Inventions Program do not fall within the specific approaches and funding priorities being supported by DOE technical programs.

U.S. DEPARTMENT OF ENERGY,
Washington, D.C.

STATUS REPORT ON THE ENERGY-RELATED INVENTIONS PROGRAM AS OF
DECEMBER 31, 1979

The Energy-Related Inventions Program was established by Congress in the Federal Nonnuclear Energy Research and Development Act of 1974 (P.L. 93-577). The Committee on Appropriations, in the report concerning the Department of Interior and Related Agencies Appropriation Bill for 1978, directed that the status of this program be reported to their Committee every six months beginning with the six-month period ending December 31, 1977. This is the fifth such report.

The Inventions Program provides first, for evaluation of inventions by the Office of Energy-Related Inventions (OERI) in the National Bureau of Standards (NBS) and then, support of promising inventions by the Department of Energy (DOE). It gives particular attention to small businessmen and individual inventors, and provides one-time assistance, usually in the form of grants to assist selected inventors in developing their inventions for eventual commercialization.

The Inventions Program is another way of discovering and developing new technologies; a method that supplements the traditional Federal way of much larger, more objective oriented R&D programs in specific technical areas. The program is flexible enough to respond to the unique needs of individual inventors.

Through the end of December 1979, OERI had received a total of 13,275 evaluation requests. They made decisions on 12,431 of these, and recommended 128 inventions to the DOE. As of that date, the DOE had awarded 61 grants or contracts totaling \$4,114,134. Fourteen of these grants are now complete. Seven other inventors have received support other than direct financial assistance, and in 11 cases there was no feasible way for DOE to help the inventor. Negotiations are in progress with the remaining 49 inventors to determine the activities to be supported with DOE assistance.

The two attachments statistically summarize the NBS work to date, and briefly describe and list the status of the inventions which have been recommended to the DOE.

There are some facets of the program which need to be highlighted, because they affect program operations and planning:

For planning purposes on an annual basis we are continuing to use an expected rate of 3,000 requests to NBS for evaluation, and an expected yield (recommendations to the DOE) of 1.3 per cent or 39 inventions per year. The short term input rate ranged from between 2,500 and 5,000 in the past six months and is currently level at the rate of about 3,000 annually. The yield in terms of recommendations to DOE is fairly constant at about 3 or 4 per month.

The time which has been required to evaluate inventions and ultimately to provide support by DOE has been of considerable concern to the program managers. To expedite the evaluation, the NBS has modified its procedures to identify the more promising inventions earlier in the evaluation process. As a result, average response time, for inventions evaluated during the period, decreased significantly from 33.4 to 22.3 weeks.

The total amount appropriated for the Program in Fiscal Year 1980 was \$6.42 million, as compared to \$4.0 million in Fiscal Year 1979. The increase of more than 50 per cent will help reduce the backlog of inventors negotiating for assistance with the DOE and also provides funding for other initiatives of direct and more general assistance to inventors.

Reduction in this backlog (some 25 inventions) and future timely and effective DOE support is critically dependant on sufficient staff to process and monitor grants, particularly experienced people who can help the inventors to determine how best to use their grant money and suggest ways of proceeding after DOE support is complete.

With few exceptions, inventors recommended to the DOE have never dealt previously with the Federal Government in a procurement or an assistance relationship. Forty-six per cent of these inventors are individuals. Another 34 per cent are associated with companies employing fewer than ten people. In the small business community we deal with those who are at the bottom end of the size spectrum. We are dealing with high-risk, potential start-up situations, where the inventor's capabilities, even to fulfill the grant, must usually be augmented with people more experienced in technology development, management, or marketing. In addition, there is invariably a need for venture capital to move to commercialization.

Program experience to date indicates that inventors need to make better use of available technical and other data, and to increase their knowledge of elements in the innovative process. Response to these needs could not only enhance the inventors' capabilities but could also lead to improved Program effectiveness. Accordingly, a conference series, to be called National Innovation Workshops is being inaugurated on a regional basis to provide practical guidance and information to inventors and innovative small businesses throughout the Nation.

These conferences will feature workshops on topics such as: turning ideas into inventions, patenting and protection, licensing and selling ideas, and new business start-up. The attendees will be informed as to sources of consultation and financial assistance, and sources of technical and socio-economic information. The general theme of these conferences will be to encourage innovation in energy technologies.

Responsibility for the management of the Invention Program within the DOE was transferred to the Assistant Secretary for Conservation and Solar Energy on October 1, 1979. This new management arrangement will provide the consideration and resource support the Program requires to operate more effectively.

GEORGE P. LEWETT,
Chief, Office of Energy-Related Inventions,
Department of Commerce.

PATRICK J. DONOHUE,
Director, Inventions Support Division,
Department of Energy.



UNITED STATES DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, D.C. 20234

ATTACHMENT NO. 1 to: Status Report on the NBS/DOE Inventions Program
As of December 31, 1979

EVALUATION PROGRAM STATUS

Operation Description

There are three principal steps in the evaluation process operated by OERI. In the first step, Disclosure Review and Analysis, invention disclosures received are either accepted for evaluation, or not, dependent on whether the invention is within program scope and sufficiently well prepared to enable evaluation. If accepted, a two-stage evaluation is initiated.

First-Stage Evaluation is a technical screening in which brief technical opinions are obtained, usually independently, from OERI staff evaluators, other Government scientists or engineers, or from consultants or contractors. If the invention is rated as "promising" in this first-stage, Second-Stage Evaluation is initiated; "promising" means the invention seems to be technically feasible, to have significant energy conservation or supply potential, and to be economically and commercially practical.

In second-stage evaluation a more in-depth analysis is conducted, resulting in a formal report. If second-stage evaluation confirms the finding of "promising," the disclosure and evaluation results are forwarded with a recommendation of Government support to the Department of Energy, Division of Business Programs.

Throughout the process the inventor is kept informed of the status of the evaluation. When evaluation is complete after either first- or second-stage, a letter is sent to the inventor explaining the results of the evaluation. If second-stage evaluation had been conducted, a copy of the formal evaluation report is sent to the inventor.

Status

Figure 1 shows in experience to date, that 47% of received disclosures are acceptable for evaluation; 8% of these are found sufficiently promising in first-stage to warrant second-stage evaluation; and 32% of the inventions in second-stage are recommended. The product of these three percentages, 1.3%, is the "expected yield" of the evaluation program. We can assume therefore that when all 13,215 evaluation requests received as of December 31, 1979, are processed, approximately 1.3% or 172 will have been recommended; of these, 128 have been identified and forwarded to date.

Figure 2 presents the performance statistics for the three process steps for the 6-month period from July through December 1979. Figures 3 and 4 show results for groupings of technology subject areas, and for each of the fifty states.

NBS INVENTION EVALUATION PROCESS STATISTICS THRU DECEMBER 31, 1979

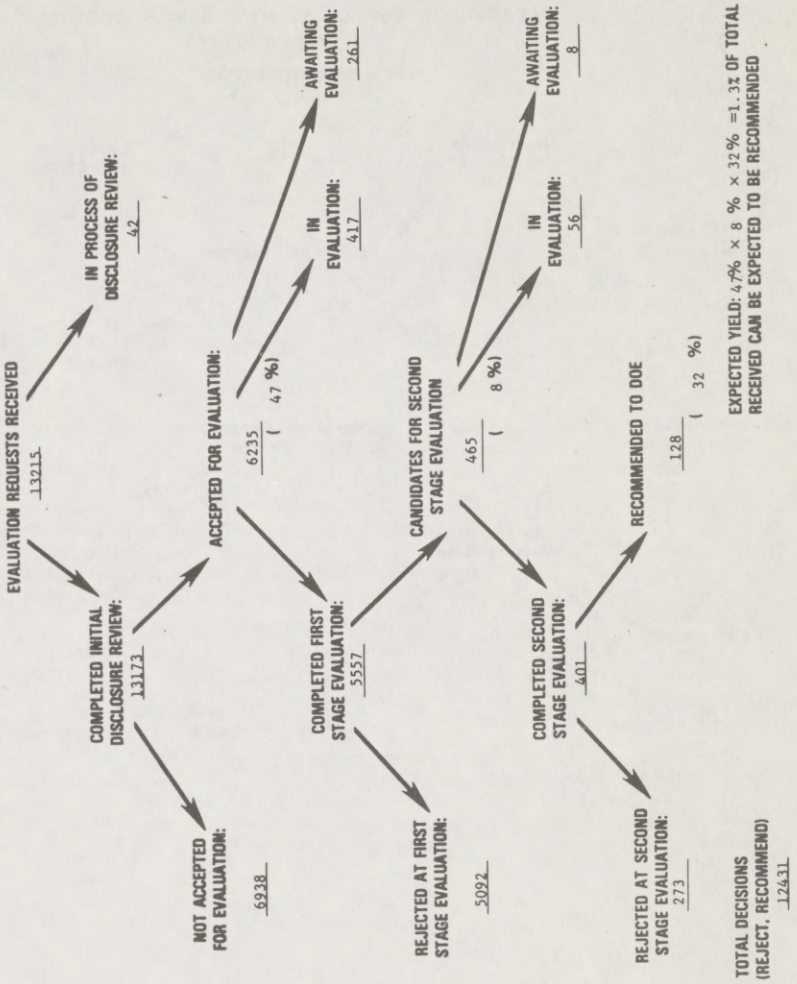


FIGURE 1. Cumulative Flow Statistics (since April 1975)

(2)

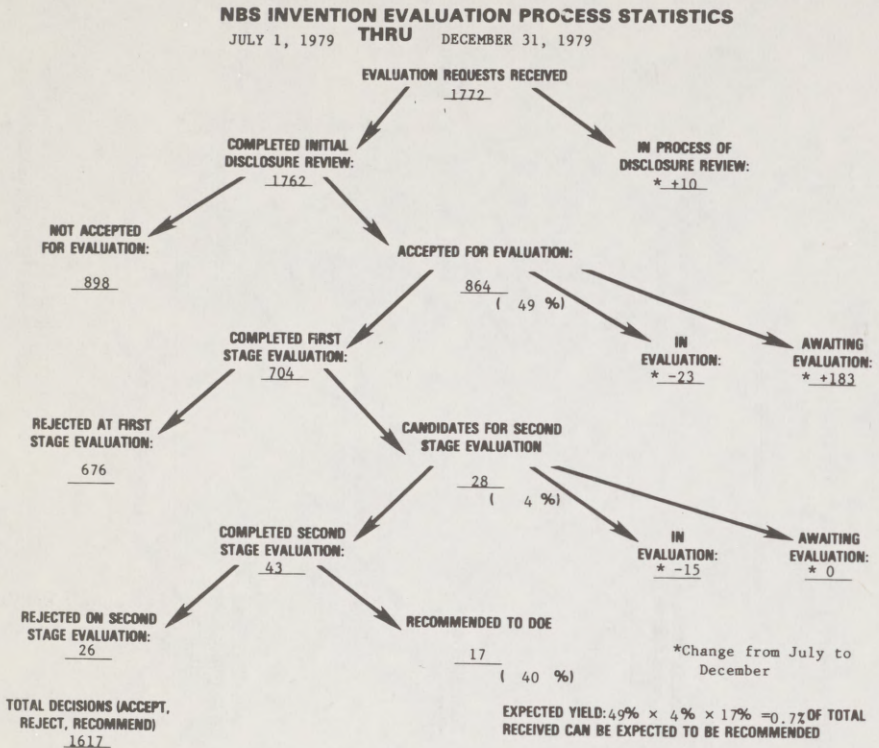


FIGURE 2. Period Flow Statistics

EVALUATION PROGRESS REPORT BY INVENTION CLASS AS OF DEC 31, 1979

Classification	Evaluation Requests Received	Accepted for First Stage	Completed First Stage	Accepted for Second Stage	Completed Second Stage	Recommended	% of Total Received	% of Total Expected to be Recommended**
Fossil Fuel Production	279	200	156	42	40	11	2.1	5.3
Direct Solar	1539	814	729	46	39	9	11.7	0.8
Other Natural Sources	1927	712	648	37	33	10	14.6	0.6
Combustion Engines & Components	1524	925	812	60	54	11	11.6	0.9
Transportation Systems, Vehicles & Components	1113	602	530	35	31	6	8.4	0.7
Buildings, Structures & Components	2140	1502	1333	86	71	26	16.2	1.6
Industrial Processes	721	544	487	107	93	38	5.5	6.8
Miscellaneous	1626	866	795	52	40	17	12.3	1.5
Out of Scope & Unclassifiable	2304	70	67	0	0	0	17.5	0.0
Totals	13173*	6235	5557	465	401	128	100.0	1.3

*Excludes 42 not yet classified. (Disclosure Review Not Completed).

** For Example: Fossil Fuel Production $200 \times \frac{42}{279} \times 100 = 5.3\%$

FIGURE 3. Subject Area Statistics

(4)

EVALUATION PROGRESS REPORT BY STATE AS OF DEC 31, 1979

	Evaluation Requests Received	Completed Disclosure Review	Accepted For First Stage	Completed First Stage	Accepted For Second Stage	Completed Second Stage	Recommended
Alabama	129	129	57	48	0	0	0
Alaska	32	32	20	17	0	0	0
Arizona	199	199	118	104	13	9	1
Arkansas	72	72	26	25	5	5	2
California	1832	1828	877	782	71	58	14
Colorado	273	271	184	166	27	25	1
Connecticut	269	269	151	135	16	12	6
Delaware	35	35	21	18	2	2	2
District of Columbia	65	65	32	26	5	5	0
Florida	757	757	350	308	14	11	5
Georgia	166	166	73	69	6	5	1
Hawaii	55	55	21	18	1	0	0
Idaho	49	49	31	29	1	1	1
Illinois	453	453	210	187	11	10	3
Indiana	199	199	91	81	5	4	1
Iowa	93	93	51	47	2	2	2
Kansas	144	144	56	52	1	0	0
Kentucky	118	118	45	40	4	4	3
Louisiana	153	153	69	61	5	5	2

FIGURE 4. State Statistics

(5)

	Evaluation Requests Received	Completed Disclosure Review	Accepted for First Stage	Completed First Stage	Accepted for Second Stage	Completed Second Stage	Recommended
Maine	68	68	29	27	1	1	1
Maryland	343	342	200	178	14	13	2
Massachusetts	530	529	231	203	22	18	7
Michigan	472	471	216	182	16	14	5
Minnesota	231	228	105	98	5	3	1
Mississippi	82	82	24	22	2	2	0
Missouri	258	256	128	115	5	3	1
Montana	41	41	19	17	1	1	0
Nebraska	76	76	35	33	3	3	1
Nevada	69	69	29	28	3	2	0
New Hampshire	70	70	45	39	9	9	4
New Jersey	482	480	244	220	20	18	4
New Mexico	112	112	49	42	1	1	1
New York	984	980	495	450	40	37	15
North Carolina	209	208	94	85	2	2	1
North Dakota	21	21	7	7	0	0	0
Ohio	417	416	189	171	15	13	6
Oklahoma	181	181	80	74	8	8	1
Oregon	277	276	117	109	11	10	3
Pennsylvania	600	597	268	229	26	22	9
Rhode Island	43	43	14	14	3	3	0
South Carolina	71	71	26	22	0	0	0
South Dakota	26	26	13	11	1	1	1
Tennessee	203	203	82	71	1	1	0
Texas	561	557	265	240	13	13	5
Utah	127	127	42	40	6	5	4

FIGURE 4. State Statistics (continued)

(6)

	Evaluation Requests Received	Completed Disclosure Review	Accepted for First Stage	Completed First Stage	Accepted for Second Stage	Completed Second Stage	Recommended
Vermont	46	46	32	26	3	1	0
Virginia	287	286	134	123	15	13	5
Washington	309	307	139	116	6	6	1
West Virginia	34	33	11	11	0	0	0
Wisconsin	247	245	108	97	7	6	3
Wyoming	21	20	7	6	0	0	0
Territories	27	27	12	10	0	0	0
Foreign Countries	597	592	263	228	17	14	3
Totals	13215	13173	6235	5557	465	401	128

FIGURE 4. State Statistics (continued)

(7)

Time to respond to an evaluation request is also a significant measure of performance. This is defined as the length of time elapsed between OERI's receipt of an evaluation request and OERI's mailing a letter to the inventor notifying him of the results of the evaluation. Current calculated response times are as follows:

Average Response Time in weeks for
Letters Mailed in Period:

	July 1977 thru Dec. 1977	Jan. 1978 thru June 1978	July 1978 thru Dec. 1978	Jan. 1979 thru June 1979	July 1979 thru Dec. 1979
Not accepted for evaluation	5.9	5.4	2.7	3.3	6.0
Accepted and evaluated	39.3	35.9	35.3	33.4	22.3

Comments

The variations in input in the 6-month period were unusual, ranging between annual rates of 2,500 and 5,000 with two sharp 1-2 month rises and returns to a steady 3,000-level. In the period, the level of disclosures accepted for evaluation decreased from 52% to 49%. It is felt that the fluctuations were largely due to general public response to national crisis, usually suggesting well-known ideas or use of available technology, and the effect on yield is not expected to be significant.

The number of recommendations in this (17) and the prior (19) period was about the same, averaging close to 3 per month. These numbers could well reflect the input of inventions from a population of serious innovators, which is less liable to short-term fluctuations.

The sharp decrease in response time (from 33.4 to 22.3) is largely due to modifications in procedure which enabled "old" technology to be identified more quickly at the first-stage evaluation level. We expect the time required to reach second-stage evaluation (and recommendation) to be also reduced as a result of the modified procedures over the next 6-month period.

Further reductions in the average are not likely to be significantly large however because of one major factor--characteristically, the inventor does not present his case effectively; he frequently does not describe his invention well and does not provide substantiation (calculation or data) for claims of superior performance. The additional information required is submitted usually only after dialogue between evaluator and inventor, and sometimes after a considerable waiting period. This process can considerably lengthen response time in individual cases, as can be seen by the fact that while response times for accepted inventions in the 6-month period averaged 22.3 weeks as noted, individual times ranged from 5 to 204 weeks; cases of response time greater than 40 weeks accounted for about 10% of the total.

The most frequent reason for rejection after evaluation is basically that the invention does not represent new technology. Frequently it has been noted that the inventor in such cases did not make use of available sources of information on the technological state-of-the-art.

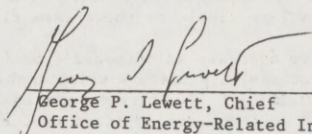
Various activities are being carried out to improve inventor capabilities to present his case, to inform him on the state-of-the-art, and to increase program awareness by the professional "serious" inventor. Those include regional outreach programs in the Northwest and New England states, and development of state-of-the-art review papers for dissemination to participants in the Inventions Program.

We are initiating another effort, a series of regional conferences to provide practical guidance and information to independent inventors and very small technology-based business firms. Some 10 or 11 conferences referred to as National Innovation Workshops, will be held in major urban areas over the next two years; the first will be in the San Francisco area in May 1980 and the second in Boston in June.

The conferences will feature a workshop format to provide instruction and answer inventor questions on such subjects as technical researching; process documentation; self-evaluation; doing market surveys; patenting and protection; presenting an idea for evaluation; licensing; and beginning and operating a small business to market an invention. Exhibits will provide detailed information and literature on the identity and use of technical and business data, and on sources of assistance of various types that can be of value to an inventor or innovative small firm.

February 12, 1980

Date


George P. Lewett, Chief
Office of Energy-Related Inventions

Senator SCHMITT. What is the fiscal year 1981 funding level for that office?

Dr. BARUCH. \$2.5 million.

Senator SCHMITT. And that's all DOE funds?

Dr. BARUCH. That's all DOE funds.

Senator SCHMITT. Do you get any manpower relief as a consequence of taking those funds off?

Dr. BARUCH. We have a group of people that are in the Bureau that function on other agency funds, but we cannot get additional manpower slots.

Senator SCHMITT. But your slot allocation does not reflect that reimbursable funding; is that correct?

Dr. BARUCH. No, there are 18 people involved.

Senator SCHMITT. How much of that are you capable of absorbing? Does the \$2.5 million represent your maximum capacity?

Dr. BARUCH. That's limited primarily by the personnel we have and the work we must do for the many, many other agencies.

Senator SCHMITT. Have you evaluated within the Department how much reimbursable money in that area you could absorb and not significantly impact other programs?

Dr. BARUCH. I think we are at that limit now with the people available. It requires roughly 18 to 20 weeks to clear a submitted invention now, and only by the addition of additional personnel could you increase that.

Senator SCHMITT. Do you know how many invention evaluations are undertaken each year?

Dr. BARUCH. It seems to me about 4,000 inventions. It's in the order of 4,000 to 5,000 inventions.

Senator SCHMITT. The Department of Energy sends you that number for evaluation?

Dr. BARUCH. Yes. The inventors submit their inventions directly to us.

Senator SCHMITT. Eighteen people sort those through?

Dr. BARUCH. Eighteen people sort those. We do use outside personnel for some of this review by contracting some of that money out to universities for their review, in order to reduce the dwell-time necessary for doing the review.

Senator SCHMITT. But that's roughly 30 to 35 people that can be funded to do that?

Dr. BARUCH. That order of magnitude, yes, sir. About half of those are in-house and about half of them are outside.

Senator SCHMITT. There must be a tremendous backlog.

Dr. BARUCH. It takes about 18 to 20 weeks to clear an invention because of the queueing problem.

Senator SCHMITT. But if you get a continual influx at that level, you're running farther and farther behind all the time.

Dr. BARUCH. At the present time the backlog is remaining fairly stable because of our increased use of outside help on the effort. If that number goes up significantly, the dwelltime will go up.

Senator SCHMITT. Is there any appeal process by the inventor within your department if the invention gets an unfavorable recommendation?

Dr. BARUCH. Yes, there are three levels of review that take place, and there is an appeal for reexamination and, of course, there is an

appeal to the Department of Energy who is not, as you pointed out, compelled to take either our positive or negative reactions.

I might mention that our increased use of university help in this area has shortened the dwelltime, which used to be 9 months, when we were trying to do almost all of it in-house.

Senator SCHMITT. Mr. Chairman, I must run over and stick my head in the Public Works Subcommittee for a few moments. I am particularly interested in the Department's justification for the basic research initiatives that are contained in the original fiscal year 1981 budget.

We expect the real 1981 budget to stand up any time.

Thank you, Doctor.

Dr. BARUCH. Thank you, Senator.

Senator STEVENSON. Well, we have some difficulties this morning. I am supposed to stick my head in, or do more than that, in those ongoing meetings between the Congress and the executive branch on the budget. So you stick your head in first.

Senator SCHMITT. I'll get back as soon as I can.

Senator STEVENSON. I may have to duck out momentarily after Senator Schmitt has returned. I think in view of these difficulties, we'd better keep moving. Thank you, sir.

[The statement follows:]

STATEMENT OF DR. JORDAN J. BARUCH, ASSISTANT SECRETARY FOR PRODUCTIVITY, TECHNOLOGY, AND INNOVATION

Mr. Chairman and Members of the Subcommittee, I am pleased to be invited here today to testify at this first Senate Authorization Hearing on the National Bureau of Standards (NBS). I am proud to speak on behalf of a Bureau which has so long applied its core of expertise in science and engineering to the pursuit of such national goals as the enhancement of innovation and productivity, reasonable and equitable regulatory decision making, equity in Commerce, and accuracy and compatibility in scientific communication and technology.

Today, I would like to begin by expressing my support for the proposals contained in the Administration's Bill submitted to the Congress by the Secretary of Commerce, which has now been introduced by Mr. Cannon as S. 2320, for re-authorization of the Bureau's programs for fiscal years 1981 and 1982.

The health of the U.S. economy is a primary concern of the Department of Commerce. In the Department's pursuit of its mission, the NBS functions as central reference laboratory and lead agency for measurements, as an expert in the application of the physical, chemical, mathematical and engineering sciences to the solution of some of our nation's problems and as a significant contributor to the technological and scientific base of our nation's productive sectors. The Department of Commerce, indeed the administration, strongly urges your continued support for NBS and its programs.

Mr. Chairman, at one of my earliest appearances before this Subcommittee, you asked how I would feel about periodic authorization hearings for the Bureau. I said at the time that I would welcome them. My welcome now, as it was then, is based on my perception that the role of the NBS in our nation's economic well being is changing. To highlight that changing role, I would like, with your permission, to leave the discussion of the Bureau's programs, plans, and budgetary needs to Dr. Ambler and Dr. Dillon who will follow me in this hearing.

The Secretary of Commerce, with both the approval and the encouragement of the President, is now engaged in establishing the Office of Productivity, Technology and Innovation (OPTI). The name, while less concise than Science and Technology, and while subsuming our earlier activities, presages an important change in emphasis—an emphasis on what we are intended to accomplish rather than on the tools we use.

The organization of this new office is shown in the accompanying chart. The principal purpose of OPTI is to enhance the productivity and development of U.S. industry through the strategic application of science and technology.

OPTI MARKETS

As an integral part of the DoC mission to promote the health of commerce, OPTI will be the prime focal point within the DoC for cooperative efforts between government and the private sector to enhance productivity and innovation in U.S. industry. Our primary market is the U.S. private sector where and when it lacks either the ability or incentives to do the job itself. The secondary market is those foreign nations whose industrial development is important to U.S. commerce and foreign policy.

OPTI MODI OPERANDI

Modern U.S. industry is based on and paced by knowledge; our task is to improve the availability and utility of that critical commodity to U.S. industry. Much of the knowledge that could advance our industry and maintain its leadership already exists. Where it does our job is to collect it, evaluate it, organize it and make it readily accessible to industry. Under existing knowledge, I include not only that embodied in final reports of the U.S. government, but knowledge embodied in people; nor do we restrict ourselves to "domestic" knowledge. Two thirds of the R&D is now done abroad and we must tap that store as well. Second, we will, jointly with the private sector, create new knowledge which is needed by U.S. industry but not being developed because of market structures or other limiting factors. Lastly, we will help industry adapt or modify knowledge to suit their needs. Such adaptation is essential to the transfer of knowledge across industrial boundaries. Let me now match the organization of OPTI to these tasks.

POLICY AND PRIORITY DEVELOPMENT

Overall policy and priority guidance to the office will be provided by the Commerce Technical Advisory Board, an arrangement that my predecessors and I have found most beneficial.

The development of strategies and the analysis on which we will base our priorities will be centralized in the Office of Strategy and Evaluation. They will also be responsible for assessing our programs and the degree of our success to ensure that we learn from our experience. This Office will also have the responsibility for tracking other Agency programs which contribute to the Federal Government's industrial innovation support program.

I have had and will continue to have an Office of Product Standards Policy to encourage U.S. products standards in ways which promote domestic and international trade. In all this endeavor to develop policies, practices, and priorities, close collaboration with U.S. industry will be a basic tenet.

THE NATIONAL TECHNICAL INFORMATION SERVICE

The collection of technical knowledge; organizing it and making it readily available in useful form to U.S. industry, is the primary function of the National Technical Information Service (NTIS). Traditionally NTIS has been thought of as only a document-dissemination operation. If it were to operate in the future with such a narrow focus, it could not play its full role. The opportunities for enhancing the dissemination of knowledge through NTIS are many. NTIS has remotely accessible data files which could be accessed through commercial and governmental computer network. That information will be used by industry and by our internal activities; Centers for Cooperative Generic Technology, COGENT Centers, for example, which are newly established in the Office of Productivity and Product Technology, will access these files as will all U.S. industry, particularly small and medium-sized businesses.

To date, the dissemination of Federal technical information by NTIS has been limited to printed material from completed projects, a marginally effective mode of dissemination in the case of rapidly developing technologies. With the fiscal year 1981 transfer of responsibility for the Smithsonian Science Information Exchange, NTIS will be responsible for disseminating knowledge about Federal projects in process as well as those that have been completed. Here again, remotely accessible computer data bases are to be used.

As a part of the President's package of innovation initiatives, I am establishing a Center for the Utilization of Federal Technology (CUFT) in the NTIS to carry out an aggressive marketing operation for Federally developed technical information. CUFT will gather information from industry about its needs and opportunities, and will gather information from Federal laboratories about available technologies, not only those which have been successfully developed for the laboratory's mission

objectives but also those which, although rejected for mission objectives, still may have commercial application. Available technology will be matched to industry's needs and opportunities through published information, conferences, forums, and services we will tailor to the operation of industry.

Patent Licensing and Patent Information will be improved through CUFT's assistance to industry in the negotiation of licenses for Federally-owned patents and by development of cataloguing systems for the patent files which may be then more readily accessed by industry.

Lastly, NTIS, as a part of the President's commitment to industrial innovation information, will collect and disseminate printed technical knowledge obtained from foreign sources. In addition, OPTI is developing a program plan to implement the President's initiative with regard to the collection of unpublished information concerning foreign technological activities.

In summary, NTIS will become the central repository and access point for knowledge and information about completed Federal technical programs, Federal programs in process, patents and foreign technical information. A common data base has been developed and will be expanded and improved so that industry can access any available knowledge it needs without knowing *a priori* whether or where the knowledge exists.

THE OFFICE OF PRODUCTIVITY AND PRODUCT TECHNOLOGY

I mentioned earlier that our second approach was to create critically needed knowledge when it is not otherwise available. To this end, we are establishing the Office of Productivity and Product Technology in parallel with NTIS. A key part of this new office is the Cooperative Generic Technology Center Program which is responsive to the President's innovation initiatives and for which we have coined the acronym, COGENT. This Center will work with, and under the guidance of, industry in developing new generic and cross-cutting technologies of industrial import.

The Office of Productivity and Product Technology will also manage an EDA funded Positive Adjustment Program which will aid ailing or threatened U.S. industries. Assistance will be given in those cases where improved technology shows promise of improving the competitiveness of firms in the distressed industries or disadvantaged geographic regions. Under that program, we try to identify why an industry is suffering, where its competition comes from, and technological opportunities to develop comparative advantages for U.S. industry and economic benefit to various geographic regions of the country.

Under our Exploratory Technology Program we are concerned with new technologies, not yet based in an existing industry. Such programs may be mandated by Congress or we may see the need for exploring the potential intersection of technology and market. Resource recovery from urban waste and the development of guayule as a source of native American latex are examples of such programs.

In recognition of the potential benefit from an extension service for industry similar to that which has been so effective for agriculture, we are establishing a Field Services Division which will promote the adoption of the best industrial practices by industries which lack such capabilities. Initially we will use the field offices of the DoC and the Regional Commissions. This Division will manage the Corporations for Innovation Development (CID) Program to be initiated during fiscal year 1981 under the President's innovation program.

THE PRODUCTIVITY REFERENCE SERVICE

The Productivity Reference Service (PRS) will develop and implement a public information program to inform the public of the meaning and importance of productivity to the economy. This Service will disseminate widely the best available national and international information on productivity improvement stressing practical and tested systems, methods and problem-solving techniques for improvement. The reference service will maintain a collection of the best current materials in the field and make them readily available to the public.

PRS will encourage other Federal agencies and Departments to initiate, stimulate and support research and demonstration to increase the rate of productivity growth and develop, refine and apply reliable measurement techniques to assess changes in productivity.

PRS will maintain liaison with the private sector and with organizations, both domestic and foreign, involved in enhancing productivity including the growing network of state, local and non-profit organizations as well as the European and Asian Productivity Associations.

Within the Department, PRS will serve as staff to the Commerce Productivity group and coordinate Departmental activities for the National Productivity Council.

THE PATENT AND TRADEMARK OFFICE

Converting new ideas to marketable assets, to solid assets on which development investment can depend, is the function of the Patent and Trademark Office. It is included under the Assistant Secretary for PTI because its policies form an integral part of the policies affecting industry's development through science and technology. To increase its effectiveness in an era of rapidly changing technology and to ensure the maximum use of the knowledge embodied in its files, much of the dissemination task will be integrated into the NTIS. We look forward to a revitalized PTO over the coming years and applaud the effort it has made in this past year to bring its management and its resources into line with its important function.

THE OFFICE OF REIMBURSABLE FOREIGN PROGRAMS

The Office of Reimbursable Foreign Programs will negotiate and manage reimbursable foreign programs on Science and Technology and on its management. It will also prepare cross-cutting budgets for the PTO, NTIS, NBS, etc. to assist the administration in the management of its international technology programs.

THE NATIONAL BUREAU OF STANDARDS' ROLE

Now to address your principal concern today, the role of the National Bureau of Standards in the context of the Office of Productivity, Technology and Innovation. I don't need to convince this Subcommittee that the National Bureau of Standards is a major national resource and critical asset to the OPTI mission. Any organization which seeks "to enhance the productivity and development of U.S. industry through the strategic application of science and technology" must look to the NBS for historical perspective, know-how, proven methods, insight, advice, consulting, and outright help. Congress wisely established NBS 79 years ago at the early stages of our industrial revolution. NBS has played a key role in the maturation of U.S. industry and has learned how to work effectively at the interface of U.S. industry, government, and the universities for the mutual benefit of all participants. NBS scientists and engineers continually collaborate with their counterpart peers in industry as a way of life and a means of implementing the Bureau's mission. U.S. industrial executives continually bring to my attention their praise for the quality of research at NBS and the effectiveness of their services.

If the best way "to enhance the productivity and development of U.S. industry" in the competitive U.S. economic system is to provide a creative environment for research, remove the technical barriers to innovation, and to help industry collaborate in doing those things which can be done better and less expensively collectively, then NBS is on target and has been for 79 years.

If knowledge is best disseminated by person-to-person interaction, then NBS has proven mechanisms already in being. When NBS was established in 1901, Alexander Graham Bell drafted a resolution accepted by Congress extending Federal legislation of 1892 (which made government S&T facilities available for use by scientific investigators and students) specifically to include NBS. During the ensuing years, more than 1,000 engineers and scientists have been formally supported by more than 400 industrial organizations for extended research collaboration in NBS laboratories. There are currently 99 Research Associates supported by 31 industrial organizations in the NBS laboratories gaining expertise and extending their organization's research horizons in a most efficient manner. Well over 150 university professors and students will collaborate this year on various research tasks within NBS under the Guest-Worker Program. There are an additional 40 Post Doctorals in the laboratories. Over 16,000 engineers and scientists will confront problems and exchange knowledge in NBS specialized topic workshops and conferences during the year. These activities coupled with the extensive writing and speaking of NBS staff, the 22 Standard Reference Data Centers for technical data exchange, the more than 50,000 replies each year to requests from the public for information, the 37,000 certified standard reference materials distributed each year to 10,000 users, and the 3,000 instruments calibrated annually for 1,000 organizations amount to a prodigious flow of high-content knowledge and technical support from a laboratory of less than 1,400 professional engineers and scientists.

In addition, the NBS works with almost every other government agency that has technology intensive problems; here again, working both with the government agencies and the industrial representatives in the transfer and application of knowledge for problem solving.

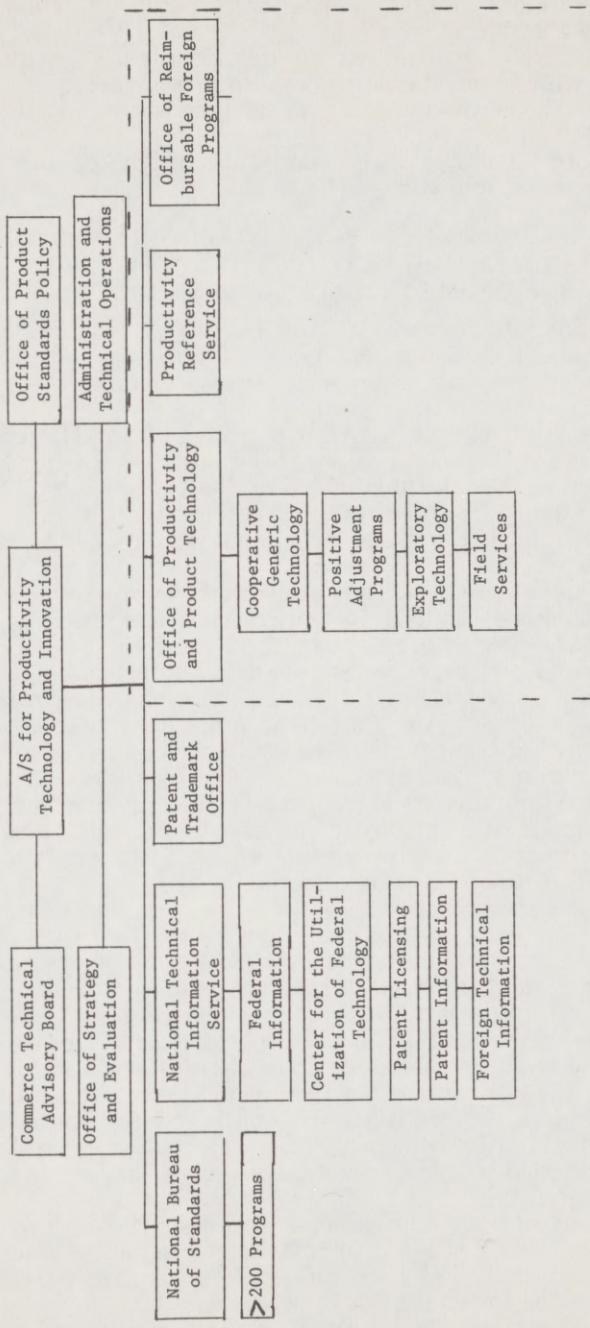
I could go on pointing out their other activities for encouraging U.S. innovation and commerce by discussing their joint efforts with state and local governments, standardizing bodies and international technology; however, the point has been made that NBS has a long-established record in the United States of programs for improving the environment and technology for industrial innovation and productivity growth. It suffices to say that NBS does early technological development long before it is appropriate to move the technology into a Cooperative Generic Technology Center or before it is practical in industry and then guides the technology into the S&T communities, standardizing bodies, national programs, government policy making, and industrial innovation. The scientific, engineering, standardizing bodies, and other agencies of government take NBS expert assistance and guidance for granted.

As in the past, I shall use NBS as a reference source for assessing the status of science and technology, for institutional guidance, for contacts with industry and universities, for historical perspective to prevent re-inventing the wheel, for expert staff assistance in critical circumstances, and for personal inspiration. Bureau programs will be continually evaluated for their potential impact on industry and on the nation's economic health. That evaluation process will ensure its continued relevance and excellence. To that I am committed.

I think it is clear, then, that the Bureau, the productivity and product technology activities, the NTIS and the PTO all fit together into a coherent whole. As I said earlier in my statement, the Office of the Assistant Secretary for Productivity, Technology, and Innovation will be "organized to enhance the productivity and development of industry through the strategic application of S&T," and in so doing will greatly enhance the opportunities and effectiveness of NBS.

In closing, Mr. Chairman, I would like to relate a comment made to me by Secretary Klutznick. When I outlined the changes to him, the new name and its acronym, he said "I like it. It's the first two syllables of "optimism" and it's where our country's real optimism lies."

Thank you for your interest today. I would be happy to answer any questions you may have.



ORGANIZATIONAL CHART FOR THE
OFFICE OF THE ASSISTANT SECRETARY FOR
PRODUCTIVITY, TECHNOLOGY, AND INNOVATION
OF THE

U.S. DEPARTMENT OF COMMERCE

KEY: - OPTI - - -

Senator STEVENSON. Our next witnesses are Dr. Ernest Ambler, Director of the National Bureau of Standards, and Dr. Thomas Dillon, the Deputy Director.

As I mentioned earlier, Dr. Ambler, we are very pleased with the job that you and your associates are doing, and immodestly claim some credit ourselves for having put you on periodic reauthorizations and subjected you to this process.

I hope it's been of help. That is certainly our intention, and we look forward to hearing from you.

STATEMENT OF DR. ERNEST AMBLER, DIRECTOR, NATIONAL BUREAU OF STANDARDS, DEPARTMENT OF COMMERCE; ACCOMPANIED BY DR. THOMAS DILLON, DEPUTY DIRECTOR

Dr. AMBLER. Thank you very much, Mr. Chairman.

Senator STEVENSON. Excuse me, but let me say to you and to all our witnesses, that if you can summarize the statements, the full statements will be entered in the record.

Dr. AMBLER. It was 2 years ago at your hearings on the National Bureau of Standards that you expressed the intent to hold regular authorization hearings. Today that intention has become a reality, and I am very pleased to be able to appear before you to testify on the subject of authorizations for the National Bureau of Standards for fiscal year 1981.

Dr. Dillon, with me at the table, was appointed subsequent to our last appearance. In his testimony he will discuss the specifics of our fiscal year 1981 budget as proposed by the President.

At our last hearings you expressed interest in the proposed NBS reorganization. I am very pleased to tell you that the reorganization took place smoothly in April of 1978, and it is working out very well. The major functions and responsibilities of the National Measurement Laboratory, the National Engineering Laboratory, and the Institute for Computer Sciences and Technology are clearly defined, and the staff skills and programs have been well consolidated by dividing the Bureau into centers which focus on important areas of scientific and technological need.

Particularly appropriate in the light of increasing concern for the support of our industry and manufacturing was the formation of focused programs in electronics and electrical engineering, mechanical engineering and process technology, and materials science. These programs are focused in three separate centers.

Electronics is one of the most important, most pervasive industrial technologies. The trend toward faster operation of smaller, more complex devices gives rise to the need for very demanding measurements. The NBS Center for Electronics and Electrical Engineering will build upon its successful program in electronic reliability to meet the measurement needs as industry moves to very large-scale integration.

In mechanical engineering and process technology, we will be concentrating on two areas of great importance to industry. One of these involves automation of the manufacture of discrete parts, a process that will reduce the unit costs of products.

NBS will support industry with research, data and standards. This will allow for the interchangeability of software in automated manufacturing, will facilitate quality assurance through in-process

inspection and control, and will support the development of improved machines for all systems.

The other area of importance to industry is that of continuous processing technology. We will provide new fluid and solid properties data for improved process equipment design and to facilitate the changeover to feedstocks produced from coal and shale.

We will provide new measurement principles and standards for online control and automation. We will provide engineering research in areas such as heat and mass transfer, separation and mixing for more efficient plant design.

And, finally, we will provide new combustion engineering data for better operating efficiency and scale-up of industrial combustion processes.

These new data, measurements and standards will help reduce capital costs, save raw materials, conserve energy, and reduce environmental pollution.

In the materials area, there is a growing trend toward the substitution of plentiful materials for those that are becoming scarce and therefore expensive. There is also the requirement to create materials having better performance characteristics.

NBS will provide industry with generic information on the performance characteristics of materials, such as durability, and on the actual chemistry and physics that take place as materials are processed.

This work will support the optimization of industrial processes for increased productivity, and the design and application of new materials and processes.

These three areas—electronics, automation, and materials—underlie most industrial developments, and can be expected to continue to make a big contribution to manufacturing productivity in the future. We have been building these programs since the time of the last hearings, Mr. Chairman, and I expect we will continue to develop these programs further.

In addition to these areas, we shall continue to work to the full accomplishment of our assignments under the "Brooks Act" to provide all needed standards and guidelines for efficient and effective acquisition and use of automatic data processing equipment by the Federal Government.

We shall strive, as a matter of top priority, to fulfill our role as the Nation's central reference laboratory. Thus we will continue our research in precision, physical, chemical and engineering measurement, and in doing so, we shall take advantage of the latest scientific developments and meet the measurement needs created by advancing technology.

In meeting national objectives in energy conversion and conservation, NBS will continue to provide support, on a reimbursable basis, to lead agencies, such as the Department of Energy, Housing and Urban Development, General Services Administration, and the Nuclear Regulatory Commission.

In the area of regulation, NBS will be increasingly called upon in the coming decade to provide measurement science, mathematical modeling and statistical analyses as a basis for rational and equitable regulation.

We are already involved in providing assistance to regulators and the regulated in areas of buildings, fire protection, consumer product safety, nuclear safeguards, and coal mine safety.

There will be special emphasis on many aspects of environmental protection, particularly with regard to radiation and toxic substances.

You also expressed concern at the previous hearings about the level of our technical competence. I am very pleased to be able to report that we have taken a number of steps to develop and support outstanding groups in world-competitive research. Such groups are expected to make fundamental contributions to scientific knowledge and to serve as resources for responding to future demands that are placed upon NBS.

To facilitate this competence buildup, we have received increments of \$2 million for competence building in 1979 and 1980, and we have also requested another \$2 million increment in the 1981 budget.

These funds are being used effectively and have had a greater impact on improving staff morale than anything I have seen in my years at the National Bureau of Standards. People are excited by this commitment and have responded with very creative scientific and engineering proposals.

I will now turn to the authorization bill. We are requesting an authorization for \$104.621 million in direct appropriations for fiscal year 1981, and such sums as may be necessary for fiscal year 1982. Our total request for fiscal year 1981 includes an authorization of \$87.733 million for our Organic Act activities, plus \$1.253 million for authorization of direct appropriations for our activities under the Federal Fire Prevention and Control Act.

In addition, we are requesting authorizations of appropriations for our activities under three other pieces of legislation whose authorizations will expire in fiscal year 1980 and which must therefore be reauthorized if we are to continue our work.

We already have an authorization for our Standard Reference Data Act activities in fiscal year 1981, but not for fiscal year 1982.

Therefore, we are seeking an SRD authorization of such sums as will be necessary for fiscal year 1982.

Activities under an additional four acts—including, for example, the Brooks Act, for which we are seeking an appropriation of \$11.603 million in the fiscal year 1981 budget—are presently under a continuing authorization. We have included them in our authorization bill so that the totality of direct appropriations to the National Bureau of Standards can be reviewed by Congress on the same time schedule.

Since the line items in our budget request are not easily identified with the statutorily mandated line items in this bill, I would like to submit for the record a crosswalk between these classifications, together with detailed levels of funding.

Senator STEVENSON. It will be entered in the record.

Dr. AMBLER. Finally, with regard to the other three items covered in the bill, two seek expanded authority, and the third seeks to statutorily embody our existing policy with respect to our work for other Federal agencies.

The first of the two items involving expanded authority concerns a need related to our ability to maintain and improve our facilities. Our proposal would increase to a \$250,000 the amount of appropriated funds which may be obligated by the Bureau for construction and improvement of existing NBS buildings.

At present, the Organic Act limits the funds which NBS may spend for such improvements to \$75,000 unless specific provision allowing NBS to exceed the limit is made by the Congress.

Since the purchasing power of the dollar has been reduced significantly since 1972 when this limit was increased to its present figure of \$75,000, we are proposing a new limit of a quarter of a million dollars, which is projected to be approximately the 1982 equivalent of \$75,000 in 1972 dollars. As you can see, our proposal essentially makes up for the effects of inflation.

The other item involving expanded authority proposes the addition of a new section to the Organic Act for the purpose of increasing the Bureau's present authority with regard to its international activities. Specifically, the section has three parts, the first would provide the Secretary with authority similar to that enjoyed by the National Science Foundation to assist foreign scientists and engineers who are performing scientific work of mutual interest to this country and theirs with some financial support beyond that provided by their foreign sponsor.

From past experience, we believe that this expanded authority would be highly beneficial to the Bureau and other scientific agencies of the Department in that it would increase our ability to attract and benefit from the collaborative research of visiting foreign scientists and engineers, and that it would prevent premature termination of research activities by such foreign scientists who come to work at NBS and at other scientific agencies at the Department, but find that they are faced with severe financial hardships due to the high cost of living here.

The second part would provide constitutionally required congressional consent for the scientific and technical employees of the Department to receive financial assistance, fellowships, lectureships, or other similar assistance from foreign governments for their collaborative scientific research in a foreign laboratory.

The third part would allow the Secretary of Commerce, when it is deemed in our national interest, to compensate aliens from neutral countries such as Sweden or Switzerland. It would provide the Department of Commerce authority similar to that presently enjoyed by the Department of Defense, NASA, the National Science Foundation, and the Department of Energy.

The third and final item in our bill would statutorily embody existing Departmental policy by specifying that the Secretary shall charge for any service performed by NBS at the request of another Government agency to comply with any statute containing a provision which specifically names the Secretary or NBS as a consultant on calls upon the Secretary or NBS to perform or cooperate in the performance of certain activities with, for, or on behalf of another Government agency, regardless of whether the statute specifically requires the Secretary or NBS to be reimbursed. Such charges, of course, will not be made when the costs are nominal.

That concludes my statement, Mr. Chairman. I certainly appreciate the interest your subcommittee continues to show in NBS, and I am gratified at the introduction in the Senate of S. 2320. Both of these will certainly assist in maintaining a strong Bureau.

[The attachment referred to follows:]

SCIENTIFIC AND TECHNICAL RESEARCH AND SERVICES—NATIONAL BUREAU OF STANDARDS CROSSWALK—PROGRAMS AND AUTHORIZATIONS, FISCAL YEAR 1981

[In thousands of dollars]

	NBS Organic Act	Federal Property and Administrative Services Act (40 U.S.C. 759f)	Fair Packaging and Labeling Act (15 U.S.C. 1457, 1458)	Energy Policy and Conservation Act (42 U.S.C. 6363)	Solid Waste Disposal Act (42 U.S.C. 6952)	Environmental Research, Development Demonstration Authorization Act	Earthquake Hazards Reduction Act (42 U.S.C. 7704)	Standard Reference Data Act	Total
Physical and chemical measurements and standards.....	19,005								19,005
Materials and thermodynamic measurements and standards.....	20,095								20,095
Measurement assurance program.....	2,684								2,684
Applied measurement program.....	2,957			1,357	1,918	245		3,248	9,725
Engineering standards.....	1,609								1,609
Safety and engineering research.....	4,579		87				425		5,091
Technical support to industrial productivity.....	17,505								17,505
Mathematical science.....	3,011								3,011
Fire science and engineering.....	1,253								1,253
Computer sciences and technology.....		11,603							11,603
Central technical support (Competence, central planning, post doc's, facilities, WCF transfers).....	16,288								16,288
Total NBS.....	88,986	11,603	87	1,357	1,918	245	425	3,248	107,869

¹ In fiscal year 1980 appropriation of funds authorized by the Federal Fire Prevention and Control Act as amended.

Dr. DILLON. Thank you, Mr. Chairman. I appreciate this opportunity to discuss the new programs proposed in the fiscal year 1981 NBS budget.

The proposed appropriation of \$107.9 million includes program increases of \$11.7 million, which reflect a continued improvement in the balance between near-term and long-term strategies for meeting our users' needs.

There is also a strong focus on contributions toward improving industrial productivity and competitiveness, particularly in the pervasive technology of electronics.

I shall now turn to a brief description of each increase.

First is competence. Two years ago, a program to enhance the scientific competence of NBS was initiated. Each year an increment of \$2 million has been added to the NBS appropriation base.

In addition to these directly appropriated funds, we have identified \$2.4 million within our base programs as work which is of the same character and which is considered part of the NBS research base.

The competence increases are putting us in a much stronger position to meet the Nation's future needs for NBS services. It allows some of our most creative researchers an opportunity to explore the fundamental questions which we anticipate will have great practical significance in the coming decades.

It also helps us to attract top technical talent to build a strong staff in the future.

The Director and I both feel that this program already has had an enormously positive effect on the creativity and overall tone of the Bureau.

The general trend in science towards multidisciplinary research is reflected in the 16 new competence projects initiated during the past 2 years. Recent advances in computers, data acquisition equipment, measurement technology and basic scientific knowledge make it possible to attack problems previously considered too complex for systematic analysis.

This has led to a natural convergence of scientific opportunity with the long-term technology needs of both Government and industry.

Thus, the long-term strategies being pursued by NBS are tied very closely to the planning thrusts described earlier by Dr. Ambler. The majority of our efforts relate to support for increasing industrial productivity, with efforts in electronics, high performance materials, and technology for continuous processing, such as chemical processing.

These technologies have been emphasized not only because of the projected economic significance of their primary markets, but also because of their secondary impact on productivity in virtually every major industrial sector.

In the general area of regulatory support, we have research related to low-level ionizing radiation and chemical toxicity. These efforts and the first-rate scientists we have attracted to work on them will provide the basis for some of the Bureau's most important contributions in the decade to come.

The second area is an increase for computing services. Our 14-year-old computer is outdated and cannot meet all the computation

demands of our scientific programs. We have surveyed our professional staff to assess their long- and short-term computing needs. All senior managers and a good cross-section of knowledgeable scientists are participating in developing a requirements study which we plan to submit to the Department of Commerce this spring.

In this budget, we are requesting \$1 million to meet the most urgent current computing requirements of our programs by procuring services from private sector vendors and other Federal agencies.

The third increase is for very large scale integrated circuits. NBS will develop test procedures and measurement techniques needed by our semiconductor industry to meet the precision measurement and quality control demands associated with the manufacture of very large scale integrated circuits, or VLSI circuits.

A VLSI circuit is a complex blend of ultrapure materials in a microscopic, but very precise, geometrical pattern. The hallmark of today's semiconductor industry has been extremely precise control of materials purity and process variables.

However, evolving VLSI technology is going to require a whole new generation of measurement techniques for the control of dimensions, materials purity, dopant introduction, impurity and defect distributions, and overall circuit performance. The semiconductor industry is looking to NBS for the development of these techniques.

The objective of VLSI technology is, in simplest terms, to etch ever narrower lines on silicon in order to pack a greatly increased number of circuit elements on a chip. Best current production technologies use line widths from 2 to 3 microns.

By comparison, a human hair is about 80 microns in diameter. At this time industry efforts are directed at reducing line widths to about 1 micron, but many scientists believe that fundamental physical limits to miniaturization might permit circuit patterns defined with lines one-third of a micron wide.

The NBS program is directed toward overcoming measurement problems associated with manufacturing circuit lines with such extremely narrow widths. Simple geometrical and dimensional control becomes extremely complex as the lines become comparable to the wavelength of visible light used in industrial microscopes.

Also, when line widths narrow by a factor of four or five, the volume of actual circuit devices decreases by a factor of up to a hundred. For these very small volumes, the precise control of impurities, dopants and crystal microstructures is very much more difficult than is the case for current devices.

Finally, many of the basic approximations used to interpret today's measurements are not valid for such small structures, and a more fundamental understanding of semiconductors will be needed.

In summary, VLSI technology will require substantially expanded measurement and control capability in the face of increased intrinsic difficulties associated with small widths and volumes.

Specifically, the proposed NBS effort has six components:

One, measurement techniques for characterizing semiconductor materials, particularly surface distortions of silicon wafers that can adversely affect subsequent processing steps;

Two, procedures for evaluating the interfaces between different materials in the circuit structure;

Three, measurements for the on-line monitoring and control of fabrication processes for VLSI, with emphasis on circuit patterning and dopant control;

Four, special circuits called test structures which are electrical diagnostic tools for VLSI circuit processing and performance;

Five, circuits that can be used to characterize reliability and the probability of faults in VLSI circuits after manufacturing is completed; and

Six, procedures for evaluating VLSI packaging technology in terms of mechanical integrity and heat transfer characteristics.

The work will require the efforts of scientists with indepth knowledge in a number of different areas such as electronic properties of solids, submicroscopic flaws, trace chemical analysis, solid state theoretical physics, surface defects, and the precise measurement of very small dimensions. NBS has this broad range of scientific and measurement expertise.

The fourth increase is for our facilities modification. With this funding, we will begin modifications to improve the accessibility for the handicapped to our major facilities at both Boulder and Gaithersburg.

Barriers at main entrances of buildings, corridors, doors, elevators, restrooms, drinking fountains, and public telephones will be eliminated.

In addition, we will begin the replacement of aging plant equipment. We are completing a study now that predicts the life expectancies for various types of plant equipment, establishes a time table for replacement, and determines the most appropriate means to finance the costs.

Priority attention is being given to the repair or replacement of any equipment which represents a potential health or safety hazard such as laboratory exhaust hoods and ducts.

Finally, the fifth area, we have a proposed increase of \$5 million for a number of basic research projects that are discussed in considerable detail in the NBS budget document.

Mr. Chairman, this concludes my statement. I will be happy to respond to any questions you might have.

Senator STEVENSON. Thank you, Dr. Dillon.

Gentlemen, how do you respond to the suggestions in the GAO report on NBS? I assume you are familiar with that report. It dealt with three items, implementation of the lead agency concept; it contained a survey of users' opinion of the Bureau's services; and an assessment of whether the various statutes affecting NBS conflicted with the Organic Act.

It suggested that the way to improve the implementation of the lead agency concept was to have Congress make clear the areas in which NBS was to have lead agency responsibility.

How do you react to that report and that suggestion, in particular? Should we be doing more up here?

Dr. AMBLER. I have always regarded the Organic Act of the National Bureau of Standards as defining the Bureau of Standards to be the lead agency in measurement science. Certainly it applies in those basic and generic measurements that underlie all of science and technology that are used broadly.

In recent times we have had difficulties with the lead agency concept, in sorting this out particularly with EPA. However, we have been negotiating at great length with EPA, and I think we have successfully negotiated a way to deal with that situation.

I have given some thought to what it would mean if the Bureau of Standards were mandated to do all measurements in the Federal Government, and I think that that would be a little sweeping and impractical, and perhaps one should think carefully about that.

For example, there are many measurements conducted by other agencies that are very specific to the kinds of programs that they are conducting.

Let me just mention, for instance the laser fusion program. By the very nature of this program, the machine, all the equipment and the measurements must be done in situ.

On the other hand, there are certain aspects to this laser fusion program such as fundamental power and energy measurements of radiation, temperature, and particle density that the Bureau should do.

So that in responding to the GAO report, I can well realize that this matter needs some thought, but I don't think it is just as simple as saying that the Bureau of Standards can be responsible for all measurements, however detailed and specific, throughout the whole of the Federal Government.

Senator STEVENSON. Well, beyond the Organic Act, there are a lot of other missions which have been assigned to NBS in recent years. What's the best way to proceed? With the Congress doing nothing more? Leaving it to the agencies involved, ad hoc, to sort out the NBS role?

Dr. AMBLER. Are you referring now not specifically to the basic measurements area, but assignments that we get through other pieces of legislation?

Senator STEVENSON. Well, both, but I wanted to bring those in.

Dr. AMBLER. Yes. Well, with regard to the latter, it was certainly true, as we had testified in our last appearance that pieces of legislation had given additional assignments to NBS without providing any funding to NBS to carry out the mandates in the legislation. Section 6 of our bill would act to statutorily embody our existing policy with respect to such cases where another agency has the lead. If we are requested to do work for another agency that Congress has not provided us with funds to perform, we will only do the work if we are reimbursed.

Statutorily embodying our policy would make it easier to deal with the problem, I think.

Senator STEVENSON. You say the problems with EPA have been worked out?

Dr. AMBLER. Yes, sir.

Senator STEVENSON. As Dr. Dillon was mentioning, the 1981 budget request shows a net increase of \$11.1 million—it is \$11.1? I understood you to say \$11.7.

Dr. DILLON. It's \$11.7 million of increases offset by about \$600,000 worth of decreases in the program.

Senator STEVENSON. Oh.

Dr. DILLON. So the net is \$11.1 million.

Senator STEVENSON. Dr. Ambler, what was the next item on your list of priorities that was not funded?

Dr. AMBLER. It was automation technology, it was the program to strengthen the automation program for discrete parts manufacturing.

Senator STEVENSON. This reorganization, I guess, won't affect NBS much, or will it?

Dr. AMBLER. This is the one that was described by Dr. Baruch?

Senator STEVENSON. Yes.

Dr. AMBLER. No, I don't expect that it will affect our own internal management operations. No, sir.

Senator STEVENSON. You requested \$3 million for research under the Earthquake Hazards Reduction Act, and 3½ million for research under the National Climate Program Act. Those are programs of special interest to this committee. We originated the legislation.

Those items were not approved. Why not? And what is the effect going to be for those programs of those denials?

Dr. AMBLER. I am not sure why they weren't approved. Under the Earthquake Hazards Reduction Act, we do have in our budget approximately \$425,000. Our first and most important assignment under that act is to incorporate existing technology and do standards for building codes for Federal buildings. We expect to have that completed by the end of this calendar year.

The act then calls upon us to do research, and essentially to update those standards, incorporating new technology. That will go more slowly than what it would have done had the request been granted.

With regard to the climate program, we have been working closely with the interagency committee in designing a plan to respond to the National Climate Program Act. We, in particular, have laid out a program for conducting or providing those measurements that would be necessary.

It is my understanding that the authorizations for the National Climate Program Act will come under the NOAA legislation, so that we would pursue that as another agency program.

Senator STEVENSON. I understand that \$5 million was added for basic research at the suggestion of OSTP. What is that money going for, and isn't more funding necessary for facilities, and equipment, including computer facilities, in order to carry out these missions, including the responsibilities for basic research? Shouldn't some of that money go into facilities as opposed to basic research?

Dr. AMBLER. In order to conduct the basic research?

Senator STEVENSON. Yes, on other missions. How about computers? You requested—let's see, an additional \$5 million for computing services, I believe. \$5.1 million for equipment modernization, and \$4.5 for facilities modernization, which were turned down, and then got to the additional \$5 million for basic research at the instance of OSTP.

Dr. DILLON. Well, Mr. Chairman, the approach we have taken, both in competence and on the basic research funds is to use those appropriations to support the scientists themselves.

In addition, we have a general equipment fund that gets extremely high priority attention, and the programs that get started under the competence and the basic research programs, will get equipment from a different source.

In addition, we are providing for the computing requirements associated with these new program starts, both in technical competence and basic research in our requirements study, and are receiving very high priority in assessing our needs for computing resources.

If we are not able to get expansions in those other items, we will have to start considering using portions of these funds for that purpose. But at this time it hasn't been necessary.

Senator STEVENSON. Well, I don't think you have the authority to do that unless we give it to you.

Dr. DILLON. We will request the allocation of the money at the time. For this budget, it will not be necessary.

Senator STEVENSON. Now you're implying that the \$15 million for computing services, equipment modernization, and facilities wasn't needed. If not, why was it requested?

Dr. DILLON. Mr. Chairman, those are all long-term programs that are very, very much needed at the Bureau of Standards, and we are developing careful studies to insure that we take the most cost-effective steps to meet those needs. Those preliminary studies have been done, and are the basis for the requests. We are doing more detailed studies now, and we will be submitting them to the Department this spring.

Dr. AMBLER. Mr. Chairman, I don't think we could use that basic research money for facilities, that's correct. However, if we determine that the programs that we were supporting under the basic research program needed, in order to be conducted efficiently, computing support, I'm sure we have that authority, because that's another object of expenditure for that program.

Senator STEVENSON. You would have the authority, but you might not have the money, it sounds like, unless you come back with a supplemental.

Now, S. 2320 authorizes such sums as may be necessary for fiscal 1982. We rarely authorize or approve open-ended authorizations.

In fact, I can't think of any.

We need an estimate of what will be required for 1982. Can you give it to us?

Dr. AMBLER. I don't have it now. I would have to consult with the Department and it will have to obtain OMB approval for the submission of any numbers.

Senator STEVENSON. Could you do that and give us an estimate? I don't think we are going to put in "such sums as may be necessary." We don't like open-ended authorizations.

Dr. AMBLER. As I said, we will have to consult with the Department.

Senator STEVENSON. Well, if you would supply that for the record, we would be grateful.

[The following information was subsequently received for the record:]

The Administration prefers not to include outyear projections in authorization bills because such estimates normally undergo numerous revisions before the final budget is formulated. Accordingly, we cannot supply the Committee with any estimates for fiscal year 1982.

Senator STEVENSON. Is the Bureau considering any activities that would develop the basic competence in biotechnology?

Dr. AMBLER. We do have programs that relate to that. For example, some of our work in the materials area does relate to synthetic implants which I think would fall in that area.

Are you asking whether we were considering it as a competence project?

Senator STEVENSON. Yes.

Dr. AMBLER. Competence funding has not been proposed for any project in that area yet, sir.

Senator STEVENSON. Well, I hope you will take a look at it.

We have developed some interest in the field. It looks explosive, like an area in which the climate is pretty congenial in the United States, and yet we are putting together some evidence which begins to indicate that the Japanese are moving ahead of us here, too.

I don't know how your missions would relate to all of it, but it strikes us as a subject that's deserving of some serious attention by the NBS with respect to competence-building.

Dr. DILLON. Mr. Chairman, we are looking into the biotechnology in the sense of gene-splicing in our central planning office, for exactly this purpose, to try to assess what would be the scientific and technological impacts in the future associated with those kinds of developments.

Senator STEVENSON. Well, that's great.

As you indicated, the Bureau has undergone a significant reprogramming. According to the visiting committee, this reprogramming was not without cost. Do you anticipate the need to conduct any further reprogramming in the next 2 fiscal years?

Dr. AMBLER. Nothing of the magnitude that was done in fiscal 1979 and 1980. I would expect some normal redirection of programs, but nothing on a grand scale.

Senator STEVENSON. Would you keep us informed about such redirections?

Dr. AMBLER. Yes, sir.

Senator STEVENSON. OK; thank you. We may have a few additional questions. I would appreciate some—well, as precise an estimate as you can give us of the 1982 authorization requirements. But if there are questions, we will have to submit them to you in writing and get back the answers for our record.

Thank you very much, gentlemen. We appreciate your help this morning.

Dr. AMBLER. Thank you, sir.

Senator STEVENSON. The next witnesses are—I'll ask them both to come forward and try to save some time—Dr. Dale Compton, vice president for research of Ford Motor Co., and Dr. Mildred Dresselhaus, director of the Center for Materials Science and Engineering at MIT.

May we proceed with you, Dr. Compton?

Dr. COMPTON. Glad to, Mr. Chairman.

STATEMENTS OF DR. W. DALE COMPTON, VICE PRESIDENT, RESEARCH, FORD MOTOR CO., DEARBORN, MICH., AND DR. MILDRED S. DRESSELHAUS, DIRECTOR, CENTER FOR MATERIALS SCIENCE AND ENGINEERING, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE, MASS.

Dr. COMPTON. I appear before you today as the current chairman of the National Bureau of Standards Visiting Committee. The other members of the committee are listed in the text of the testimony.

As you know, the visiting committee has a statutory obligation to visit the Bureau at least once a year and report to the Secretary of Commerce upon the efficiency of its scientific work and the conditions of its equipment.

During my membership on the committee, we have met twice a year and reported to the Secretary annually concerning our findings and our recommendations.

Let me begin by noting that the visiting committee believes that the Bureau of Standards is in good hands. Dr. Ambler and his staff continue to offer the Bureau the strong creative leadership that is needed as the Bureau strives to maintain its reputation as a center of excellence.

The visiting committee strongly believes that the Bureau must be recognized as the leading authority in its fields of expertise with personnel and programs of unquestionable excellence. Only then will the Bureau be capable of fulfilling its long-term responsibility of enhancing productivity and innovation in the U.S. measurement techniques, technology, standards, and data that are crucial to the process in quality control for R. & D. and innovation with the exchange of goods for equitable regulations.

The future needs for these services are particularly clear in some pervasive technologies that are critical to many sectors of the U.S. industry to which the NBS will be providing important support in the 1980's.

The NBS policy of close collaboration with both industry and academic counterparts will be particularly important in insuring rapid transfer of technology to the actual users.

The past few years have not been easy for NBS. Events, many beyond their immediate control, combined to create an atmosphere that threatened to destroy the viability of the Bureau.

While I am pleased to report that the visiting committee recognizes that the Bureau has made considerable progress in solving these problems, we want to encourage this subcommittee to provide the financial flexibility that is needed to sustain the revitalization of the Bureau.

It is essential that the progress made during the past 3 years not be lost.

In order to place in perspective the issues that we consider so important, I would like to review some of the key events that have taken place over the past 3 years. I believe this can best be illustrated by extracting selected sections of the past reports that were made by the chairmen of the visiting committee to the Secretary of Commerce.

In 1977, Mr. Peck stated the following:

NBS is on the brink of serious trouble. The persistent retrenchment that has taken place threatens to bring NBS to a mediocrity that is unacceptable * * *.

Shocking gaps exist in NBS' ability to carry out its basic assignments, even without supplemental assignments. New assignments thrust on the Bureau without funding or personnel have forced NBS leadership into defensive management, whereby long-range programs are sacrificed to salvage short-term objectives. The declining quality of work is reaching a critical state. One study indicates that basic research in constant dollars may have dwindled to half the level of 10 years ago. Fifteen new laws since 1965 have given NBS assignments, yet the NBS overall budget in constant dollars has not increased * * *.

Perhaps the most important signal of trouble is the effect on the talented people who make NBS a strong institution. Weakening morale and individual concerns for lack of consistent direction and support are plain. * * * Effects are apparent also in the difficulty NBS has in attracting the very best graduating scientists * * *.

You can see that the situation was far from good. But, fortunately, there were indications that it was about to improve. Late in 1978, Dr. Robert Dicke wrote to Secretary Kreps:

Recovery is underway and a positive attitude pervades NBS. While the Congress has not yet completed its actions on the 1979 budget request, it appears quite certain that the Bureau will receive a very substantial increase in its appropriations. It is now possible for the Director of NBS to look forward and not backward.

In its continuing concern about the allocation of resources, the visiting committee made four points in its 1978 report to the Secretary:

First, the 1979 budget recommendations give NBS a good start on the road back to excellence. But one budget cycle will not suffice for more than a start. If the commitment to increased investment is not continued in 1980 and for at least five succeeding years, the Bureau will fall short of the goals and objectives of the Administration.

Second, the visiting committee places its highest priority upon the continuation of "competence building" at the NBS as the single most strategic approach to public investment in scientific excellence. We believe that "competence building" should be at least a five-year program in the Bureau. Damage incurred in a large institution over many years cannot be corrected in a shorter time than that.

Third, we strongly endorse the new directions represented by the proposed budget increases for 1980, because they will position NBS to make a timely start in areas of advancing technologies which will strengthen U.S. industry in the world markets. * * *

Fourth, the visiting committee is fully aware of the President's 1980 budget policies. In scaling the Bureau's budget estimates for the 1980 budget, in terms of realism, the managers of NBS have undertaken a bold initiative to reduce or terminate a wide range of existing projects in order to accommodate higher priority budget increases. * * *

On the matter of reprogramming, it is very doubtful, in our view, that the orderly pursuit of scientific investigation can be achieved if reprogramming is attempted on such a large scale repeatedly and especially at short intervals. The current reprogramming actions should be seen for what they are: an unusual and extraordinary managerial effort to present a supportable budget increase within the policy constraints of the 1980 budget. * * *

And now briefly from last year's report.

The major reprogramming of the Bureau's activities is now 50 percent complete, with the remainder planned for the coming year. It should be emphasized that good and important programs were eliminated with this reprogramming to permit the introduction of new programs. The cost to the Bureau of this reprogramming was high, particularly to morale. The committee believes that another major reprogramming of the Bureau in the next few years would represent a serious threat to the continuation of the Bureau as a valuable laboratory.

The committee has examined the new competence building program with care and believes it to be well managed. We have heard from the individual scientists and have examined their plans. Rebuilding the scientific competence of the Bureau will require an extended period of time, and both the committee and the Bureau give the continuation of this program the highest priority.

The competence of the scientific and technical staff of the Bureau is central to the competence of the Bureau. But a good staff requires good equipment, and your committee regrets to report two serious deficiencies: first, the computational support system of the Bureau is obsolete and inadequate. Second, the rate of replacement of obsolete experimental equipment is so slow that it falls steadily behind.

Reports from the 21 evaluation panels of the National Research Council emphasize the need for a major initial effort in catching up, followed by a continuing program of upgrading of computer facilities, necessitated by the rapid advances in computer technology and concomitant rapid obsolescence of computer equipment. * * *

From these excerpts, I am sure you can understand why we are cautiously optimistic about the future. To remove our remaining concern would require assurances that actions already taken would not be reversed and that support for critical fundamental activities would be continued.

And since most of the problems are related to budgets, we feel that these authorization hearings occur at a key time. The continued health of the Bureau depends upon many factors, but we would place top priorities on the following:

First, major shifts in program direction; that is major reprogramming, should not be allowed to recur.

Second, the competence building program must receive continued support.

Third, the equipment needs of the Bureau, including both the replacement of obsolete equipment, and the acquisition of new computers, must be addressed.

And fourth, any new legislation that assigns tasks to the Bureau must include provisions for additional funds and positions for the Bureau.

If these actions were to be assured, we would be confident that the management of the National Bureau of Standards could accomplish its objective of returning the Bureau to its previous position of recognized excellence.

The NBS visiting committee recommends these factors to this subcommittee for their consideration in formulating both the current and future authorizations for the Bureau of Standards.

The question then is whether the proposed fiscal year 1981 budget for the Bureau and the funding levels indicated in the authorization bill are adequate to accomplish these objectives.

At the February meeting of the visiting committee, the then proposed fiscal year 1981 budget was reviewed by the visiting committee. We considered that proposed budget as being responsive to the high priority needs enumerated a moment ago. We understand that events since that time may force modifications to that budget that could raise new problems for the Bureau.

So my next few comments will relate to what we understood the situation to be in February.

As of February, major reprogramming of a magnitude that would be detrimental to the health and well-being of the Bureau was not anticipated. The competence building program continues with an increase in the proposed fiscal year 1981 budget of \$2 million over that contained in the fiscal year 1980 appropriation.

While we view this as a very modest increase, we strongly support the allocation of an additional \$5 million in basic research funds for programs that will be developed within the National

Engineering Laboratory and the National Measurement Laboratory. The combined effort of these two increases will be very positive and we strongly recommend your support of them.

If more recent budget constraints should lead to a reduction in either of these items, the visiting committee would view this with a very considerable alarm. This program is the core of the entire effort to rebuild the scientific base of the Bureau.

To reduce it at this stage would doubtless cause serious delay and damage to the rebuilding effort. I simply cannot overemphasize this issue to you.

It appeared to us that the equipment needs of the Bureau are only marginally met by the February proposed authorization. We viewed this with serious concern. As you know, this is not a new problem for the Bureau. The problem was most recently recognized in the early 1970's.

In 1974, an equipment modernization program was initiated that was intended to replace obsolete equipment. The plan was to add about \$2.1 million to the NBS budget each year, until a total of \$15 million was reached.

This program was scheduled to terminate in fiscal year 1981, with a final appropriation of \$1.4 million to reach the total of \$15 million.

I understand that the budget as proposed in February instead includes \$2.1 million for equipment modernization, and that this is viewed as a 1-year extension of the equipment modernization program.

While we endorse the inclusion of this item and its increase from the originally planned \$1.4 million, we are concerned that there is apparently not a long-term commitment to solving this problem.

Any further reduction in this budget item would create a still greater barrier to achieving the restoration of the Bureau to its level of excellence.

Of a more serious nature is the lack of adequate budget to address some of the computing needs of the Bureau. The inclusion of a \$1 million increase for computer services appears to the visiting committee to be quite inadequate.

Not only does this amount appear inadequate for the purchase of computer services, the proposed budget apparently includes no provision for computer acquisition.

Furthermore, since this authorization bill addresses both fiscal year 1981 and fiscal year 1982, the visiting committee urges this subcommittee to go on record as recognizing that the equipment and computer needs of the Bureau are not accommodated in the proposed fiscal year 1981 budget or the authorization bill.

I must also draw the attention of the subcommittee to the fact that the 1980 pay raise supplemental for the National Bureau of Standards is not fully funded in fiscal year 1981. This represents an approximately \$2 million decrease in the NBS budget.

This action would effectively wipe out a net \$2 million programmatic increase that was appropriated at the NBS for fiscal year 1980.

We recommend that serious consideration be given to authorizing the full amount of the fiscal year 1980 pay raise supplemental.

The final issue was alluded to in an earlier portion of my remarks. On a number of occasions over the past several years, the Congress has enacted legislation that assigned specific responsibility to the Bureau of Standards.

These assignments have not generally carried with them appropriations of additional funds and positions. Such legislation has the impact of forcing a reprogramming of Bureau efforts.

I am sure you will understand that the visiting committee considers this to be a very undesirable action. We urge the subcommittee and the full committee to do everything in its power to assure that any new assignments for NBS be accompanied by sufficient new resources to do the job.

As we understand it, the bill under consideration would authorize a sum that was exactly equivalent to the budget as proposed in February. We would urge you to authorize an amount somewhat in excess of the proposed budget. We believe that this action would have two important benefits:

First, it would provide the flexibility to accommodate any additional directives of Congress.

Second, it would provide a knowledge that the proposed budget for fiscal year 1981 does not adequately address the need for modern equipment.

Mr. Chairman, on behalf of the visiting committee, I want to express our appreciation to you for inviting us to express our views.

Senator STEVENSON. Thank you, Dr. Compton.

Dr. Dresselhaus.

Dr. DRESSELHAUS. I'm very pleased to appear here today with Dale Compton to discuss my views on the activities and priorities of the NBS program.

I appear here in my capacity as chairman of the steering committee of the evaluation panels of the National Bureau of Standards.

In the testimony that I submitted, I had a description of what it is that the evaluation panels do. For the sake of brevity, I might skip over that description, unless you would like to hear about it explicitly.

Senator STEVENSON. Your full statement will be entered in the record, too, Dr. Dresselhaus.

Dr. DRESSELHAUS. I'd like then to move on to some general observations. Many of these are in concert with what you have just heard from the Chairman of the Visiting Committee to the Bureau.

The Evaluation Panels and Visiting Committee in some sense worked together, the Visiting Committee providing advice and the Evaluation Panels providing evaluation and critique of the current programs and suggestions for change.

The size of the NBS staff has remained constant for many years. During the last decade, the frontiers of science have advanced rapidly in many important fields and the areas of responsibility of the Bureau have also been greatly expanded. As new technologies develop, new science and understanding is needed to fully utilize these technologies and to extend their exploitation to new areas of opportunity.

To develop the underpinnings of each technological advance, an investment of resources and personnel at this basic level of understanding is needed in order to be able to carry out the application effectively.

With the constraint of a constant-sized staff, some of the vital needs of the Bureau program have not been met adequately in recent years.

Pressures to meet short-term goals have often been satisfied at the expense of long-term objectives. Standards work is exacting and demanding, and it must be done by a highly experienced and competent staff. It takes a long time to develop such scientists and engineers.

Thus, the evaluation panels in recent years have consistently emphasized the need for increased effort in the basic underpinnings of the science and technologies used to carry out the unique NBS mission in metrology, standards and data.

The evaluation panels have further continued to emphasize the importance of maintaining the technical excellence of the NBS program which is so vital to the nation and is unrivaled internationally.

On the other hand, the evaluation panels strongly emphasize that the vitally needed increase in effort in the basic sciences and engineering sciences not be accomplished by another major reprogramming exercise.

In the opinion of the evaluation panels, the Bureau has in recent years undergone more reprogramming than the fabric of the organization can withstand.

In my invitation to speak before the subcommittee, there was a specific request for my views regarding activities and priorities of the Bureau as reflected in the fiscal 1981 budget. I will speak to some of these briefly.

Top priority should be given to the \$2 million increase in the competence building program, and in addition to the \$5 million in basic research funding. To maintain the technical viability of the Bureau for carrying out its mandated mission, both programs together are essential.

Attention to equipment modernization is vital, and must be addressed by a long-term commitment. The present equipment modernization program which currently provides a 5.9 percent equipment replacement is lower than the norm in industry and academia by at least a factor of two.

Attention must also be given to the serious problem of inadequate computation capabilities for carrying out the Bureau's mission. The proposed \$1 million increase for computer services represents a step in the right direction, but is far below what is needed to provide even marginally adequate computation capabilities.

Increased appropriations will be necessary in fiscal year 1982 to address these needs both for equipment and for computation.

I will skip over some of my prepared statement on the new initiatives. I discuss them in some detail in my written statement.

I had expected to say more in support of the competence building program, but Dale Compton covered that so completely that I think I'll just leave it at that and answer questions that you may have during the forthcoming question period.

I would now like to make a few remarks concerning the laboratory equipment situation. I'd like to cover that topic more completely than Dr. Compton did, primarily because this is an area which each of the 17 evaluation subpanels examine annually.

In 1973, the Evaluation Panels identified the lack of state-of-the-art laboratory equipment as the most pressing Bureau need. The Department of Commerce responded by starting an equipment modernization program. This program has annually provided additional money to the working capital fund from which general equipment purchases are made.

The working capital fund is then reimbursed from operating funds over the expected lifetime of the equipment. Because of economic inflation and because of the increasing sophistication and cost of state-of-the-art equipment, reimbursements to the fund are inadequate to provide replacement cost of equipment and to allow purchase of newly developed equipment capability.

The Evaluation Panels have consistently stressed the importance of providing increments to the fund each year for new equipment purchases. The equipment modernization program has been absolutely vital to the implementation of automatic measurement and test procedures made possible by recent developments in the computer industry, including microprocessors, and minicomputers.

The equipment modernization program is absolutely vital for carrying out the Bureau's mission. It must be adopted as an ongoing program and at a somewhat accelerated rate to maintain proper support to the overall Bureau program.

I will now make some comments on the Bureau's computing needs. This year I have asked each of the Evaluation Panels to consider the specific issue of the scientific computing needs of the program under its purview.

When all Evaluation Panels have met, we plan to assemble an overall picture of the scientific computing needs of the Bureau.

Based on the meetings to date, I can summarize succinctly the major preliminary findings; namely, that the central computing facility of the Bureau is inadequate for carrying out the present NBS programs. This computation need is reflected in the fiscal year 1981 budget, which contains a request for \$1 million for the purchase of external computing support.

The Evaluation Panels have stressed the need for updating central computing facilities and computational capability by the lease or purchase of additional computing equipment.

The Evaluation Panels further stress the need for development of a long-range plan to provide adequate computation capabilities to carry out the Bureau's mission.

To some extent, the computational needs of the Bureau can be accommodated by the rapidly developing capabilities of minicomputers, and in this context, the Evaluation Panels have strongly endorsed an increased use of minicomputers within the Bureau.

Nevertheless, there are many needs that cannot be met by minicomputers, and to accommodate large and complex computations that are necessary to carry out the basic Bureau mission, a new central computing facility is desperately needed.

It is recommended that this need be given high priority in the fiscal year 1982 budget.

I have some comments on other agency funding in my prepared statement. This has come up several times. Perhaps I could skip over that since it is in my prepared statement.

Dr. Compton has also covered this quite well.

So, in closing, let me add that the Bureau is in good hands, as Dr. Compton said. The present Bureau administration provides stable, strong, and imaginative leadership. The Evaluation Panels have provided an annual and systematic program review as well as an abundance of constructive criticism.

These evaluations have provided the stimulus for systematic planning and reprogramming. Though the Evaluation Panels act very independently of the groups under evaluation and of the NBS management generally, an excellent rapport and working relation has been established over the years.

It is the goal of both the Bureau management and of the Evaluation Panels to insure that the National Bureau of Standards remains an international center of excellence in areas of its responsibility, and we work together in our separate ways to achieve this goal of excellence.

I thank you for this opportunity to speak.

[The complete statement follows:]

STATEMENT OF MILDRED S. DRESSELHAUS, CHAIRMAN, EVALUATION PANELS FOR
THE NATIONAL BUREAU OF STANDARDS

INTRODUCTION

I am pleased to appear here today to discuss with you my views on the activities and priorities of the National Bureau of Standards with particular relevance to the fiscal year 1981 budget. I appear here in my capacity as the Chairman of the Steering Committee of the Evaluation Panels for the National Bureau of Standards. I have served in this capacity since July 1978, subsequent to the expiration of the term of office of Dr. William O. Baker, then president of the Bell Telephone Laboratories. I speak to you today on behalf of the Evaluation Panels also as a private citizen and an academic research scientist with a great personal interest in the vital functions that the Bureau performs for the nation. I commend the Subcommittee for its interest in this important national institution and express my appreciation to you for inviting me to speak on behalf of the Evaluation Panels. Let me now provide some background on the Evaluation Panels for the National Bureau of Standards.

Since 1959, the Department of Commerce and the National Bureau of Standards have invited the National Research Council, the operating arm of the National Academy of Science, to provide, on an annual basis, an external evaluation of the technical functions and operations of NBS. The evaluation program is supported by a contract between the National Academy of Sciences and NBS.

In discharging its responsibility, the National Research Council selects and appoints experts in areas relevant to NBS operations to a series of Evaluation Panels. The term of a Panel is usually 3 years and never more than 6 years. There are currently about 230 Panel members participating in this evaluation process, each giving freely of his or her time with reimbursement only for travel expenses. These experts serve the Bureau and the nation out of sense of patriotism.

The detailed evaluation of specific program areas is accomplished by 17 Subpanels, which consider a variety of issues in their evaluation including: technical functions and operations of each specific program area, the importance and relative priority of the specific projects, the quality of the programs and the staff, the adequacy of equipment, computation facilities, funding and personnel for carrying out each of the specific projects, and the relation of each project to the mission of NBS. These Subpanels, composed of our nation's leading scientists and engineers from the academic, industrial, and government communities, provide a continuing and valuable resource for information transfer to the staff and management of the National Bureau of Standards.

In addition to the 17 Subpanels, there are Panels responsible for the evaluation of the three major technical units of NBS: the National Measurement Laboratory, the

National Engineering Laboratory, and the Institute for Computer Sciences and Technology. The membership of these three Panels includes the Chairmen of the constituent Subpanels, several members at large, and a Panel chairman. These three Panels are responsible for examining the broad programs and long-range plans of each major technical unit, and for reviewing and coordinating the work of the constituent Subpanels. The chairman of these three Panels make presentations to the NBS Visiting Committee on an annual basis. Guidance and general oversight to the entire evaluation program is the responsibility of the Steering Committee consisting of the chairmen of the Panels for the three major technical units, some at-large members, and a chairman, who is responsible for coordinating the whole activity and making presentations to the NBS Visiting Committee, the Secretary of Commerce, and the National Academy of Sciences.

Each Panel and Subpanel annually prepares a written report summarizing its findings. After undergoing the review process of the National Academy of Sciences, these reports are delivered to the Director of NBS. They are also available to the public. Mr. Chairman, in order to provide you with the detailed findings of the Evaluation Panels, we regularly submit to the staff of your Subcommittee these Panel reports after they have passed through the review process of the National Academy of Sciences.

GENERAL OBSERVATIONS

In the field of science and technology, the National Bureau of Standards has a unique and essential national function. This function is in contrast to the roles served by industry, universities, and other government agencies. The role of university research is to extend the frontiers of science and technology. Many of the important details are left undone, and the results are often not fully quantified or validated. Industrial research is usually focused on research areas with potential for significant practical application to the industrial product line. Research in other government agencies is highly focused on accomplishing the goals of those agencies more effectively, efficiently, and economically. Academic research, R&D in industry, and R&D in other government laboratories all depend critically on the availability of standard and validated methods of measurement, standard reference materials, and evaluated data, all of which constitute the central focus of the National Bureau of Standards. Thus, the program of the NBS is absolutely necessary for the entire national R&D enterprise, and the excellence of the NBS program is of national concern.

The size of the NBS staff has remained almost constant for many years. During the last decade, the frontiers of science have advanced rapidly in many important fields, and the areas of responsibility of the Bureau have also been greatly expanded. As new technologies develop, new science and understanding is needed to fully utilize these technologies and to extend their exploitation to new areas of opportunity. To develop the underpinnings of each technological advance, an investment of resources and personnel at this level of basic understanding is needed in order to be able to carry out the applications effectively. As technologies mature, the need for research decreases, but attention must still be given to the applications of new technologies (for example, computer control of measurements and computerized data processing), and an effort must still be given to address the needs of the nation for calibration, validation, and data acquisition. With the constraint of a constant-size staff, some of the vital needs of the NBS program have not been adequately in recent years. Standards work is exacting and demanding, and it must be done by a highly experienced and competent staff. It takes a long time to develop such scientists and engineers.

Thus, the Evaluation Panels in recent years have consistently emphasized the need for increased effort in the basic underpinnings of the science and technologies used to carry out the unique NBS mission in metrology, standards, and data. The Evaluation Panels have further continued to emphasize the importance of maintaining the technical excellence of the NBS program, which is so vital to the nation and is unrivaled internationally.

NBS FISCAL YEAR 1981 BUDGET

In my invitation to appear before this Subcommittee, there was a specific request for my views and comments regarding the activities and priorities of NBS as reflected in its fiscal year 1981 budget. Because the budget was released very recently, the Evaluation Panels have not yet had an opportunity to study and comment on it. Nevertheless, it is important for the Evaluation Panels to provide you with specific input on this budget, and we are most pleased to have this

opportunity to do so. I am basing the following remarks on recent findings and recommendations made by the Evaluation Panels.

Top priority should be given to the \$2 million increase in the competence-building program and to the additional \$5 million in basic research funds. To maintain technical viability of NBS for carrying out its mandated mission, both programs together are essential. Attention to equipment modernization is vital and must be addressed by a long-term commitment. The present equipment modernization program, which currently provides a 5.9% equipment replacement, is lower than the norm in industry and academia by at least a factor of 2. Attention must also be given to the serious problem of inadequate computation capabilities for carrying out the Bureau's mission. The proposed \$1 million increase for computer services represents a step in the right direction, but it is far below what is needed to provide even marginally adequate computation capabilities. Increased appropriations will be necessary in fiscal year 1982 to address these needs for equipment and computation.

COMPETENCE PROGRAM

I am especially pleased that the fiscal year 1981 budget for the Bureau contains \$2 million for the competence program. The Evaluation Panels originally recommended the initiation of such a program, and they have subsequently given the highest priority and enthusiastic endorsement to this effort. This vital program will allow NBS not only to restore competences that have been eroded over the past few years but also to build new competences in areas that are becoming of increasing importance to NBS and to the nation. To carry out its mission, the Bureau depends on the availability of teams of scientists and engineers working at the forefront of research in various areas related to future technologies. It is vital to have such highly skilled teams available to devote their efforts to specific new problems as they arise. Building these competences is absolutely necessary to provide improved measurement technologies in anticipation of future needs. During fiscal year 1979, eight competence-building projects were initiated in the areas of surface science, organic electrochemistry, advanced neutron methods, wave optics for metrology, physics of defects in semiconductors, nonlinear modeling of convection and smoke dynamics, fluid mixtures properties, and abstract data models; and in fiscal year 1980, nine such projects were initiated in the areas of physical and chemical effects of ionizing radiation on matter, picosecond laser chemistry, synchrotron radiation research for materials science, physics of compound semiconductors, soot formation processes during hydrocarbon combustion, new techniques in mathematical optimization, transient heat transfer, abstract data models, and measurement and control of local area networks. These programs have had a very positive effect on overall creativity, enthusiasm, and morale at NBS. The programs have also been vital to the ability of NBS to attract first-rate people. The Evaluation Panels have strongly and consistently recommended that the initiation of new competence programs be continued until a balanced effort is achieved between applications programs with short-range objectives and the basic science upon which the applications are based.

NEW PROGRAMS IN BASIC RESEARCH

In addition to the competence programs, the Evaluation Panels have strongly recommended the launching of research programs in new areas of opportunity and national need. This appears in the 1981 budget in two ways: first, in terms of the very-large-scale integrated circuits program and second, in terms of the President's \$5 million package for basic research. The largest of these programs in the President's package is in basic metallurgy and materials science research, which represents the scientific underpinning of the metals processing program.

In addition, several smaller basic research programs appear in the President's request to Congress. These include programs in intrinsic transport standards, time-resolved measurements of thermodynamic variables, quantitative compositional mapping, real-time topography facilities and research, relativistic effects in atomic and molecular interaction, testing strategies for complex electronic systems, and metrology for electronic and optical gigabit signal processing. Proposals for research in these basic areas have been developed in many cases under recommendations of the Evaluation Panels. The implementation of these research programs would have a major and beneficial impact on the total NBS program. Our ability to do short-term applied work, so important to industry and to other agency needs, stems from previous long-term fundamental research. I comment now on the two larger programs, and, for lack of space and time, on only one of the smaller programs.

VERY LARGE SCALE INTEGRATED CIRCUITS

The fiscal year 1981 budget contains an initiative on very-large-scale integrated (VLSI) circuits for \$3.259 million. The Evaluation Panel for Electronics and Electrical Engineering has carefully reviewed NBS plans in this area and has provided extensive and valuable suggestions and comments. The Evaluation Panel gives this initiative its strongest support and encouragement. The Panel, chaired by Dr. Daniel Muss, Manager of the Solid State Research and Development Division of the Westinghouse Research and Development Center, believes that a great revolution based on VLSI has already begun in the electronics industry. New frontiers are being created almost daily, and there is a great need for systematic and careful research (which is the Bureau's strength) to study materials properties and characterization on the micron and submicron level, interfacial effects at junctions, process control and evaluation, diagnostics, testing of chips containing thousands of circuit components, computer-aided design, lithography (e-beam, x-ray, and UV), packaging technology, and bonding. The Panel believes that in this electronic revolution, NBS should and must play a vital and essential role *complementary* to the efforts in industry and academia.

The Evaluation Panels have stressed the importance to U.S. industry of retaining its world leadership in high technology electronics, especially in view of the intensive international competition in VLSI. To maintain this leadership position, the industrial members of the Evaluation Panel in particular have stressed the urgent need for the unique contributions of NBS. It should be recognized that equipment costs in the VLSI area are extremely high and rapidly rising, and this is reflected in the cost of this initiative relative to the number of new permanent positions.

INNOVATIVE METALS PROCESSING

The budget contains an initiative for \$2 million on basic metallurgy and materials science research. The NBS has long been in the business of supplying standard reference materials to the metals industry in general and to the steel industry in particular. New high performance alloys are needed to solve today's problems, such as how to provide increased strength-to-weight ratio for the aircraft and automobile industries and how to provide better performance at higher temperatures for applications to more-efficient energy production. Recent developments in the rapid solidification of molten metals provide great opportunity for the fabrication of lightweight alloys resistant to cracks and corrosion. Better scientific underpinnings of this technology are desperately needed for rapid progress in this area, which is highly competitive internationally. It is essential that NBS participate in developing new measurement methodologies necessary for the measurement and characterization of these rapid quench rates (about eight orders of magnitude faster than what is currently used in the metals industries) and for the development of standards for the characterization of these materials. NBS has outstanding international leaders in this field, who, with the requested funding, could lead a program that would have an international impact.

AUTOMATIC TEST EQUIPMENT

The budget contains an initiative for \$400 thousand on strategies for complex electronic systems. The emphasis of this program will be directed to automatic test equipment (ATE), allowing the automatic testing of the very large set of operating states accessible to large complex electronic systems. This program addresses the needs of the automobile, aircraft, medical equipment, and other industries for high-speed, automatic testing of complex electronic systems. This initiative, which emphasizes the development of testing strategies, built-in test and calibration features, and standards for performance confidence levels, has the potential for a major impact on the industrial and military sectors. In anticipation of the approval of this initiative, the Evaluation Panel for Electronics and Electrical Engineering held a workshop in February 5-6, 1980, to provide more definitive recommendations to NBS on this subject.

LABORATORY EQUIPMENT

In 1973, the Evaluation Panels identified the lack of state-of-the-art laboratory equipment as the most pressing NBS need. The Department of Commerce responded by starting an equipment modernization program. This program has annually provided additional money to the Working Capital Fund, from which general-purpose equipment purchases are made. The Working Capital Fund is then reimbursed from operating funds over the expected lifetime of the equipment. Because of economic

inflation and because of the increasing sophistication and cost of state-of-the-art equipment, reimbursements to the Fund are inadequate to provide replacement costs of equipment and to allow purchase of newly developed equipment capabilities. The evaluation Panels have consistently stressed the importance of providing increments to the Fund each year for new equipment purchases. The equipment modernization program has been absolutely vital to the implementation of automatic measurement and test procedures made possible by recent developments in the computer industry in microprocessors and minicomputers.

NBS SCIENTIFIC COMPUTING NEEDS

This year, I have asked each Evaluation Panel to consider the specific issue of the scientific computing needs of the program under its purview. When all Evaluation Panels have met, we plan to assemble an overall picture of the scientific computing needs of the Bureau. Based on the meetings to date, I can summarize succinctly the major preliminary findings, namely that the central computing facilities of NBS are inadequate for carrying out the present NBS programs. This computation need is reflected in the fiscal year 1981 budget, which contains a request for \$1 million for the purchase of external computing support. The Evaluation Panels have stressed the need for updating central computing facilities and computational capabilities of NBS by the lease or purchase of additional computing equipment. The Evaluation Panels stress the need for the development of a long-range plan to provide adequate computation capabilities to carry out the NBS mission. To some extent the computational needs of NBS can be accommodated by the rapidly developing capabilities of minicomputers, and in this context the Evaluation Panels have strongly endorsed an increased use of minicomputers within NBS. Nevertheless, there are many needs that cannot be met by minicomputers, and to accommodate large and complex computations that are necessary to carry out the basic NBS mission, a new central computing facility is desperately needed.

OTHER AGENCY FUNDING

Other-agency funding for NBS programs has been a matter of concern to the Evaluation Panels in recent years. A significant portion of NBS funds come from other government agencies, for example, for fiscal year 1981, the anticipated other-agency funds are \$78.7 million as compared with nearly \$108 million in direct NBS appropriations. Other-agency funding results in problems as well as benefits. On the beneficial side, collaborative ventures with other agencies result in intimate contact, ensuring relevance of NBS programs to national problems, providing a mechanism for the increased utilization of the Bureau's work. In fact, service to other agencies was wisely prescribed as a Bureau function in the Organic Act of 1901.

On the other hand, the Evaluation Panels have also stressed the problems arising from other-agency funding, with particular concern expressed for the "lead agency" concept, a government management principle according to which management in a specific area of national importance is assigned to one agency, which is given responsibility for priorities in that area. Although theoretically such management could be carried out through coordination among agencies, the principle is currently invoked by the Office of Management and Budget by assigning all funds to the lead agency. The Evaluation Panels have stressed the importance for NBS to be the lead agency for measurement methods and standards. Unfortunately, the OMB usually views these metrology and standards functions as subordinate parts of large problems. Thus, the NBS is reluctant to identify portions of in-house-funded programs directed to national problems because the funds might be withdrawn and transferred to the lead agency. Such a withdrawal of funds actually happened in the case of environmental measurements.

There is a need for reexamination of the "lead agency" concept as it impacts on other-agency funding. The Evaluation Panels have observed that when another agency controls priorities, longer-term research of a generic nature is usually slighted in favor of short-term projects addressing immediate goals. Thus, short-term work for other agencies should be balanced by longer-term, in-house-funded research on basic measurement principles. It is in the latter area that the competence-building program has been of such great value. The Evaluation Panels have also stressed the need for adequate reimbursement to NBS for services rendered to other agencies.

In closing, let me add that the bureau is in good hands. The present NBS administration provides stable, strong, and imaginative leadership. The Evaluation Panels have provided an annual and systematic program review as well as an abundance of constructive criticism. These evaluations have provided the stimulus

for systematic planning and reprogramming. Though the Evaluation Panels act very independently of the groups under evaluation, and of the NBS management generally, an excellent rapport and working relation has been established over the years. It is the goal of both the bureau management and of the Evaluation Panels to ensure that the National Bureau of Standards remains an international center of excellence in areas of its responsibility. And we work together in our separate ways to achieve this goal of excellence.

Senator STEVENSON. We thank you for the testimony and also for the good work of your panels.

You both seem to agree that the fiscal 1981 budget as submitted is adequate as far as it goes, but that more needs to be done for equipment modernization and computing services. How much more for fiscal 1981?

Dr. DRESSELHAUS. I don't think we said that fiscal 1981 is in such bad shape. I think that in my statement I was emphasizing the inadequacies for the year ahead. This is an authorization hearing, I understood, for 2 years.

Senator STEVENSON. Well, there are 2 years. I haven't come to 1982 yet. Fiscal 1981 starts next October 1.

Dr. DRESSELHAUS. Right. The plan for this coming year is to continue on the equipment modernization program as it is now, which is marginally doing the job. We would like to see some increase in that amount for fiscal year 1981. However, the major point requiring emphasis is the scheduled termination of the equipment modernization program at the end of fiscal 1981, I was making a very strong pitch that such a termination would have a devastating effect on the Bureau.

Senator STEVENSON. Well, are you saying now that the amount for fiscal 1981 is adequate?

Dr. DRESSELHAUS. No, I didn't say that. I said that it was marginally adequate to keep things afloat as they are going now. I said, that compared to university and industrial equipment support, it's a factor of two less than what is commonly adopted in industry and academia.

Senator STEVENSON. But how much would be adequate for equipment modernization in fiscal 1981?

Dr. DRESSELHAUS. Well, I would say approximately an increase of 50 percent over what is in the present budget would be very much appreciated.

Senator STEVENSON. And we have now a total of what, \$2 million?

Dr. COMPTON. \$2.1 million.

Dr. DRESSELHAUS. \$2.1 million.

Senator STEVENSON. \$2.1 million. ?

Dr. COMPTON. \$2.1 million.

Senator STEVENSON. So another million? Would you agree with that, Dr. Compton?

Dr. COMPTON. Well, I think there are several issues here, Senator Stevenson. For the central computing facility—

Dr. DRESSELHAUS. We were talking about equipment.

Dr. COMPTON. For the central computing facility, the Bureau has not yet come forward with a proposal so we can not give you a figure. I will, though, just from my own experience, give you a round-house number that I would suspect would be close to what

they will need. I would expect it to be something on the order of \$25-30 million in fiscal year 1982, for a central computer facility.

Senator STEVENSON. Is that an equipment modernization or—

Dr. COMPTON. I don't know how you bill it, but it's needed for new equipment.

Dr. DRESSELHAUS. That would comprise the purchase of a central computer facility.

Dr. COMPTON. Funds would also be needed to provide continuing support for the facility.

Now in terms of the smaller laboratory type of equipment, I think I could agree very well with what Dr. Dresselhaus said. An additional million dollars in fiscal year 1981 would be a very important contribution to the equipment modernization program. But continuing on at \$3 million a year with the current rate of inflation would not be adequate for the future. An annual expenditure of \$3 million for an institution the size of the Bureau is simply inadequate for equipment replacement.

Senator STEVENSON. Well, let's see. Let's finish up with 1981 first. I think the suggestion from both of you is that approximately \$1 million more is needed for equipment modernization. How much more in fiscal 1981 for computing services?

Dr. COMPTON. The Bureau in fact asked in their original budget proposal, for a total of \$5 million. I would think that roughly the number that could be viewed as appropriate.

Senator STEVENSON. And they got one?

Dr. COMPTON. Two.

Senator STEVENSON. For computing?

Dr. COMPTON. One. \$1 million.

Dr. DRESSELHAUS. I think we should point out the discrepancy between the \$25 million figure and the \$5 million figure, because that is a rather large difference. The \$5 million figure corresponds to use charges, the payment for use of other facilities, that is buying time and services at other computing facilities. The \$5 million figure does not pay for bringing a new central computer facility to the Bureau.

That latter operation, which would make the Bureau self-sufficient in the computation area, and not dependent on the whims and idiosyncracies of other agencies or suppliers, corresponds to the \$25 million figure.

Senator STEVENSON. That would ultimately reduce computing service costs?

Dr. DRESSELHAUS. Yes.

Senator STEVENSON. They'd have their own facility. And the computer—

Dr. DRESSELHAUS. The \$25 million figure is a large one-time investment. Then we must consider some additional maintenance costs and personnel that go along with the computer. There is thus also a long-term increased commitment in the maintenance personnel area in addition to the large initial expense.

Senator STEVENSON. Our staff tells me that the Bureau's main computer is 14 years old. There have been some changes in computer sciences during that—

Dr. DRESSELHAUS. There are changes every year, every month, every day.

Dr. COMPTON. There have not only been some changes in the capability of computers, there have also been changes in the types of problems that need to be done that require computers, and a combination of those two factors just amplifies the deficiencies.

Senator STEVENSON. Senator Schmitt hasn't returned, so I am not getting to that meeting. That meeting that I alluded to earlier is part of this effort to slash the budget for everything except military in order to control inflation.

Would you care on the record to express any opinions about this conventional wisdom that suggests it doesn't matter what the money is spent for or not spent for, just so long as you decrease demand by decreasing the Federal budget, we will control inflation?

Dr. COMPTON. I'll make one observation, Senator Stevenson: In any period of a budget reduction, it's been my observation that whether it's the Federal budget or an industrial budget, the areas that suffer the quickest and the most are the longer range work. The organization that is dependent upon that long-range effort suffers far more than can be gained by the short-term cost cutting.

It's very hard to set priorities, I realize, but I would urge some very considerable care in looking at the longer-range R. & D. areas for which we are going to be dependent in the next decade.

Dr. DRESSELHAUS. I would like to answer your question in a slightly different way. The Evaluation Panels have consistently pointed out in recent years the inadequacy of the basic scientific underpinnings of the Bureau program. This long-range program has eroded over the last 10 years because of emphasis on short-term applied activities, and increasing demands on the Bureau for specific programs. The effort required to carry out the short-term programs has come out of the hide of the longer term programs. Effort is now headed to build the competence in the future resources of the total organization.

It's the feeling of the Evaluation Panels that the Bureau has gone far too far in this direction of cutting the basic underpinnings, and it is high time now to try to recover lost time.

Sometimes you cut programs out to an extent that it becomes counterproductive. When you've cut too much, you can't even do the basic things that you have to do. The Bureau has gone in the opinion of the Evaluation Panel gone too far in that direction, and this has to be controlled.

Senator STEVENSON. Well, I don't think the Bureau has gone in that direction voluntarily.

Dr. DRESSELHAUS. Well, we're here to testify and offer our considered advice. The competence program is certainly an extremely important positive step in gaining ground, and this program must be given the highest priority.

Senator STEVENSON. About 40 percent of the Bureau's budget is received from other agencies. Do you have any opinions about the effect of this dependence on other agencies on the NBS, whether there is anything we should do about it? I address this to either of you.

Dr. DRESSELHAUS. Well, the Evaluation Panels have discussed this in their reports time and time again. There are two sides to the coin:

On one side, the contact with the other agencies is very important to the Bureau's function. It brings the Bureau's function into the realm of real national problems, and it provides a mechanism for the utilization of the Bureau's work and expertise. Thus other-agency work does have a very beneficial and important function for the Bureau, and that shouldn't be overlooked.

But the other-agency work can get to be too much, and too large a fraction of the total program. The evaluation panels have felt in recent years that at least for some parts of the Bureau, the optimal balance between in-house and out-of-house, other-agency work, has exceeded this optimal balance with too much, too large a fraction of the program being other-agency programs.

What this means is that the Bureau itself lacks control over its programs to some extent. If the lead agency decides tomorrow that they want to go in a new direction, they could pull out their resources and programs from the Bureau, and the Bureau people are just left holding the bag.

There is a balance above which you don't want to go with other-agency programs, and I think that Dr. Compton will comment on this issue as well, because the visiting committees have also discussed this problem. They too have felt, I believe, that the present balance is about as high as you might care to go, and in some parts of the Bureau, it has been exceeded.

Dr. COMPTON. I personally think it's too high. I'm not sure that's shared by all of the members of the Visiting Committee.

One of the other problems that results from such a high percentage of funding coming from the fact that the other agencies are generally not willing to support the fundamental long-term work that is so needed to keep the Bureau vital. In fact, this long-term work provides the expertise that the other agency is coming to the Bureau to use.

As a result, when the percentage of other agency funding is this high, the Bureau must spend a very large percentage of its own funds to the longer range research. This causes particular concern in a period of inflation and reduced budgets. Whether they can sustain the long-range research that is essential, whether they have the resources available to go into new fields, to develop new areas of expertise, these are problems that are exacerbated by the fact that there is such a large percentage of funding from other agencies.

Senator STEVENSON. How can we right that balance?

Dr. COMPTON. There have been various ways suggested. I think the best way is to try and develop as much flexibility as one can, but one great asset would be if the Bureau could in fact charge to the other agencies a portion of whatever the amount of monies that come into their Bureau from that agency, a portion of that being allocated to longer range basic—

Dr. DRESSELHAUS. It's like an overhead charge.

Dr. COMPTON. Well, it's not unlike what the Department of Defense does with the industrial groups in terms of their R. & D. It would almost be an internal governmental I.R. & D. program.

Dr. DRESSELHAUS. The advantage of such an overhead charge, rather than having the other agency directly supplying funds, is that long-range programs would thus be built into the program

automatically. It guarantees that there will be some basic underpinnings for every applied program that's undertaken.

The competence work does in part address this need for building competence in these areas of the Bureau where there is large other-agency funding. However, if you have a very small amount of competence money, it doesn't extend to all the areas of needs. To date the competence program has not yet covered the basic needs, especially in the engineering area.

Dr. COMPTON. I might point out that in the 1981 budget as submitted, there was a swing in the funding between other-agency and the internal Bureau funding. The \$5 million for basic research was in fact being used to replace some other-agency funding, so that there was some effort being made by the Bureau to accomplish that within a more or less fixed personnel ceiling.

Dr. DRESSELHAUS. The specific topics that were selected for this \$5 million program are to a large extent of technological interest, like the metals program. The study of rapidly quenched alloys has many applications in the metals industry, which are absolutely dependent on the basic underpinnings of metals science. This metals program represents \$2 million of the total \$5 million program.

The LSI program is another example of an applications area which depends heavily on basic research.

Senator STEVENSON. We've run out of time, I'm afraid. Thank you.

The subcommittee is adjourned.

[Whereupon, at 11:50 a.m., the subcommittee was adjourned.]

[The following information was subsequently received for the record:]



