THE FEDERAL TECHNOLOGY TRANSFER ACT: THE FIRST TWO YEARS

A REPORT TO THE PRESIDENT AND THE CONGRESS

BY

THE SECRETARY OF COMMERCE

AS REQUIRED BY

SECTION 11 OF THE STEVENSON-WYDLER TECHNOLOGY

INNOVATION ACT OF 1980

FEBRUARY , 1989

Honorable George Bush
President of the United States
The White House
Washington, D.C. 20500

Dear Mr. President:

It is my honor to transmit to you and to the Congress the first biennial report on the extent to which federal agencies are using the authorities vested in them by the Federal Technology Transfer Act of 1986.

The report comes at a time of challenge to our nation's technological leadership. The signs are everywhere. The rate of increase in research and development in the United States is declining. Foreign applicants are obtaining increasing percentages of patents issued in this country. U.S. industry has become increasingly dependent upon foreign-born scientists and engineers.

Nevertheless, the United States has some powerful trump cards at its disposal. Our educational system still produces innovators who can think analytically and who can work with complex, emerging and unpredictable technologies. Product design, systems integration and software development are among our strengths. Venture capital is available to the entrepreneur.

With so much at stake, a top priority must be to get more value from our enormous $63 billion annual federal investment in research and development. It is important that we continue to invest in generating new knowledge, but we must also make sure that the knowledge generated by federal scientists or by others with federal support contributes to U.S. competitiveness in the form of new products, new processes, new industries - and most of all, new jobs.

This report focuses on one of our greatest national resources - federal laboratories. Much of the work done in federal laboratories is at the cutting edge of technology. With proper incentives and management tools, this technology can be successfully transferred to the private sector for commercial development. The Federal Technology Transfer Act provided these incentives and tools.

As the report indicates, although many agencies viewed the Act as a challenge to their long-held views on the proper role of federal laboratories and scientists, most have eagerly embraced it and are implementing it as the Congress intended. I believe that in future years we will look back on this Act as one of the seminal developments in the history of federal efforts to put technology to work for the taxpayers who paid for it.

Although the Stevenson-Wydler Technology Innovation Act calls for a biennial report of somewhat broader content, much of that ground was covered in the June, 1988, report by your Office of Science and Technology Policy entitled "Progress in Facilitating Access to Science and Technology, Highlighting Superconductivity."

Under Secretary of Commerce for Technology Ernest Ambler and I look forward to working with you and the other members of your team to ensure that this nation maintains its technological leadership.

Sincerely,

Secretary of Commerce

THE FEDERAL TECHNOLOGY TRANSFER ACT: THE FIRST TWO YEARS

1. Introduction and Overview:

Enactment of the Federal Technology Transfer Act (FTTA) of 1986 as Public Law 99-502 was largely a response to the increasingly tough international economic competition facing the United States. By all accounts, this competition will intensify as more countries, anxious to promote their economic development, enter the high technology sweepstakes. This is a healthy competition. However, we will be unable to meet it if we take our technological leadership for granted.

Remaining competitive in fields such as superconductivity, biotechnology, new materials, pharmaceuticals, and other research intensive areas could well depend on our ability to link our unsurpassed public research institutions with the private sector. Indeed, at a time when U.S. industry is cutting back on basic research, its cooperation with universities and Federal laboratories will become even more critical to our ability to remain on the cutting edge of technology.

The Federal Government funds the lion's share of basic R&D not only in this country, but in the world. If this public investment is not translated into new jobs, products, and processes, the American taxpayer will be seriously shortchanged.

Recognizing this, Congress enacted, and the President approved, the FTTA. This law, along with President Reagan's multi-phased program for improving access to federally funded research contained in Executive Order No. 12591, charged Federal agencies with linking their government-owned, government-operated (GOGO) laboratories to the private sector. This report summarizes how agencies are meeting these challenges.

More than two years have passed since President Reagan approved the FTTA. Most federal agencies have now completed, or are close to completing, the internal administrative arrangements necessary for managing programs of cooperative research with the private sector, universities, and state and local governments. Many have already begun the process of negotiating agreements and a number of these have already been concluded.

In general, agencies have made substantial progress and have developed firm foundations for successful technology transfer operations. Their attention was of necessity first concentrated on resolving sensitive internal questions of control and accountability. Now they are addressing the practical problems of attracting the interest of the private sector and designing arrangements that will appeal to it.

To help them accomplish this, Secretary of Commerce Malcolm Baldrige formed the Interagency Committee for Federal Laboratory

Technology Transfer. The Committee's Executive Working Group, consisting of senior headquarters and laboratory personnel within the Executive branch, has met thirteen times and has become an important support network for addressing the practical problems agencies face in implementing the law and Executive Order.

The evolving agenda of the Working Group illustrates these efforts. It has included such topics as the development of model agreements for working with industry, model delegations of authorities for Federal laboratories, employee conflict of interest issues, impact of the Freedom of Information Act, access by foreign companies and scientists to federal laboratories, protecting intellectual property in international science and technology agreements, problems in commercializing computer software, and training laboratory personnel in technology transfer.

But the real credit goes to the individual agencies. Their accomplishments have been particularly gratifying, given the many obstacles that had to be overcome before the FTTA could be successfully implemented. These obstacles must be understood if progress to date is to be evaluated properly.

First, the FTTA challenged the status quo. It forced many agencies to confront and reassess long-held attitudes with respect to:

- the role of federal laboratories and scientists in promoting joint R&D with industry and transferring the results to the marketplace,
- the necessary methods and incentives for accomplishing this, and
- the relationship between the laboratories and their parent organizations.

These various factors are discussed more fully in the pages that follow. For now, the important point is that in view of these challenges, it could not be assumed that agencies would embrace the FTTA with much enthusiasm.

These worries proved to be unnecessary. In practice, most agencies are taking advantage of the opportunities the new law afforded them. Agency personnel at headquarters and in the laboratories are making sincere efforts to implement the new law as the President and Congress intented. Many practical problems have, with hard work, been resolved.

In short, the future of the FTTA looks very promising.

2. Objectives of Federal Technology Management Policy:

The fundamental objective of federal technology management is to promote U.S. competitiveness by allowing the private sector to pursue original R&D with our public research institutions, and by taking the fruit of that research and adapting it to the marketplace.

Congress and the Executive branch were continually frustrated by the failure of the federal research establishment to return more to the taxpayers in the way of tangible returns on their annual $63 billion federal investment in research and development. This frustration often revealed itself in the common complaint that the U.S. wins Nobel Prizes while other countries walk off with the markets.

Federal technology management policy responds to this by building upon certain fundamental principles.

- First, the federal government must continue to be willing to underwrite the cost of much of the important basic research in scientifically promising areas that takes place in the United States.

- Second, transfering this research from the laboratory to the marketplace is the job of the private sector, with which the Government should not compete.

- Third, Government can encourage the private sector to

undertake this by judicious reliance on market-oriented incentives and protection of proprietary interests.

The first great test of these principles came in 1980 with enactment of the Bayh-Dole Act (P.L. 96-517) upon which the Federal Technology Transfer Act was modeled. The Bayh-Dole Act generally allowed universities and small businesses to elect to own inventions made by them with federal funding and required universities to share royalties with the inventor.

That Act has been tremendously successful in promoting university-industry cooperation. In its April, 1987, report to Congress (GAO/RCED-87-44), the General Accounting Office found that such cooperation had increased 74% since passage of the Act. This was accomplished without diverting the universities from their primary educational missions.

Certain fundamental factors to the university successes quickly became evident:

- First, technology will rarely, if ever, be translated into commercial products without the full cooperation and involvement of the people who created it and who best understand its potential. Research reports can never hope to convey all that the researchers have learned and absorbed. This is especially so in the case of federally-supported R&D where the resulting technologies tend to be

far from commercialization. As such, supervision from "headquarters" must be such as to ensure proper accountability, but not so heavy as to discourage active involvement by laboratory personnel.

- Second, there must be interaction between the creators of the technology and those who understand the complexities of manufacturing and marketing it. Technology developed in disregard of these practical considerations will rarely benefit the public through practical application.

- Third, to bring this about there must be powerful incentives for all sides to cooperate. This is particularly true at federal institutions where an expenditure of effort to pursue commercial ramifications of research undertaken in support of specified federal programs may be viewed as incidental to the laboratory's mission.

The FTTA responded to these lessons. The new Act called upon agency heads to delegate to laboratory directors the authority to enter into cooperative research and development agreements with the private sector and other entities, and to agree in advance on the rights the cooperating parties would have in any resulting inventions made by a federal employee. The employee was entitled to a guaranteed share of the royalties received by the government. The lab itself was also entitled to retain the

majority share of the remaining royalties.

Thus, the key principles of decentralization, federal-private sector interaction, and suitable incentives were all satisfied in the new statute.

3. The Challenge to Prevailing Practice:

Congress quickly recognized that the proposed FTTA challenged prevailing existing theories, practices and prerogatives in the agencies.

Probably the most serious concern was that the provisions authorizing laboratory directors to enter into cooperative arrangements threatened traditional management prerogatives. In other words, the Act transfers very real power from headquarters to the field.

Some argued that such requirements undermined the agency head's ability to manage the agency. More specifically, it was feared that the exercise of such authority could (a) divert laboratory attention from the performance of mission-related research, (b) create animosity on the part of agency scientists assigned to facilities or projects with little commercial potential, and (c) by emphasizing rewards to the inventor, implicitly undervalue the contributions of other personnel who contribute to the technology transfer process.

As finally enacted, Congress authorized, but did not require, agency heads to delegate appropriate authority to the laboratory directors. President Reagan in his April 10, 1987 Executive Order No. 12591 resolved the argument in favor of decentralization by instructing the agencies to follow the delegations prescribed in the Act.

But even its most enthusiatic supporters knew that it would take time to change a culture that had existed for so long. That agencies are coming to grips with these questions is reflected in comments made to the Department of Commerce by representatives of the Department of the Navy in providing information for the preparation of this report. In Navy's words:

> ...(S)everal challenges exist in DON in implementation of technology transfer....(F)or nearly two decades the DON has taken the position that all appropriate DON-developed technology should be available to all comers without charge. This practice must be modified by adopting a policy oriented more to marketing....(W)ithin the DON laboratory and R&D communities, the most favorable results seem to accrue to those who publish their findings. While such publication is worthy professionally, it tends to slow (as well as limit) commercial application on each published topic. DON is now striving for a "patent before publish" philosophy as a superior goal, and one more in keeping with the legislation on technology transfer.

These concerns were not unknown to the FTTA's sponsors. They had before them examples of university-industry research partnerships. They knew that similar issues had been successfully resolved by university scientists. They were confident the

federal research establishment would do no less. Whether that confidence was justified is discussed in the next sections.

4. The Relationship of the Laboratory to its Parent:

Decentralization is a central feature of the Federal Technology Transfer Act. Consistent with the principle that those who understand a developing technology best are those who created it, it assumes that appropriate authorities will be delegated to laboratory directors and not retained at headquarters, except to satisfy legitimate oversight needs.

In providing for a decentralized approach, the FTTA implicitly reflected a concern of the 1983 Report of the White House Science Council's Federal Laboratory Review Panel (the "Packard Commission") which had deplored the tendency of some agencies to micromanage their laboratories. The Commission had emphasized that "excesssively detailed direction of laboratory R&D activities from agency headquarters...has seriously impaired R&D performance in some laboratories."

A review of agency rules implementing the Act reveals that agencies have displayed considerable sensitivity to the need to decentralize and to reduce the administrative burden on individual laboratories. All recognize that the point at which "the rubber meets the road" - where the heart of an agreement is

developed - is the point at which contact between industry representatives and the federal scientist occurs.

Most have made efforts to delegate authority to enter into agreements, subject to appropriate higher level review, to the largest practical unit that can realistically be called a laboratory, which is defined in the Act as "a facility or group of facilities." But because of differences in agency missions, structures and traditions, there is no clear uniformity.

For example, within the Department of Commerce, authority has been delegated to the Director of the National Institute of Standards and Technology, formerly the National Bureau of Standards, for all arrangements within the scope of that organization's program responsibility. The Director has in turn delegated the authority to the directors of NIST's major laboratories: the National Engineering Laboratory, the National Measurement Laboratory, the Institute for Materials Science and Engineering, and the Institute for Computer Sciences and Technology.

The National Oceanic and Atmospheric Administration, also at Commerce, has delegated authorities to five laboratories and three Assistant Administrators for research services.

The Department of Agriculture, on the other hand, has delegated authority to the Agricultural Research Service which, unlike NIST or NOAA in the above discussion, has chosen to treat itself as a single laboratory. To some degree, USDA's decision is rooted in practical considerations: it has 120 field locations, many of which are two- and three-scientist operations. USDA's approach is intended to insure that these smaller operations receive encouragement and administrative support.

On the other hand, some of ARS's facilities have over two hundred scientists. Accordingly, ARS and other organizations with similar arrangements must ensure that they do not unnecessarily restrict the independence of larger, more capable facilities in the interest of controlling and assisting smaller, less capable components.

The Environmental Protection Agency, to cite yet a third example, has defined laboratories so broadly that it can apply to very small operations and even to those not normally considered to be laboratories in the layman's use of that term, such as its General Counsel's Office. EPA's view is that even its lawyers are experimenting with computer models for controlling their casework and that such work may eventually have a commercial spinoff.

Given different agency needs and organizational charts, we cannot

conclude that there is one "right" way. It is sufficient for the present to note that we have not detected any pattern of misuse by which agencies are using definitions to defeat the objective of decentralized management. In future reports, the Commerce Department will discuss how particular delegation modes are working. Right now it is simply too soon to tell.

It must be noted, however, that NASA is the lone agency not using the FTTA as the basis for its cooperative agreements, although it does use other authorities in that Act as a basis for sharing royalties. NASA has chosen to continue its centralized technology management system based on the authorities of the Space Act.

The Space Act, unlike the FTTA, (a) permits the agency to commit federal funds to cooperative ventures and (b) provides for greater centralization of authority, which NASA believes is more appropriate for its needs. In future reports we will compare NASA's record with respect to the number of cooperative agreements with industry, royalties returned to the agency, number of inventions reported by its laboratories, and any other relevant factors, with the records of other agencies relying on the FTTA.

In the final analysis, however, while the success of the FTTA depends to a considerable extent on the degree of freedom that laboratories have to enter into cooperative arrangements, it

depends even more on the respect which private firms have for the laboratories, their knowledge about laboratory capabilities, and their perception that these capabilities are consistent with their own needs.

It is here that the agency headquarters have a major role to play. The Packard Commission, in reviewing agency-laboratory relations, complained that many laboratories had only ill-defined missions or obsolete missions and that "in most cases, the agencies' oversight means an excessive amount of reporting and paperwork, but inadequate scrutiny of the quality and relevance of the laboratories' activities."

The Packard Commission's warnings are particularly relevant in assessing progress under the FTTA:

- Some laboratories could delude themselves into thinking that their main problem is "getting the word out" to the private sector when the real problem is that what they do is of limited value to either Government or industry, thus wasting scarce resources.

- Agencies with no clear idea of what they want their laboratories to achieve will have no clear basis for reviewing proposed cooperative agreements. Under such conditions, review of minutiae and technicalities will take the place of more meaningful content review.

The Administration and Congress should closely monitor which laboratories are attracting private sector partners and those which are not. It might be well to re-examine the mission of those labs in which there is little private sector interest to see if their charter is sufficiently broad or if they are otherwise fulfilling essential federal missions. As the Packard Commission emphatically declared: Preservation of the laboratory is not a mission.

The Department notes that the establishment of research advisory committees, such as those of USDA and NIST, could be important devices for agency use in ensuring that their R&D has practical applications.

5. Cooperative Agreements Under the Act:

The Department of Commerce estimated that, as of the close of FY 1988, federal agencies had concuded, or were in the final stages of negotiating, approximately 111 cooperative agreements within the meaning of the FTTA. Many of these are based on a model agreement which was developed by Commerce's Office of Federal Technology Management and modified by individual agencies to meet their specific needs.

These included agreements involving the Department of Agriculture (39), the Department of Health and Human Services (29), the

Department of the Air Force (17), the Department of Commerce (10), the Department of the Army (7), the Department of the Interior (6), the Department of Veterans Affairs (2) and the Environmental Protection Agency (1). Agreements in fairly early stages of negotiation are not reflected in the above figures.

A number of caveats are called for in reviewing these figures.

First, some agencies do enter into agreements similar to those described in the FTTA but rely on other authorities. To the extent that they do so, the figures above are lower than they might otherwise be. Moreover, the absence of a particular agency from the above list, or a relatively low figure could be misinterpreted as a lack of commitment to the importance of technology transfer.

Second, and related to the first point, agency use of the FTTA does not necessarily mean that the cooperation is "new" - i.e., that it would not have taken place in its absence.

Agencies such as Commerce's own National Institute of Standards and Technology have a long and rich history of cooperation with the private sector, state and local governments, and academic institutions through a variety of arrangements, including contractual arrangements for use of NIST facilities for proprietary research. NIST representatives have advised us that

much of the research covered by its ten agreements might have occurred anyway, but that the FTTA is often a better vehicle for establishing cooperative relationships.

Third, simply counting numbers misses the importance of vital new relationships formed under the Act such as USDA's Peoria, Illinois Biotechnology Consortium. This historic project combines the resources of the USDA's Northern Regional Research Center, the University of Illinois, six private companies contributing $1 million each, the State of Illinois (which is investing $4 million), and the city of Peoria. This type of highly promising cooperation fulfills the promise of the the Federal Technology Transfer Act and would be impossible without it.

Similarly, it obscures other important initiatives that agencies undertake to further the goals of the FTTA. For example:

- In October, 1988, HHS held its first NIH-Industry Collaboration Forum which was attended by more than five hundred representatives of leading drug and pharmaceutical companies. The Forum provided a means by which those representatives could meet directly with individual NIH scientists to discuss potential cooperative research. Such actions send a clear signal that the FTTA is not "business as usual."

- The U.S. Army's Electronics Technology and Devices Laboratory developed a formal, comprehensive, well-focused procedure for implementing the Act which includes establishment of teams in specific technology areas, careful definition of objectives and responsibilities of each player, methods for developing statements of work for the research project, customization of model agreements and attendant legal reviews, all of which make it easier to obtain necessary approvals from higher authority. In short, ETDL appears to be striving to make the process routine while treating each agreement as a unique individual.

Despite some caveats, some tentative conclusions to use of the law can be drawn.

First, many agency officials are of the view that a good number of the agreements do represent research and cooperation that would not have otherwise taken place -- illustrated most dramatically in the Peoria Biotechnology Consortium. Representatives of the Army, Health and Human Services, and USDA's Agricultural Research Service were especially convinced of this. For future reports, the Department will closely watch for new relationships with the private sector that are forming because of the FTTA.

Second, officals of other agencies that believe the research would

have taken place anyway note that the FTTA still provides a better basis for undertaking it and that this value should not go unrecognized.

Finally, most personnel believe that the Act has greatly stimulated agency personnel to think creatively in terms of technology transfer. That is discussed more fully in the next section.

6. Impact on Laboratory Personnel:

Federal scientists have traditionally had little reason to delay publication of their research, even though the disclosure of an invention in a printed publication before a patent application is filed destroys patentability in most of the world.

As the Packard Commission reported more than five years ago - and as the Navy Department's experience confirms - many federal scientists rightly take great satisfaction from being able to advance scientific knowledge through publication of research results. Traditionally many Federal scientists have viewed the private sector as an awkward partner with a different value system, and have published their findings even when this would prevent a patent from issuing.

Before the FTTA, there was little incentive for them to delay

publishing the results of their work to allow federal officials time to decide if the invention had commercial potential and was worthy of patent protection. There was also virtually no reason for their supervisors to encourage them to go beyond what was required for the government's own needs since the laboratory received no direct benefit from successful technology transfers.

The Federal Technology Transfer Act addressed this concern by directing agencies to pay the inventors at least 15% of any royalties their invention might bring in, or authorizing them to adopt an alternative payment plan, providing certain qualifications are satisfied, and by allowing the laboratories to share in the royalty stream as well. All agencies have opted for the automatic royalty sharing plan.

A review of agency experience to date permits certain observations:

a. Increase in Number of Reported Inventions.

The widespread publication of information about the possibility of receiving royalties and the growing commitment of agencies to the principles of technology transfer appears to have contributed to the remarkable upsurge in the number of reported inventions by federal scientists during FY 1988, the first full fiscal year since enactment of the FTTA.

In FY 1987, the Department of Agriculture reported 76 inventions; in FY 1988 this figure had increased to 139. The Army reported 309 inventions in FY 1987; this figure was up by almost 40% in FY 1988 to 424. The Navy, where the tendency to publish had been particularly strong, saw its reported inventions increase by more than a third - from 336 in FY 1987 to 463 in FY 1988.

HHS figures, reported on a calendar basis, reveal that the number of inventions (133) reported during the first nine months of 1988 approximated the number (132) reported for all of CY 1987, a figure which itself represented an increase of almost a fourth over the number (109) reported in CY 1986.

This bodes very well for the impact of the Act. A similar jump in invention disclosures at the universities was the first sign of the impact of the Bayh-Dole Act. In 1976 there were about 230 patents issued to universities. By 1986 the number had tripled to about 700, increasing to 900 in 1987. Particularly striking is that this sharp increase in university patenting and invention reporting by federal scientists is occurring at a time when U.S. patent rates have levelled off or have declined for other sectors. Discussions with federal officials suggest that this increase in federal invention activity is likely to have real commercial significance, rather than leading to "paper" patents. This is an encouraging sign that U.S. creative activity is alive

and well in our public sector and underscores the wisdom of President Lincoln's observation as to the importance of adding "the fuel of interest to the fires of genius."

Today universities are becoming engines for economic development because of their successful technology transfers. High technology centers across the United States are forming around them. Future reports will closely monitor whether the Federal laboratories are following this heartening example.

b. Diversity of Plans:

The agencies have shown remarkable resourcefulness in devising royalty payment plans to suit their individual needs. Many recognize that inventions may bring in relatively modest dollar amounts and, to ensure some meaningful return, allow inventors to keep higher percentages of the first dollars that come back to the agency.

The military services, for example, will allow their inventors to keep 20% or the first $1000, whichever is greater. Within HHS, the National Institutes of Health, the Centers for Disease Control, and the Alcohol, Drug Abuse and Mental Health Administration allow their inventors to keep 25% of the first $50,000 in royalties, 20% of the next $50,000 and 15% of any additional royalties.

The Food and Drug Administration, also within HHS, takes the opposite approach. Greater percentages of the first dollars are retained by the agency. The FDA allows its inventors to keep 15% until program costs are recovered and 35% of any additional royalties.

Congress evidently recognized that agencies would take different approaches and encouraged experimentation. It directed the Comptroller General to report to it on the efficacy of different plans in 1991, thus giving agencies a chance to experiment and to alter their programs, if appropriate.

Accordingly, the Commerce Department will withhold further comment at this time except (a) to note that such differences do exist, (b) to express the hope that GAO's report will also discuss the experiences of agencies, such as NASA, which prefer to rely on authorities other than the FTTA, and (c) to assure the Congress that the Commerce Department will also monitor these various plans.

c. Royalties to Date:

Although interest is high and implementation plans are in effect, the agreements under the FTTA are too new to have generated any significant royalty income.

However, data from the Department of Energy and the National Technical Information Service provide some useful insights.

In 1980 Congress enacted legislation which, as discussed earlier, allowed certain federal contractors to own and license inventions made with federal funding. This law applied to most of DOE's contractor-operated facilities. Certain other DOE contractor-operated facilities received ownership on a case-by-case basis under other authority. All of these facilities, however, established royalty sharing programs with their employed innventors.

In 1981, DOE's contractor-operated laboratories received $14,000 in royalties. In FY 1985, these royalties had increased to $144,000 and in FY 1987 they stood at $267,000. For the first nine months of FY 1988 alone the figure was almost $400,000.

Preliminary data from the National Technical Information Service (NTIS) suggest the same trend is beginning for Federally owned and operated laboratories. NTIS, even prior to enactment of the FTTA, licensed federally owned patents for royalties or other consideration under the provisions of Section 207 of Title 35. Although prior to passage of the FTTA, NTIS paid inventors a percentage of the royalties, its authority to do so was challenged by the Office of Management and Budget on the ground that NTIS lacked legal authority to reward inventors in this manner. The FTTA made it clear that inventors were entitled to a

share of royalties under either a cooperative R&D agreement or the Government's "207" program.

NTIS advised us that for FY 1985, it collected $1.5 million in royalties in connection with 146 federally owned inventions and paid out approximately $69,000 to inventors. For FY 1988, when the concept of royalty sharing had received widespread publicity and statutory blessing, royalty payments had increased almost fourfold to $5.6 million and the number of inventions increased by almost 40% to 201, with awards to inventors amounting to $356,200.

Thus, there is compelling reason to believe that the application of royalty sharing principles to federally employed inventors will continue to yield similarly dramatic results. As noted earlier, we have already seen a dramatic increase in the number of reported inventions at universities without any corresponding decrease in the number of scholarly publications. At most, there has been delay to afford the laboratory an opportunity to decide if a patent should be sought. Indeed, universities are generally seeing an increase in both patenting and publishing rates.

In short, if the experience of the universities and NTIS is any guide, a fair program of royalty sharing, when coupled with support and encouragement by laboratory managers and the parent agencies, will yield steady progress.

8. International Considerations:

The ultimate aim of all federal technology transfer initiatives is, as indicated in Section 2, to promote the ability of U.S. firms to compete in world markets. U.S. taxpayers contribute more than $63 billion each year to federal R&D initiatives. To the extent that this investment can yield new products, new processes, new industries and new jobs, those taxpayers ought to be the principal beneficiaries.

In the Bayh-Dole Act, Congress prohibited not-for-profit contractors electing to take title to federally financed inventions from giving exclusive licenses to firms that did not agree to manufacture the invention in this country, except to the extent that domestic manufacture was impractical or efforts to find licensees that would agree to such terms proved unsuccessful.

During the 1980's, as concern about U.S. competitiveness began to mount, this emphasis on domestic manufacture as a means of protecting the taxpayers' investment was seen as insufficient. Focus shifted from the relatively narrow issue of where a particular invention might be used or manufactured to the broader question of whether the taxpayer-financed technology on which the products of tomorrow might be based was being given away without

receiving an adequate quid pro quo, particularly as other nations demonstrated an adroitness at turning basic research into products for the marketplace.

It has long been evident that our foreign competitors routinely scour our public R&D institutions looking for technology leads. Historically the U.S. has been by far the leader in conducting - but not necessarily commercializing - basic research. Countries such as Japan are redoubling their efforts to close the basic research gap.

Thus, the drafters of the Federal Technology Transfer Act were concerned that the advantages of entering into cooperative research arrangements with federal laboratories not be extended to participants from foreign countries that deny U.S. entities the right to enter into similar ventures. The Act required laboratory directors to consider such practices when deciding which proposals to pursue.

Since then there have been a number of other instances in which Congress and the Executive branch have expressed their determination that the United States receive an appropriate quid pro quo before making its technology available to foreign entities whose governments fail to protect our interests or discriminate against us.

In Executive Order No. 12591, President Reagan expanded upon that principle by requiring lab directors to consider also the extent to which the relevant foreign government protects intellectual property. In the recently passed Omnibus Trade and Competitiveness Act of 1988, Congress required that federally supported international science and technology agreements be negotiated so as to ensure that the U.S. enjoys similar access to the research facilities of the other countries as we grant here (i.e., the agreement should ensure "symmetrical access"). It also required that proposed science and technology agreements be reviewed for their consistency with the principles of the Bayh-Dole Act and the Federal Technology Transfer Act.

In short, the requirements of the FTTA should not be viewed in isolation but as part of broader, evolving policies aimed at encouraging agencies to exercise greater discretion with respect to, and control over, commercially valuable, federally financed technology.

In consultation with the various agencies, an informal system has been devised whereby laboratories will simply notify the Department of Commerce when they have identified a party proposing an agreement as being foreign controlled and the Department will consult with the United States Trade Representative. The laboratories will then be advised as to whether the home country's intellectual property protections are

adequate and whether there is any evidence that it denies U.S. firms the right to enter into similar agreements or otherwise precludes their access to its research facilities.

It should be noted, however, that Congress has not provided agencies with much guidance for determining what is meant by "foreign controlled." However, Congress recently defined the concept in the "Buy American Act of 1988" (see Title VII of Public Law 100-418) and the Department and USTR are considering the extent to which these standards can be adapted for use by agencies in implementing the FTTA.

The Department of Commerce published a request in the Federal Register in April, 1988, for information from the public concerning denial of access to foreign research facilities. It followed up with press releases, letters to private firms and calls to trade associations to urge them to bring the request to the attention of their members. The Department to date has received few examples of Governmentally imposed barriers to U.S. industry participation in foreign R&D programs.

This response is not surprising given the newness of the concept of conducting R&D with foreign research institutions to most American industry. U.S. firms, until recently, have shown only limited interest in working with federal facilities, much less with those operated by foreign governments. Many domestic

companies are skeptical as to whether invitations from foreign entities to enter into such agreements are made in good faith or are attempts to tap into our existing technology base. These views may change with the increased internationalization of science and technology.

The Department of Commerce will continue to monitor this situation so that it can advise Federal laboratory directors when barriers are encountered in specific countries. It is currently participating in an interagency task force chaired by the National Science Foundation which is aimed at developing concepts for measuring the symmetricality of access in the context of the recently-concluded U.S.-Japan Science and Technology Agreement. The Committee's work should be useful in reviewing U.S. access in other situations.

Nevertheless, while implementing the Congress' instructions will take time, the Congress is absolutely justified in insisting that agencies remain sensitive to these issues. Foreign nations have been remarkably adept at identifying the sources of valuable technology in the United States that will lead to new products. To the extent that foreign firms perceive advantages in entering into cooperative relations with federal laboratories that are overlooked or ignored by domestic firms, the principal benefits of the Act will not be reaped by U.S. firms or U.S. taxpayers.

Accordingly, even though the relative newness of the FTTA and the small number of agreements entered into thus far permit no conclusions to be drawn, it will be necessary to monitor the relative degree of foreign versus domestic interest in entering into collaborative arrangements under the FTTA.

9. Statutory and Other Problems:

a. Computer Software.

Because copyright law prohibits federal employees from obtaining copyright protection for works created in the course of their official duties, the incentives of proprietary protection and royalty sharing - so vital in the case of inventions - are unavailable to spur the development of commercially valuable computer software that for legal or practical reasons cannot be patented. Such software can have substantial commercial value.

The Department of Defense, for example, spends considerable effort in developing vocational training materials and shock trauma peocedures.

The Agriculture Department noted that virtually none of the cooperative agreements signed or under negotiation dealt with expert systems, artificial intelligence or other forms of knowledge engineering, even though the systems approach and software derived technology reflected a growing portion of its

research. Indeed, USDA also noted that this problem antedated the FTTA and that the Government's inability to provide software protection had been a major factor in its inability to interest the private sector in its activities in such fields as crop production, forage-livestock interaction, and food processing-quality interaction.

It thus appears that the absence of an ability to convey proprietarty rights is resulting in the loss of significant opportunities for federal-private sector cooperation in areas of significant commercial potential.

Merely making software available without proprietary protection is often self-defeating. Much federally developed software is complex, containing thousands of lines of code. It is often useless to businesses unless they are willing to make substantial investments of time and money. For software to be commercially valuable, it has to be debugged, simplified and customized and training manuals must be available as well. Without an appropriate license, a firm could not be assured of recouping the necessary investment in providing such services.

Simply stated, the plain fact is that without a system for federally-developed software paralleling that of federally-developed inventions, the prospects for developing and commercializing the former will remain as limited as they

used to be for the latter. We have learned too much to continue repeating earlier mistakes.

The drafters of the FTTA were certainly aware of this. The legislation specifically required the Commerce Department to study the issue and make appropriate recommendations. In May, 1988, Secretary of Commerce William Verity submitted the required report recommending corrective legislation; at about the same time, the Comptroller General issued a report to Congress (GAO/RCED-88-116BR) which also noted that the absence of copyright protection for computer software was perceived by laboratory and agency officials as a technology transfer constraint.

The Department of Commerce, in consultation with other agencies, will develop appropriate legislation for review within the Administration and submission to Congress in early 1989. The Department and agencies will also consider the question of whether the prohibition on obtaining protection should also be lifted for semiconductor chip mask works.

b. Freedom of Information Act:

One major incentive for the establishment of cooperative relations between a private firm and the government is the existence of an expensive or unique research facility where federal scientists and scientists employed by the firm can work

"shoulder to shoulder" on proprietary research. But, as GAO's March, 1988, report found, the opportunities for this are limited at least in part by the Government's inability to assure industry that the results will not be made public to their competitors under the Freedom of Information Act (FOIA).

The experience of the federal laboratories since that report was issued confirms GAO's earlier finding. Many agencies reported that protection of proprietary information was one of the first issues raised by potential R&D partners, a situation which raises the possibility that the concern is a real one and may have deterred other firms from seeking cooperative arrangements with federal institutions.

Agency experience to date suggests that FOIA is a "thorn in the side" of negotiators, but that the wound is not a fatal one.

Accordingly, the Department will continue to work with agencies to determine the extent, if any, to which FOIA becomes an obstacle to the successful negotiation of cooperative research and development agreements. If this can be conclusively demonstrated, we will seek the assistance of the Department of Justice and other appropriate agencies in crafting legislation that balances the objectives of FOIA with that of technology transfer initiatives. Most likely, such legislation would give

the sponsoring partner a limited period of exclusivity after which it would be subject to disclosure under FOIA.

c. Personnel Matters.

Personnel in federal laboratories rarely have the knowledge and skills essential to effective negotiation with the private sector in these complex areas, a limitation which undermines the FTTA's basic objective of encouraging the laboratories themselves to take an active role in promoting the transfer of federally funded technology. As such, it will be necessary to consider methods - such as the development of an appropriate training course and materials - that can be used by all facilities to improve the skills of their technology managers and scientists. A course of this nature could also be useful to universities that are just beginning to develop technology management operations and to state and local governments many of which are beginning to take active roles in forging academic-governmental-industrial linkages as a means of spurring regional economic development.

Several agencies have also expressed concern that their efforts to promote technology transfer may be adversely affected by their inability to secure the services of patent attorneys in sufficient numbers. These agencies noted that patent lawyers were much in demand in the private sector and that federal agencies could not hope to offer the salaries that private firms

can and do pay such individuals.

Patent counsel are essential to the process of determining patentability, drafting technical documents, and negotiating advantageous licensing arrangements. Moreover, because of the importance that control of the technology not be divorced from those who created it and best understand its potential, such skills must be readily available not only at the agency level, but at the laboratory level as well. The FTTA does authorize agencies to use royalties to pay for such services. Perhaps as royalties increase this problem may be somewhat eased.

At the present time, the Department of Commerce does not believe it has sufficient data to justify any other specific recommendations. However, these personnel matters warrant careful monitoring. We expect to return to it in the next biennial report.

c. Conflicts of Interest:

In September, 1988, the U.S. Office of Government Ethics (OGE) advised the Department of Commerce that royalty sharing under the FTTA is "a form of compensation from the Government which does not cause an employee to have a personal financial interest to which the conflict of interest laws are applicable." OGE noted that under the statutory scheme, a federal employee is not placed into a direct relationship with the party paying royalty fees.

However, agency employees remain bound by the statutory provision (18 USC 207) that bars former federal employees from representing another person before an agency on matters that the ex-employee worked on while at the agency. Any matter in connection with the invention in question would appear to bring that section into play.

In addition, some agencies, while aware of OGE's opinion, believe that their particular mission may obligate them to impose additional standards of conduct. The Food and Drug Administration, for example, has expressed concern about potential conflicts that could arise when its scientists stand to profit from inventions that cannot be marketed without that agency's express approval. FDA is in the process of reviewing its regulations to ensure that its concerns are addressed without unduly limiting the ability of its personnel to take advantage of the opportunities accorded them by the FTTA.

Other agencies may have similar concerns and the Commerce Department will, if requested, be pleased to work with them.

10. Conclusion:

In sum, progress to date under the FTTA has been much better than expected.

o Agency administrative personnel, despite their initial

opposition, have come to recognize the Act's merits and are anxious to make it even more effective.

- Laboratory personnel are becoming more and more interested in making their work useful to the private sector and are overcoming old ideas that commercial considerations are somehow incompatible with the ideals of public service and the advancement of science.

- U.S. firms are becoming increasingly aware of the Act and in many cases are overcoming their preconceived notions that the federal laboratories are doing little that could be of value to them.

There are still problems to be resolved, but the hope of the Act's drafters - to foster a new era of scientific and technical cooperation between the public and private sectors - appears well on the way to fulfillment.