S. HRG. 101-259, PT. IV

PREPARATION FOR THE 1990 FARM BILL

HEARINGS

BEFORE THE

SUBCOMMITTEE ON AGRICULTURAL RESEARCH AND GENERAL LEGISLATION

OF THE

COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY UNITED STATES SENATE

ONE HUNDRED FIRST CONGRESS

FIRST AND SECOND SESSIONS

ON

THE STATE OF AGRICULTURAL RESEARCH AND EXTENSION

JUNE 9, JUNE 20, AND JULY 27, 1989
MARCH 22 AND MARCH 29, 1990

Printed for the use of the
Committee on Agriculture, Nutrition, and Forestry

U.S. GOVERNMENT PRINTING OFFICE
33-199 ≤ WASHINGTON : 1990

For sale by the Superintendent of Documents, Congressional Sales Office
U.S. Government Printing Office, Washington, DC 20402

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need to challenge ourselves pretty substantially as to where we are applying our research and for what purpose. Otherwise we're apt to be like rats in a maze and have a difficult time finding our way out.

Senator DASCHLE. I endorse that entirely. I hope that as we go through the next few months that we will have the opportunity to consult with you further. This is just the opening shot, and you have a lot to offer us in terms of your experience, and certainly, your philosophy. I think the combination here has been a very excellent one, and we appreciate both of your contributions this morning.

Dr. Hess and Dr. Marshall, thank you.

Our next panel includes Charles Benbrook, the executive director of the Board on Agriculture, National Research Council, Michael Phillips, the Office of Technology Assessment, and John Harman, of the GAO. If those three gentlemen could come forth. Gentlemen, thank you for coming. We would like to invite you to present your testimony. Obviously, as you heard me say, the entire text of your prepared statement will be inserted in the record. We would like you to keep your opening remarks to 5 minutes so we can get into some dialog afterward. Dr. Benbrook let's begin with you.

STATEMENT OF CHARLES M. BENBROOK, EXECUTIVE DIRECTOR, BOARD ON AGRICULTURE, NATIONAL RESEARCH COUNCIL, WASHINGTON, DC

Dr. BENBROOK. Thank you, Mr. Chairman.

LET ME BEGIN WITH AN IMPORTANT POINT THAT WAS RAISED WITH THE EARLIER PANEL, AND THAT IS YOUR CONCERN ABOUT THE SYSTEM BEING ABLE TO RESPOND TO PRIORITY AREAS OF RESEARCH

Let me begin with an important point that was raised with the earlier panel, and that is your concern about the system being able to respond to priority areas of research. You raised the question what structural problem or institutional problem does our current system have in responding to new priorities? I think in an era of, if not level funding, perhaps even modestly increasing funding with all the changes in the world, it's going to be very difficult to respond with the kind of programs that we have today because of our current funding mechanisms. And you asked well, "Shouldn't we just have four priorities?"

I think it is very important to keep in mind that while there probably are three or four priorities in say three, four, or five areas that certainly are the most pressing challenges that the country faces, there are still going to be a lot of routine areas of research that have to be ongoing to meet the needs of the food and fiber system. So really what you have to begin to think about is developing in the system the capacity to have part of the Federal research dollar and programs freed up and capable of responding to emerging priorities very quickly, and this capacity will need a big enough part of the total funding to really make a difference, while preserving capacity to respond to ongoing needs. I think that what you will find is as you pursue these hearings is that because of fiscal austerity over the last several years, and the other budget pres-

sures that the Department of Agriculture has faced during the 1980's there really hasn't been the opportunity to develop the capacity to put new Federal money into the system so it could respond to some of the new priorities.

In a range of our reports, and I list 12 that we have done in the last 4 years that address a range of research policy, environmental, conservation, food safety and nutrition issues, each report contains a set of research recommendations that relate either to substantive and technical priorities, or to programmatic needs. And I would offer the overall judgment that three or five factors routinely contribute to the ability of the Department and the system to respond.

First of all, there is a tremendous about of progress going on in science. It's a very exciting era when biotechnology, new engineering developments, et cetera, have opened up many new ways to address old problems that we face in agriculture, and there just hasn't been much new money to put behind these new exciting, dynamic areas. And because our current system as it's structured does not have a high degree of flexibility to redirect money, because of personnel policies, because of funding mechanisms. This is true despite enumerable statements of priorities that everyone agrees with. There is limited opportunity, or ability to put money behind new priorities. So statements of priorities are a dime a dozen. How does the allocation of money actually change?

We have been working for a year or so on a major national agriculture research initiative. I might mention, Mr. Chairman, that this initiative is related to one of our major reports: "Agricultural Biotechnology: Strategies for National Competitiveness." This report came out in 1987, and contains a recommendation for a $500 million increase in competitive grants targeted to exciting new biotechnology. The study committee that we convened to do this report was chaired by the distinguished and capable deans of the College of Agriculture and Natural Resources at Davis, California, who now happens to be our new Assistant Secretary for Science and Education. So we'll be working with Dr. Hess to try to implement the report that he wrote.

In the context of analyzing where we stand in agricultural research, the Board asked itself the question where has the money gone? What areas of research, what programs, over the last 8 fiscal years have had more than a 5 percent change in any one year in budget levels, either up or down? And then we analyzed why has Congress shifted spending priorities in these areas? Who's recommendation were they following? And I would urge the committee in its investigation to—working with the budget staff, and with the Department, and with GAO—to basically formalize the analysis that we did, because I think you're going to find some rather surprising results.

You will learn that it generally takes 2 or 3 years for a top priority item in the Joint Council in UAB cycle, often before there is any discernible change in the money appropriated by the Congress, and sometimes not even then. In fact, rural economic development and diversification popped onto and off of the top 10 chart with nary any sign that anybody paid any attention. And it wasn't until the third or fourth year of water quality being either No. 1 or No. 2 that there was any discernible response in the executive branch

budget process. And let me in closing set the stage for the appropriation markup which is about to begin. Senator Kerrey will have the opportunity to watch how this scene plays out.

Senator KERREY. Believe me we'll do it in an enlightened fashion, too.

Dr. BENBROOK. The executive branch, after several years of recognizing water quality as a major priority, has come up with a request for a substantial funding increase. New money, $41 million spread across the Department for water quality protection. Leading Members of Congress have identified this $41 million as a source of funds to provide an $11 million increase in the LISA Program, $20 million increase in biocontrol, and maybe leave a little bit for water quality.

So we will all witness as the Congress moves ahead with the 1990 budget markup, evidence of the difficulty that the Congress faces now in responding to very strongly felt, clear, major national needs. Water quality protection, safer ways to control pests, sustainable agriculture. Those needs are all profound and deeply felt. The Congress is going to respond, but the mechanisms that you have to respond now tie everyone's hands and are really threatening both the credibility and the performance of this system in a very profound way. So I hope that your efforts will lead to a more overall solution to the problems this country, and the agriculture research system faces in meeting the priorities with real dollars. Thanks.

Senator DASCHLE. Thank you Dr. Benbrook.

[The prepared statement and attached addendum (a list of pertinent NRC reports) of Dr. Benbrook appear at the conclusion of the hearing.]

STATEMENT OF MICHAEL J. PHILLIPS, Ph.D., SENIOR ASSOCIATE, FOOD AND RENEWABLE RESOURCES PROGRAM, OFFICE OF TECHNOLOGY ASSESSMENT, WASHINGTON, DC

Dr. PHILLIPS. I have my prepared statement that I will submit for the record, and let me just amplify on a couple of points.

RESEARCH PRIORITY SETTING

Some of the areas that have already been mentioned here by yourself and others I have covered as well as we look at this whole research priority-setting process. You asked what our Office has done over the past decade or so, the kinds of research priorities that we've laid out in various studies, and how the system has responded, and I've summarized those in the first part of my prepared statement. Basically I think that you can say that as you look back as to how research agencies have responded to our findings, that it's a mixed bag.

In some cases, such as work that we did in the late 1970's, that resulted in competitive grants being implemented within the Department, I would say that the system's response to that was fairly rapid. We did see competitive grants come on the scene quicker than many of us might have thought. But in areas that Mr. Benbrook and others have mentioned that relate to investigating alternatives to present agricultural practices because of our concern

about the environment, food safety, and the like, those have been on and off the research list, now and again, and the system has been slow to respond. We're seeing here in the late 1980's, in some cases 10 to 15 years after they were first identified as high priority areas that we're beginning to move into these areas. So it is a mixed bag as you look at this whole system.

FEDERAL SUPPORT

When you look at the priority-setting process many of the points that have been made by the previous panel in terms of what has happened to the Federal support are important. It's a concern that I think we can't overstate enough, because we do have what Congress formed back over a 100 years ago, a Federal-State partnership that over the last 25 years, at least the Federal portion of this has not been a true partner. And if you can look at just the last 10 years in particular we've seen the Federal support decline by at least 15 percent, and States have had to basically make up for this difference. And we've come to a point where I think States are saying, "We probably can't do much more than we have." We're going to reach a stalemate here fairly soon. And so I mention that only in passing in terms of what happens then when you try to establish priorities, because in this type of an environment, Federal funds as they continue to decline to establish and then implement national research priorities, it becomes difficult within this type of a Federal, State partnership.

WE SEE THE PRIVATE SECTOR BECOMING MUCH MORE INVOLVED

We see the private sector becoming much more involved, we see joint arrangements between land-grant universities and the private sector to conduct research, especially the biotechnology research. And we see that this research may, or may not, match what we consider to be national priorities. So you do have a "Russian Roulette" in terms of what goes on out in the research community, as to whether or not research does match up with national priorities anymore.

PRIORITY SETTING

The Senate and House both established two Boards that we've talked about here today to recommend priorities. The Joint Council, and the Users Advisory Board, and we've heard quite a bit about that already today.

Prior to the establishment of the Joint Council and UAB, much of the priority setting for agricultural research was done by administratively administered advisory committees that basically came up with laundry lists of research topics. Little, if any, real priority setting existed.

DEFINITION OF A PRIORITY

As you mentioned, and as I have in my statement, I thought it was important to include the definition of a priority, according to Webster, "is the quality or state of being prior; superiority in rank or position; or a preferential rating." And it's something I think as

you've mentioned earlier we've gotten away from, and we use that term very loosely.

In work that we've done in the past, we've found that the Joint Council and the Users Advisory Board really struggled with being able to establish priorities. Our view today is that they are doing a much better job of that priority setting than when they were first established. But, as the previous panel already mentioned, there is a lot of maturing yet that needs to go on, and basically I would say at this point that there is little, if any mention made, particularly by the Joint Council, as to what the research community is willing to give up to attain new priorities.

PROVIDE SOLUTIONS TO THESE PROBLEMS

We talk an awful lot about what we need to be doing and the important areas that we need to direct resources, but we don't in the same breath then say, to do that, we're going to have to cut off programs in other areas. In the business world this is what goes on all the time. And I think we are very lax in the public sector for not being able to say we're going to give up some areas. These are areas in which we've done research, the research has resulted in these types of success, and it's time now to reallocate resources and move on to higher priority areas. That type of debate does not take place within the public sector.

I think as we work in the study that we're currently doing for the committees we're going to use some criteria, that which has been suggested by Congressman George Brown as a basis on which to make some decisions as to the appropriateness of how you should go about reauthorizing in your debate here, the Joint Council and Users Advisory Board. And I think these are important questions.

SUGGESTED CRITERIA ON WHICH TO BASE THE DECISION WHICH WE THINK SEEM APPROPRIATE

First, does the Joint Council and Users Advisory Board provide a unique function in determining research priorities? Are the priorities any different than what you get from other groups?

Second, does the Joint Council and UAB provide sufficient advance planning, given the lag time in research activities? Can we identify problem areas enough in advance that you can reallocate resources to get the job done?

Third, does the Joint Council have a sufficiently broad membership to integrate research needs and scientific advances coming from the nonagricultural disciplines? Things that were mentioned in the first panel.

Fourth, is the UAB membership representative of the users of agricultural research?

Fifth, and most important, what impact does the Joint Council and the UAB have on the priorities set by the Department of Agriculture in its budget, or the priorities set by the Office of Management and Budget, or on the priorities reflected in congressional appropriations?

MORE ACTORS THAN THE JC AND UAB

I think as Chuck has just mentioned, I think a follow-on as to what has happened with all the recommendations that have been made. And I think sitting on the committee you can't ignore the fact that there are many other actors out here that are establishing research priorities. And Congress is probably one of the biggest actors in this, because you all are beseeched daily by desires of your constituents, and this has resulted, for example, in agriculture research of commodity groups, or particular universities receiving higher priority for funding than some predetermined research policy thrust. The fact that most major commodity groups and many universities have Washington offices is certainly not accidental. Such offices have proven to be very effective for these groups and, as a result they can complicate the more formal research priority-setting process. It should be noted that there are a few major universities that have established a policy of not accepting research funds that are directly solicited from Congress.

ESTABLISHING RESEARCH, EXTENSION, AND TEACHING PRIORITIES IS MORE ESSENTIAL TODAY THAN EVER BEFORE

So as you look to the title XIV of the role that the Joint Council and the Users Advisory Committee make I think we need to realize that this is a very dynamic process, that research priority setting in this day and age is a very frustrating process, and that we do need to examine whether or not we currently have mechanisms in place that can really help us get on top of this situation and to try and look out to a more bold and clear vision of what will be the problems that need to be addressed in the future and the role that the research system can plan in terms of preparing us for the next century.

DEFENDING THE STATUS QUO WILL NOT DO THE JOB

I think defending the status quo, as we are want to do, is just not going to be satisfactory for us to be a competitive nation in the future. And with that I will stop at this point.

[The prepared statement of Mr. Phillips appears at the conclusion of the hearing.]

Senator DASCHLE. Thank you, Dr. Phillips.

Mr. Harman.

STATEMENT OF JOHN W. HARMAN, DIRECTOR, FOOD AND AGRICULTURE ISSUES, RESOURCES, COMMUNITY, AND ECONOMIC DEVELOPMENT DIVISION, U.S. GENERAL ACCOUNTING OFFICE, WASHINGTON, DC

Mr. HARMAN. Thank you, Mr. Chairman and Senator Kerrey. I do appreciate the opportunity to be here this morning to present information on our earlier reports on agricultural research activities. Although we have not had the opportunity in recent years to review programwide aspects of such activities, we issued several reports in the 1980's dealing with various aspects of agricultural research. My prepared testimony discusses several of these previous reports, including the recommendations we made at that time and

an update of the actions that have been taken on those recommendations.

As you requested, I will summarize the prepared testimony focusing primarily on one of those reports, which I believe has the most applicability to the subject of the hearing here this morning.

LONG-RANGE PLANNING

We reported in July 1981 that the U.S. agricultural research and development system did not perform adequate national long-range planning, including setting priorities. I think that is something that has been confirmed several times here this morning already. We said that increasing demands for food and fiber, combined with increasing pressures on agricultural inputs, made it essential that national long-range planning be undertaken for agricultural research and development. And certainly that environment has not changed. If anything, the issues currently facing agriculture make good planning more essential.

We pointed out that the key participants in the agricultural research system carried out long-range planning to only a very limited extent. No rationale for long-range planning had been developed; and past planning efforts had not resulted in national, systemwide long-range plans. We also pointed out that a number of factors inhibited such planning. Management and planning for individual research projects were split among Federal, State, local, and private authorities; and this fact, plus frequent changes in departmental leadership, a lack of continuing congressional interest, and limited executive interest and guidance, made long-range planning extremely difficult.

RECOMMENDATIONS

We recommended, as we had in a 1977 report, that the Secretary of Agriculture develop an agencywide long-range plan for agricultural research and development.

The Congress later in 1981 reemphasized the importance of long-range planning by, among other things, requiring the Secretary to take the initiative on overcoming barriers to long-range planning by, first, developing a long-term needs assessment for foods, fiber, and forest products and, secondly, determining the research requirements necessary to meet those needs.

Now, although we have not evaluated the effectiveness of the planning actions that have been taken since that report, the process does seem to have improved; again, something that seems to have been confirmed here this morning.

Following enactment of the amendments, USDA asked the Joint Council, which was created by the 1977 farm bill, to direct the preparation of a long-term needs assessment, and that needs assessment was published and sent to the Congress in January 1984. In addition, the Joint Council has become much more active since our earlier report, issuing several key planning documents. And finally, USDA has developed long-range plans as a basis for future research management. In 1983, for example, as the Assistant Secretary mentioned, it developed a plan consisting of a strategic plan, an implementation plan for the period 1984 to 1990, and operation-

al plans supporting the strategic plan. In September 1985 USDA published its second implementation plan, which covered the period 1986 to 1992.

Now, we've not looked at those plans from the standpoint of whether the priority setting is adequate—whether the planning process indeed is achieving what it is intended to achieve. But what I am saying here this morning is that a process at least does exist now that did not exist when we looked at that planning process earlier.

PERSONNEL NEEDS

The other reports discussed in my prepared statement, all of which were issued in the early 1980's, dealt with such subjects as personnel needs, use of research facilities, and funding. Regarding personnel needs, we reported in 1981 that USDA could do a better job in carrying out its responsibilities as the Federal Government's lead agency for keeping abreast of personnel needs in the food and agricultural sciences. USDA's former Assistant Secretary for Science and Education earlier this year emphasized the broad need to strengthen the programs at the Nation's colleges of agriculture and natural sciences. In support of this need, USDA has made several proposals for improvements in this area.

FEDERAL AGRICULTURAL RESEARCH FACILITIES

In the January 1983 report, we said that despite the underuse of existing agricultural research labs, new laboratories were under construction and others were being planned. We questioned the wisdom of this approach and recommended that the Secretary develop a plan to consolidate agricultural research activities at fewer locations, something which seems almost as difficult to achieve as setting priorities. In developing its long-range plans, USDA has included laboratory needs as part of those plans, and has included suggested consolidations and closures.

FEDERAL AGRICULTURAL RESEARCH FUNDING

Finally, a 1983 report discussed some aspects of funding and provided some information, but we did not make any recommendations in that report. That concludes the summary of my statement, Mr. Chairman.

[The prepared statement of Mr. Harman appears at the conclusion of the hearing.]

Senator DASCHLE. Mr. Harman let me just start out with a question to the three of you, because it's another facet of this that I wanted to get into this morning, and that deals with this concept of consolidation of research. Critics have argued that there is too much overlap, and that is as Dr. Marshall said, we're putting research in the hands of those, especially in some very technical areas, that may not have the capacity to use it effectively. Number 1, given your experience would you favor research consolidation, and secondly, if you do, would you favor the approach Senator Leahy and others have at least advocated we consider. And that is develop a DoD like board to go after those locations which may not have a purpose any longer and take that research and consolidate

it with those which do. Let's start with Mr. Harman since you mentioned it.

Mr. HARMAN. Well, we are currently doing some work for one of the House Agriculture subcommittees trying to get some more information, updated information, on consolidation of laboratories. Based on our earlier work, solely on that earlier work because we haven't reviewed this area since then, I would say, yes, we do favor consolidation of laboratories and research facilities in those cases where it looks like—and it looks to us like the situation may still exist, but where it looks like the labs are so small that they can't take advantage of some of the types of information that could be gained from the combined research labs and from scientists being able to interact with each other. And the situation that has existed is that more labs are being created while the personnel ceilings have stayed basically the same. So you do have a situation where, in our view, it looked like there was a need to consolidate some of these facilities.

Senator DASCHLE. This may be an unfair question, but if you were to do that, and wave a magic wand and somehow eliminate the facilities that in your opinion are unnecessary. Are we talking about 10 percent, 15 percent, 20 percent?

Mr. HARMAN. I wish I could answer that question. I think this has to be taken as part of your overall planning process. You cannot just say we don't need a facility here because it has only 10 people in it. It could be that those 10 people are working on something that is very "high priority," but——

Senator DASCHLE. That is all we need is another priority list of priority stations.

Mr. HARMAN. Well, I think you have to look forward, and that is why we were advocating a longer range planning process back in 1981. You can't look at 1 or 2 years and say here is where we're going to be. You have to say well water quality is going to be an issue, and we know it's going to be an issue for some time in the future. Now, where is our capability? Where does our capability exist to carry out that kind of research? And you're going to put the funds in there and carry that out, and that is true for food quality, food safety, and other issues. But I would tend to agree, looking at these lists, that it's not a problem that is unique to agriculture. I spent a good deal of my time in energy R&D, and energy faces many of the same problems in terms of what is a priority, because you also have constituencies there.

So it's a very difficult problem. I think what you have to do is develop the criteria that you're going to use on which to base your judgment of priorities.

Senator DASCHLE. Mr. Phillips.

Mr. PHILLIPS. Well, I would basically agree with what Mr. Harman is saying, that there is quite a bit of consolidation that can be done, and to ARS's credit they have made attempts in the past to do that. And I think over the last 6, 7, 8 years or so, they've been able to make some inroads. I recall in the late 1970's there was something like 140-some type of laboratories under their control, and I think now it's down to somewhere around 120.

Senator DASCHLE. It's in the 120's now.

Mr. PHILLIPS. So that is not a great consolidation, but at least it's some headway, and I think they would be the first to tell you they ran into a lot of stiff resistance to be able to do that. And I think as you mentioned a DoD type of approach to this might end up being the way to go. An authoritative body that says these are the ones that should be closed, and these are the reasons why. But, I think it is very important to make the point, many of these labs have sprung up and we've hung on to them for reasons that don't have much to do anymore with what are the kinds of problems are facing agriculture and the science and technology to address those problems. I think that gets to be the real nub of it.

It is part of a symptom of a problem where we're still out here, if you are in plant science, you are upset because there are more resources going to animal science and vice versa. Or if you are in the crop sciences you are more or less upset because not enough is going to plant science, too much is going to soil science. We have those kinds of debates that take place around the margin of this research priority setting, and you end up funding new labs because of constituent pressure. And this is something we have to finally get over, we have to finally get that behind us and look at what are the problems facing American agriculture for this next century, and what is going to be the science and technology to confront those problems. And that is something that I think is lacking, and there is probably a number of reasons for that, not the least of which is you have to go back and look at resources. As we said earlier to make decisions that there are some areas that just have to be cut out. And we haven't really been able to stand up and say that.

Senator DASCHLE. Dr. Benbrook.

Dr. BENBROOK. Mr. Chairman, the need for consolidation, which I might add exists both in ARS and in the academic sector, is driven by two factors. One is that science and technology and the tools of the trade have evolved very rapidly requiring some very expensive equipment, and even more important, teams of researchers that posses among them some very specialized new skills. You have to continually be able to support improvements in human talent, facilities and equipment so that the best work possible is undertaken, and to advance science the most rapidly.

It is very difficult to sustain sufficient resources in many of the smaller, isolated research locations that ARS currently manages, and also in some of the universities around the country in departments that are not highly relevant to the major agricultural industries in the State. It can be very difficult to maintain a credible range science department in some of the eastern universities. It is not difficult to maintain a world class range science department in Wyoming.

Senator DASCHLE. Or South Dakota.

Dr. BENBROOK. Or South Dakota, of course. The other point is that we need to consolidate and think about relocating the critical mass of agricultural research and technology development in this country because we have to do a better job in utilizing quickly the results of science in practical, management-based systems for farmers, for technologies for the food processing, and agribusiness industries, and in the development of better policies. And for that to

happen we have to bring the generation of knowledge, and the people that carry out S&T activities closer to decisionmakers, leading farmers, farm organizations, commodity groups, and industries. If they're out in the countryside isolated, it is difficult to get partnerships, dialogs, and communications essential to the transfer of knowledge in place. As a result, it is hard to quickly move from the discovery stage of science through the application phase. It is not that work going on at any of these locations is no longer important or that the work of the individuals is somehow of a lower quality. That is rarely the case, but it is simply a matter of whether there may be a way to tap their talents and use that money to get more results.

Senator DASCHLE. Senator Kerrey.

Senator KERREY. Mr. Benbrook, let me ask you a question, and anyone of you can pick up on it. It seems to me that one of the things that is awfully difficult to plan around is that every now and then some human being gets it in their mind that they're going to do something and they just get it done. And they reorder the priorities all of a sudden. I have a good friend by the name of Woody Varner in Nebraska who decided he wanted to build a performing arts center in Lincoln, Nebraska, and all of a sudden performing arts moved to the top of the list. And we built a performing arts center. He raised the money privately, talked me into supporting it, and he just singlehandedly pushed the darn thing through. Very often the trouble with plans is that every now and then people get in their mind to do something different and they just do it.

The thing that I'm trying to wrestle with and the reason that I see priorities as being extremely important, particularly ones that are centered on the producer themselves and the problems that they are facing, is that I'm very much aware that technology has a tendency to go in a certain direction. It is often predisposed to head in one direction or the other. There is a terrific book by Neal Postman called "Amusing Ourselves to Death," a political discourse in an electronic age wherein he says that the light bulb would have been on the market a lot sooner, except Thomas Edison kept turning it on and holding it up to his ear and saying hello, hello.

Now, the light bulb was going to affect the world and move the world in a certain direction because of what it did to us. And priorities become very important because they guide us as to when we should say no in trying to shape what the policy for the Nation is going to be. And one of the things that I heard you say, that I think I have to personally guard against just because I tend to like things that are new and improved, is that you recommend that $500 million be targeted to new and exciting technologies.

And, I'm very confident that new and exciting is an insufficient criteria to judge whether or not we're going to invest money. I'm curious as to how you factor in the objective portion of technology investment. Where we are trying to go is awfully important. My job is to try to develop national objectives, and then establish some priorities that enable me to measure, particularly in relation to the farmer, if I'm moving in that direction. How do you determine all that?

Dr. BENBROOK. Our studies, most of the studies that OTA, and GAO have done focus on Federal research programs, but we have to do so cognizant of the fact that we have a Federal-State partnership, and as Mike pointed out the Federal investment, or portion of that contribution, has declined somewhat as the States have become more responsive to the very pressing problems that producers in your various States face. They want a solution to the wheat aphid. I mean it is eating up the wheat and we have to do something about it. That kind of immediate problem at the national level is what we face with AIDS. Look at the response in Federal science funding within the National Institutes of Health, within the Congress of the United States to the problem of AIDS. When the Nation faced what was a clear and compelling challenge it gripped everyone, the Federal Government responded.

If you look at some of the problems that agriculture deals with, the nutritional attributes of the food supply, the safety of the food supply, dealing with foodborne illnesses, we are talking about public health problems, issues of the same magnitude as AIDS, perhaps not as dramatic, but which certainly affect just as many people. You look at the incidence of heart disease, and cancer, and other illnesses that are diet-related, that are all determined or influenced by the food supply, the enormity of the impact is just as great, but there has not been as clear a voice at the Federal level of government articulating the opportunities and challenges that science must meet if the Nation is going to move in a new direction.

So, I guess the problem, Senator Kerrey, is that no one has been speaking with sufficient force of vision in the area of Federal science priorities in food and agriculture. There has been a sort of maintenance mentality to keep the programs going, keep the agencies on a steady course, but there has not been, despite many reports and studies that have identified exciting new areas, there hasn't been much response.

Now, the definition of an exciting new area of science and technology is knowledge that makes it possible for agriculture to solve a problem that we either don't have the ability to solve today, or do so only after spending lots of money and time in lawyers, et cetera.

We have the capacity to present the consumer with essentially risk-free food. We're practically doing it now, and yet we're dealing with this as if it's a crisis of equal proportion to overconsumption of fat, which is ridiculous.

Senator KERREY. I have to interrupt. Are you saying the consumer is wrong?

Dr. BENBROOK. I'm saying that——

Senator KERREY. Are you saying that I ought to go back to my farmers and say that the customer is not always right. If consumers become frightened, they're frightened.

Dr. BENBROOK. It depends if you want to get reelected. I mean the consumers are rough, they have reason to be concerned. What they read troubles them, but what I'm saying is that the system has the capacity to deal with a lot of those problems in a way that

does not feed into consumer concerns. And it's the inability to deal with these problems that I think continues to plague us.

Let me give you a tangible example. This was one of our first reports on pesticides and ground water quality, it came out in 1986. It offered a series of recommendations that would have led to a much improved data base for knowing where in American agriculture, and under what conditions a farmer is likely to contribute to the contamination of his or her ground water with pesticides and nitrates.

In the absence of any sense at the national level that we are getting a handle on that problem. One of your colleagues, Senator Fowler, has written a bill [S. 970, Farm Conservation and Water Protection Act of 1989]. It's a low-input sustainable agriculture bill that includes a provision that would require farmers to voluntarily test their wells, federally cost-shared, in order to find out if they have pesticides in their wells. And in the absence of the farmer voluntarily doing that they have to keep detailed records of all pesticide applications et cetera, et cetera, and make those records available. That provision in the Fowler bill is a response to a lack of information that was identified as important and missing years ago, not just by us but by others. It is this inability of the system to respond to important and legitimate concerns when they are first brought to bear, in a credible way that satisfies people, that remains a major problem.

We know enough about the presence of pesticide residues in food to do whatever we need to do about it. Whether it is regulation, or changes in commodity programs, or conservation provisions, the country lacks the sense that we have a handle on these problems.

Senator KERREY. Doesn't that have a lot to do with the way it is presented. Food safety comes from these spectacular reports on "60 Minutes" and on all these nightly news programs whereby a sensitivity is created that doesn't exist, for example, in fat consumption issues, because it is not presented in the same spectacular way. Is that not a part of it?

Dr. BENBROOK. The pesticide side of the food safety issue has been characterized by a perceived lack of progress in the environmental and public health community that really goes back to the late 1970's. You're aware, Senator, of all the effort to try to get FIFRA reform legislation through, which finally culminated at the end of the last Congress in the bill we've come to know as FIFRA Lite. Well, despite that legislation, the record of performance in dealing with a lot of the old pesticides that appear to pose risk above the negligible level—which is what EPA has identified as of concern—is at best spotty and is interpreted by environmental groups as evidence of great danger in the food supply.

Very few scientist believe that because the residues of a few dozen pesticides may occasionally be above the tolerance level that there is a grave and immediate threat to the food supply. Yet the public has this sense that if the Government says that this level is safe, that anything over it is unsafe.

It is the same thing with priorities in agricultural research. Many of us can agree, and many reports do agree on what the priorities are, but the response in the system is what is lacking. The same thing holds true in the regulatory area. We know where the

potentially excessive risk are in the food supply, we haven't done anything about it. So the environmental groups turn that fact around and trumpet it on "60 Minutes" and in some cases that grabs attention and we have the makings of the pesticide of the month treadmill which we've been on now for a couple of years.

Senator KERREY. I hear in that, unfortunately, that you believe that if you could just educate these consumers everything would be all right. I remember hearing my cattlemen saying that all the way through the 1970's. I'm in the restaurant business, and we have a rule in my business that says no matter how good I think the food product is, if the customer thinks it is garbage, it by definition has become garbage. I hear in what you are saying that if the consumer gets frightened by a food product the answer is to go to the consumer and say quit being so scared. The fact of the matter is the world has changed.

Two generations ago we all prepared our own food. But I eat out of a bag today. Other people are not only growing my food, but processing and cooking it. So I am increasingly dependent upon somebody else to process it, and increasingly anxious about what they are doing in the course of doing that. I think it would be a mistake for me as a representative of an agricultural State to go back to my producers and say, "gee don't worry about the customer, I'll take care of the customer. I'll tell the customer that don't get so frightened." I think that would be a mistake, I should instead encourage my producers to be increasingly concerned about what that customer wants; increasingly concerned about what the consumer thinks. The closer they get to the consumer, the more apt they are to respond to consumer needs, and the more apt they are at responding to consumer needs, it seems to me the more they are going to be profitable and successful out there on the farm itself.

I get very concerned about this view that if we just educate the consumers a little bit everything will be OK. How do you think the consumers feel in Oakridge, Tennessee right now? They have heard the Department of Energy say don't worry about this plutonium enrichment factory out here, we're doing a great job. But they dump cesium and strontium into the water supply that's run through the community. The consumer has good reason to distrust the reports that come out and say don't worry about it, it's safe.

Dr. BENBROOK. I'm speechless.

Senator KERREY. Well, you don't have to be speechless, you can jump back in and say I'm wrong.

Dr. BENBROOK. But I think the point is that if they are sensitized as they should be to food safety, they ought to also be sensitized to education and other elements of food safety, in addition to pesticides which is what we're not doing. For some reason they aren't as concerned, for whatever reason, on fats and on cholesterol, although people are becoming so much more sensitive in recent years.

Senator DASCHLE. But I get a different sense from Mike and from you with regard to responsiveness. As I read through your report Mike, the sense I have is there has been response to OTA studies. You list the results of each one of these studies and if one reads the testimony it appears that that responsiveness has—I mean

there isn't any editorial here that along the way that says they haven't responded adequately, it just says result. And in each OTA study there is a result. Would you agree with Dr. Benbrook that in many cases the result has not been satisfactory?

Dr. PHILLIPS. Well, I guess in many respects that is in the eye of the beholder as to how much change you want to see.

Senator DASCHLE. OTA has put the study together. Obviously they have some expectations with regard to what they would like to see as a result. I guess the question would be, are you satisfied that your expectations were met with the studies as they were presented each and every time?

Dr. PHILLIPS. Well, it's a matter of I guess, you see change take place. I think it is probably not all that uncommon to not see change. I mean there are enough pressure points, I mean it's not just the fact that there was an OTA study, but there were other studies, the Academy, or the GAO, or the system itself. And many times you see reports come out that tend to push the system in a direction, and so kicking and screaming at times you do see change take place. I think what I tried to point out in my testimony is that you'll see a range here.

Sometimes you'll see change take place fairly quickly, quite a rapid response. That means somebody was at a pressure point within the system. Others, such as the concern for environment, food safety, that has taken us awhile. You can go back to reports that we've done over the past 10 years that pointed out that there were these concerns. And we're only seeing now change take place with the LISA Program, and others, here late in the decade of the 1980's. There was research going on by what the system considered to be real splinter groups out here that didn't know what they were doing, and really were put down in many respects because of that type of research. They weren't considered a credible part of the science community.

Well, now I think enough credibility has been established for many of these groups that now there is something to be said that maybe there on to something. And now maybe we need to put some more resources to helping build up the science that we need to develop a track record to see if this is indeed a way in which can open some new roads to agriculture to develop new crops, or to do a better job of not using so much chemicals, and clearly in terms of biotechnology and the direction it goes.

Senator DASCHLE. Dr. Benbrook, do you share that view?

Dr. BENBROOK. Well, I certainly agree with Mike that some of the environmental and food safety concerns have been responded to perhaps somewhat more slowly than more traditional production oriented concerns. Another important point I think is that many of the principal recommendations in an OTA report are directed to the Congress, and I think Congress has been, and continues to be, fairly responsive institutionally to recommendations that come from GAO and OTA. I think that, in concert with the congressional interest in seeing executive branch action on OTA recommendations, there has been an additional pressure point in the institutional process for OTA reports that have proven very helpful. I think that bodes well for the ongoing work that OTA is doing. I think OTA reports have had, in general, more impact than those of

any other institution outside of the system. I hope that that continues, because their reports have generally been very insightful and constructive.

Senator DASCHLE. Let me just see if I can summarize real briefly from what I've heard, at least the first two panels and see if you share this few or not.

One, we do lack adequate prioritization.

Two, there may be a need as we look at the way we approach research to look at the facilities themselves for the kind of overlap, and duplication, and lack of focus that might otherwise be created if we were to put greater focus on research.

And, three, there does seem to be some difference of opinion with regard to responsiveness.

Dr. Marshall left me with the clear impression that we aren't as responsive as we ought to be to changing needs. You seem to be a little less severe in your criticism of the research community with regard to responsiveness than Dr. Marshall was. Is that a fair assessment of position?

Dr. BENBROOK. I would simply like to add that I believe that the major problem is a discontinuity between the process we use to set and agree upon priorities, and the processes we use to direct money behind those priorities. And, I would urge you to look at the structural aspects and the funding mechanisms that are used both within the executive and legislative branches to try to come up with some ways to bring about greater harmony in both the congressional and executive branch views of priorities. Incidently, our institution did a report on science and technology budget setting that has some suggestions that may be useful.

Senator DASCHLE. Dr. Phillips.

Dr. PHILLIPS. Well, I agree with what your saying. I just want to make one other point to that. Yes we have done a pretty decent job of seeing some change take place, but I think we have a ways to go and I don't want to say that I'm sitting here saying that we are satisfied. I think we are seeing something take place in the biotechnology arena that is a good example of how we can do a better job. We have technologies that are going to basically be coming on the market in the early part of the 1990's, that if you look back and said, if we were to have done some prioritization and planning, is this the way in which we would like to have seen technologies come onstream.

And, I'm particularly thinking in the animal area of the bovine somatotropin, as well as the porcine somatotropin. And how in many respects these are going to have many different impacts on the industry, as well as the way society views the use of these technologies. We have, essentially, a technology coming onstream in a part of our agriculture industry in which we already have surplus conditions. And the question is do we really need to be making a bad situation worse, and it's going to give you in the Congress as you look at the farm bill, you're going to have some real tough decisions to make, because you're going to have a real impact on the dairy title when you're looking at something akin to a 20 percent increase in production. As opposed to the porcine somatotropin which is basically as close to a win, win situation as you can have

in a technology development in terms of getting consumers something that they really desire.

So you sort of look back and say, if we had tried to plan this in any sense, maybe we could have looked at the way in which we allocate resources and made some difference in terms of priorities of which one of these would come on the market first. Because, I think what you're going to see in the bovine somatotropin is one in which we're going to have a hard hurdle to get over in terms of future advancements that we want to make in the biotechnology arena. Like it or not, I think that is going to be reality.

There is a lot of myth out there about what bovine somatotropin is going to do, and I think as Chuck said, we have to do a better job in terms of educating consumers about that. But, still it's going to be a perception that is going to be out there that the science community is going to have to overcome. And, so, that is just an example of how I use to say we can still do a better job, in terms of how we plan research and what we consider a high priority, and the way in which we allocate resources.

Mr. HARMAN. I would agree, Senator, with what you said. The one area that is somewhat intriguing is the point you made on responsiveness, and I have listened to the people here that have commented on that. I think part of the problem is we have an agricultural system here and it does not deal just with research, it deals with a lot of other changes we try to make in agriculture, which has been around for some time. It's built up quite a lot of special interests in different areas, and you don't change a system like that overnight, and in research, you don't make changes in research overnight.

I think a first step is the one that we advocated in the late 1970's and early 1980's when we started talking about planning, and then once you start talking about planning, you get into these questions: what's a priority and what do we mean by priority? And to me a key step that Congress could make and the administration could make is to define the criteria they're going to use. And Dr. Marshall in his testimony—the five things you talked about earlier there and referred to them as priorities—I would almost look at those as criteria. And then you have to look at to what extent do the kinds of research that we want to do, looking at the problems down the road, meet those kind of criteria, if those are the criteria you decide upon. It has to be flexible, and I think you have to have a system that allows for "new and exciting things" to be done. I like new and exciting things; that is why I buy a car and end up in debt, because of new and exciting things.

So we have to be careful about those new and exciting things, and you have to have some idea about where they're going to take you. But you have to have some way to be able to work those into your research system.

Senator DASCHLE. Well, my hope is that we're going to have as good an appraisal of the need to write into law some criteria by this fall, because it's certainly the intent of the committee to begin taking up the research title of the farm bill this fall, and I hope we're prepared for it. In that regard you've all presented us with some good comment this morning, some good testimony. Thank you very much.

Our final panel includes Dr. Alice Pell, assistant professor of the Department of Animal Sciences, University of Vermont, and Chip Morgan, with the Delta Council of Stoneville, Mississippi. If you two could come forward.

Dr. Pell, thank you for coming. Mr. Morgan we're appreciative of your presence here this morning.

Senator Leahy has asked if he could ask some questions of Dr. Pell, prior to the time that she leaves, and I'm going to ask a unanimous consent that after your testimony has been complete, and after Senator Kerrey and I have completed our questions that you stay if you will, long enough for Senator Leahy to be able to ask questions of you as well when he arrives. He should arrive within the half hour. But, let's proceed with your testimony.

The entire prepared statement will be submitted for the record, and you're welcome to comment as you see fit.

STATEMENT OF ALICE N. PELL, ASSISTANT PROFESSOR, DEPARTMENT OF ANIMAL SCIENCES, UNIVERSITY OF VERMONT, BURLINGTON, VT

Dr. PELL. Thank you.

BACKGROUND

Mr. Chairman, members of the committee, I appreciate the opportunity to discuss funding for agricultural research. As an assistant professor whose appointment is 75 percent research it has a very direct impact on my life. I'm in the animal sciences and one of the areas that I have a great concern right now is not only the amount of money available for agriculture research, but also the balance between the funds available from governmental and industrial sources.

I AM DOING RESEARCH IN TWO VERY DIFFERENT AREAS

A little bit of background may be necessary. I'm currently doing research in two very different areas. In one project, in collaboration with somebody from the medical school, who is a molecular geneticist, we're looking at the surface structures on cellulose-digesting bacteria to increase understanding of the process by which fiber is broken down. Although we are currently working with bacteria from the cow's rumen, this is an area which has applications in both human and animal nutrition, development of alternative sources of energy, and solid waste disposal. This project has been supported by Hatch funding and a grant from the EPSCoR program of the National Science Foundation. The second project which I have been working on is funded by industry and involves research to investigate the effects of bovine somatotropin, or bovine growth hormone, on the health and productivity of lactating dairy cows.

THE FUNDING SCENE IN AGRICULTURE RESEARCH IS CHANGING DRAMATICALLY

It's very clear that the funding scene in agriculture research is changing dramatically. When I was a graduate student, most agricultural researchers relied on Hatch formula funding for a signifi-

STATEMENT OF CHARLES M. BENBROOK, EXECUTIVE DIRECTOR, BOARD ON AGRICULTURE, NATIONAL RESEARCH COUNCIL

Mr. Chairman, members of the Committee, thank you for the invitation to present testimony to the Subcommittee on Agricultural Research on priority setting mechanisms utilized by the U.S. Department of Agriculture. My comments this morning are based upon recommendations offered in several reports written under the auspices of the Board. I will summarize in general terms the extent to which different types of recommendations relative to R&D priorities and programs have been acted upon. I attach as an Addendum a list of pertinent NRC reports, some of which will be referred to herein.

First, let me emphasize that R&D priorities generally shift rather slowly. Rapid shifts are possible -- and can be desirable -- but occur only rarely when major scientific advances open up important new opportunities to address or overcome problems in new ways. Scientific priorities also can shift more dramatically than routinely is the case when the demands, needs, and expectations placed by society on the food and fiber system dramatically change. Science and technology priorities in food, agricultural, and environmental research are likely to be driven in new directions in the 1990s by both sources of change -- major new scientific capabilities and the new demands and challenges being placed upon the systems.

Our reports survey a number of the most important demands which the system is now being called upon to meet:

- The public's desire for safer, more nutritious food at reasonable prices.
- Better ways to balance production and environmental quality goals.
- Development of new technologies applicable to the conversion of raw agricultural commodities into value-added uses -- both food and non-food.
- Fiscal accountability and responsiveness in order to more effectively utilize scarce public dollars.
- Assuring high-quality science, often organized differently than in the past to give researchers support and encouragement to take on complex, multidisciplinary problem-solving projects.
- Integrating progress -- and human talent -- from across the entire scientific and engineering communities into the day-to-day activities of researchers in all food and agricultural research institutions.

The challenge of improving system responsiveness to emerging needs while also supporting top-quality science

should be met head on through a review and reform of the mechanisms used by USDA in allocating funding. This, in addition to rectifying the grossly inadequate level of federal support, is the most important R&D issue the Congress should address in the 1990 farm bill.

Importance of Competitive Grants

Several Board on Agriculture reports stress the importance of expanding reliance across USDA's research programs on peer review and competitive grant funding mechanisms as the most cost-effective way to both attract top quality scientific talent to the food and agricultural research system and to attain a high degree of annual flexibility in funding the most promising areas of research.

One Board report, Improving Research Through Peer Review, focused on the procedures and consequences of peer review in the Agricultural Research Service, and concluded that even within ARS, some research funding should be allocated competitively, and that across the Agency's programs the outcome of routine and credible peer review evaluations should have a more direct, discernible impact on the allocation of resources and personnel advancement within the Agency. Another report, Animal Health Research Programs of the Cooperative State Research Service, stressed the unique importance of competitive grants in stimulating research on the causes of widespread animal diseases and their effective diagnosis and treatment.

Agricultural Biotechnology: Strategies for National Competitiveness, a major report released in 1987, laid out in considerable detail the need for and essential components of a national strategy to more fully exploit the many beneficial applications of biotechnology in the nation's food and fiber industries. A key element in doing so was highlighted by the committee in its principal recommendation, which calls for $500 million annually in competitive grants targeted toward critical applications of biotechnology. Incidentally, the committee which wrote this report and made this bold recommendation in 1987 was chaired by Dr. Charles Hess, then Dean of Agriculture at the Davis campus of the University of California, and now USDA's Assistant Secretary for Science and Education. The Board looks forward to working closely with Assistant Secretary Hess in evaluating both R&D priorities and programmatic needs in the food, agriculture, and environment sciences. We are, of course, particularly eager to work with him in implementing the recommendations in the Hess report.

Capacity to Respond to Emerging Priorities

Our 1987 report on agricultural biotechnology was preceded in 1985 by a major report on biotechnology research in the Agricultural Research Service entitled New Directions

for Biosciences Research in Agriculture: High-Reward Opportunities. Both the 1985 and 1987 reports stress many of the same R&D needs. While the ARS and academic sector have made some progress in acting upon the recommendations in our reports, the system's response is constrained by three factors. They are:

- Funding needed to underwrite essential new investments in facilities, equipment, and scientific talent in major new areas of research.
- The challenge of shifting resources from marginal and less productive areas to more promising lines of work; and from outmoded, or too small and isolated research locations to laboratories with the capacity to more effectively pursue cutting edge research and participate in the establishment of new research partnerships.
- Personnel procedures and policies (such as the ARS and academic tenure systems) which make it difficult either to bring in a sufficient number of new scientists, with new skills needed to pursue promising lines of research; or to rotate assignments of existing staff in ways needed to assure that research teams include an optimal mix of scientific expertise to advance knowledge and technology in a given area.
- Institutional barriers to multidisciplinary research, and to the formation and nurturing of partnerships across disciplines, departments, and institutions -- including in some cases private sector research laboratories.

Conclusions From Recent NRC Reports

Our food and agricultural research system has gone through a sometimes difficult period of planning and introspection. Despite very limited new funding, the system has sought constructive ways to respond to recommendations contained in a series of sometimes critical reports issued by external organizations including the General Accounting Office, the Office of Technology Assessment, scientific societies, farm organizations, and others. The role of my institution -- the National Research Council -- is to help identify needs and opportunities, and support positive change within the system. We pursue this role in two basic ways. First, our technical reports identify emerging, promising S&T opportunities, and offer detailed guidance on new directions which USDA and other federal research agencies and programs should pursue. Second, our reports assess the policies and procedures used by USDA, other federal agencies, and state

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agricultural experiment stations to support food and agricultural research. It is the combination of these two roles which serves as the basis of the following summary statements relative to priority setting mechanisms and the responsiveness of the system:

- There are many effective internal and external priority setting mechanisms and bodies, which generally tend to offer complementary if not largely identical recommendations.

The problem is not an absence of direction to the system. There is, however, a missing link in most assessments of R&D needs -- only areas in need of more emphasis (and resources) are noted; rarely if ever are areas also identified of declining importance (from which funding can be shifted).

- The capacity of the system -- ARS, CSRS, Extension, other agencies and universities -- to coordinate a collective response to emerging needs should be improved, particularly in light of growing tension over turf and budget allocations.

In recent years the three USDA research and education agency heads and planning staff have rarely gotten together to plan, discuss, and coordinate their budget requests prior to the submission of agency budgets to the Assistant Secretary for Science and Education. Several of our reports have stressed the importance of more routine and ongoing coordination and collaboration across the system in planning collective strategies to address major national needs like protecting water quality, advancing competitiveness, and supporting rural economic development and diversification.

An emerging spirit of competitiveness among USDA's research agencies, in contrast to cooperation, is cause for concern. In the years ahead competition for budget and program responsibility is likely to extend beyond USDA and involve several other agencies with either an S&T, or possibly regulatory role. As this occurs, the planning and coordination of federal government activities will place new challenges on existing institutional mechanisms for coordinating policy and budget reviews. Our institution recently completed a report for the Congressional Committees on the Budget assessing how S&T budget priorities are reviewed across the federal government. (See Federal Science and Technology Priorities: New Perspectives and Procedures, NAS/NAE/IOM, 1988).

A last point is emphasized in several of our reports on pest management, nutritional attributes of foods, and resource conservation.

- Complex new demands related to the performance of the food and fiber system are emerging, driven both by public expectations and economic necessity. These demands often place new strains on the research system,

agribusiness, and the farm community to come up with management-based, environmentally friendly farming systems that utilize genetic and biological resources moreso than chemical inputs, while still achieving high and profitable levels of production. The need for more timely, practical responses to food safety and environmental concerns, as well as our competitiveness, warrants a reassessment of R&D programs and priorities, as well as overall funding levels.

Summary

Congress faces important challenges in drafting the research title of the 1990 or 1991 farm bill, and in deciding upon the proper level of federal investment in different R&D programs. Our reports document instances in which our nation is not utilizing to best advantage a publicly funded R&D system which has been steadily built over a 100-year period. Farmers, consumers, rural businesses, bankers, the biomedical community, corporate leaders, scientists, and hopefully Congressional leaders sense opportunities to more effectively tap science for the benefit of the nation. Our work has been, and will continue to be dedicated to this goal.

I will be glad to answer any questions you might have. Thank you very much for the opportunity to appear this morning.

ADDENDUM

The following reports contain a number of research recommendations. Some address research needs and priorities; others assess programmatic needs. The need for an expanded competitive grants program, better ways to organize the peer review process, and the critical importance of providing new support for multidisciplinary research are highlighted in several reports. The first group of reports are general, focusing on both R&D priorities and programmatic issues. Each subsequent section contains reports within a particular area.

Priority Setting and Program Needs

1. Agricultural Biotechnology: Strategies for National Competitiveness, BA/NRC, 1987.
2. Educating the Next Generation of Agricultural Scientists, BA/NRC, 1987.
3. Improving Research Through Peer Review, BA/NRC, 1987.
4. New Directions for Biosciences Work in Agriculture, BA/NRC, 1985.

Plant and Animal Productivity

1. Agricultural Biotechnology: Strategies for National Competitiveness, BA/NRC, 1987.
2. New Directions for Biosciences Work in Agriculture, BA/NRC, 1985.
3. Alternative Farming, BA/NRC, In Press.
4. Pesticide Resistance: Strategies and Tactics for Management, BA/NRC, 1986
5. Report of the Research Briefing Panel on Biotechnology in Agriculture, COSEPUP/NAS, 1985
6. Animal Health Research Programs of the Cooperative State Research Service: Strengths, Weaknesses, & Opportunities, BA/NRC, 1986
7. Designing Foods: Animal Product Options in the Marketplace, BA/NRC, 1987.
8. The Ecology of Plant-Associated Microorganisms, Board on Basic Biology, Commission on Life Sciences. NAS Press, 1989.

Nutrition, Food Quality, and Health

1. Designing Foods: Animal Product Options in the Marketplace, BA/NRC, 1987.
2. Diet and Health: Implications for Reducing Chronic Disease Risk, FNB/CLS/NRC, 1989.
3. Meat and Poultry Inspection: The Scientific Basis of the Nation's Program, FNB/CLS/NRC, 1985.
4. Poultry Inspection: The Basis for a Risk-Assessment Approach, FNB/CLS/NRC, 1987.
5. The Effects on Human Health of Subtherapeutic Use of Antimicrobials in Animal Feeds, FNB/CLS/NRC, 1980.

Natural Resources and Environment

1. Alternative Farming, BA/NRC, In Press.
2. Pesticide Resistance: Strategies and Tactics for Management, BA/NRC, 1986.
3. Pesticides and Groundwater Quality: Issues and Problems in Four States, BA/NRC, 1986.
4. Soil Conservation: An Assessment of the National Resources Inventory, Volumes 1 and 2, BA/NRC, 1986.
5. Regulating Pesticides in Food: The Delaney Paradox, BA/NRC, 1987.

Engineering, Products, and Processes

1. Designing Foods: Animal Product Options in the Marketplace, BA/NRC, 1987.
2. Agricultural Biotechnology: Strategies for National Competitiveness, BA/NRC, 1987.

Markets, Trade, and Development

1. Technology and Agricultural Policy Conference Proceedings, BA/NAE, (Forthcoming).
2. Designing Foods: Animal Product Options in the Marketplace, BA/NRC, 1987.