Chapter 7

National Science Policy Study

Sharon Hays, *AAAS Congressional Policy Fellow*

Introduction (Robert G. Fuller)

Congressman Vernon Ehlers was asked by Speaker Gingrich to head a national science quality study for the House of Representatives. It turns out the United States has never actually had a science policy except for the policy formulated by the executive branch of the government. The legislative branch of the government has never, in the history of the United States, had a science policy. Congressman Ehlers thought that this was a wonderful opportunity for him at an auspicious time for the country to formulate a policy to be ratified, ultimately, by the House of Representatives and the Senate that would represent the best thinking of the Congress about what the policy of the United States ought to be with respect to science. I invited him to come to this conference, but he was not able to attend. We have instead a member of his staff, Dr. Sharon Hays, who was in fact writing the policy statement. Sharon has a Ph.D. from Stanford in biochemistry and joined his staff as an AAAS congressional fellow. Her task over the last several months has been to write this document which at midnight last night was supposed to be released to the public. Unfortunately, Congress decided to wait a few weeks. So, what she's going to tell us tonight is sort of preamble of what the National Science Policy study will be about. Dr. Sharon Hays.

Sharon Hays

It is really an honor to be here tonight and to be able to address you. I am sorry to have to be in a position where I just create suspense and cannot deliver all the details of the policy report itself but hopefully you will stay tuned until September, which is our planned release date. That will be when Congress comes back in session after their August recess and hopefully will have a little bit more time to focus on it than they would if we released it right now, and of course all that depends a lot on what a guy named Kenneth Starr comes up with at that same time. So, we will see how much attention we get.

I want, before I start, to extend my apologies from Congressman Ehlers, who would have loved to be here today to address you in person. He has a Ph.D. in physics. He's the only Ph.D. physicist in Congress. He has an intense interest in education, and while he was at Calvin College, where he started the physics department after getting his Ph.D. at Berkeley, he became very involved in education issues. He worked with the department of education at Calvin College to create classes where they could bring teachers, primarily elementary school teachers, in and teach them how to teach science. It is a somewhat revolutionary thing to do in the scientific community, but this is an area of intense interest for him. So I will focus a fair amount on education issues and how Congress sees them and how we are looking at them in terms of our overall science policy report.

So, a little bit of background just about how this study is working, how it's going. The project hasn't really even been underway for a full year at this point. We really got into gear about October of last year when the science committee hired a full time staff person to work on this project. This is a science committee project so the science committee of the House of Representatives is leading the study. It's been assigned to Congressman Ehlers in his capacity as vice chairman of the science committee and this idea really did generate from the Speaker, Newt Gingrich, who has an intense interest in science and technology and the chairman of the Science Committee, James Sensenbrenner Jr., a congressman from Wisconsin who has truly taken hold of the Science Committee, really revitalized it. It's a committee that some, believe it or not, were talking about dismantling not so many years ago. So this effort really comes from the highest levels of the congressional leadership and I think we have the right person working on it in Congressman Ehlers.

I'd like to start by saying a few words about education and first of all besides the science policy project that Mr. Ehlers was given, which obviously is huge, he was given another not so trivial assignment by the leadership which that was to evaluate math and science education, particularly at the K-12 level, and find ways to improve it. So he is doing these two little jobs while being a congressman that is only an 80-hour a week job to begin with, and we have two full time staff people, myself and the committee staff person working on it. But what we've done in the last nine months is hold a number of hearings, 11 hearings all together, a number of those on K-12 education. We've convened a number of round tables where we invited scientists and science policy experts to come in and tell us informally what we should be doing and what we should be thinking about. These meetings were very helpful. They were off the record, or at least not for attribution. We really wanted to find out what was on the minds of people. After the first meeting, which convened a lot of very notable scientists and people in the science policy community, it was pointed out to us that if you're writing a science policy that you hope will last, or provide a framework, for twenty or even thirty years, you'd better get some young people in to your meetings, because that's who decides policies truly going into effect. We really took that to heart and that's when we convened the second round table discussion, which was comprised entirely of early career scientists. It was very interesting to compare the two different groups. Interesting because they were both very focused on K-12 education but there were some significant differences as well and those were important to hear. At the same time we opened this up to the general public in that we have a website through which we've asked for input. We want to know what anyone thinks about this, not just the people who happen to be in Washington and can come and actually sit down and talk to us. So that has been quite different. If we do what we hope to do, which is to get the science policy framework approved by the House of Representatives, ideally by the Senate, and if at all possible by the administration in some form, perhaps through the Office of Science and Technology Policy, it really will be a first. It will be the first science policy that was generated by the legislative branch and approved by that branch so we're writing this report truly for Congress. A lot of what's in it might seem obvious to people like you but we really do have to educate Congress about what science's role is in society, how important it is and why science and math education is so important.

Well, why is science and math education so important? First, I think we have to recognize that science and technology are extremely important in our society as a whole and in our economy in particular, and that this economy is global in nature. So, I think that the importance of science and math education is really rather simple. If we want future generations of Americans to have the same opportunities as we have, they must be scientifically literate in order to compete in the economy. If we want all Americans to partake of future prosperity we have to insure that every American gets an education in science and math and not treat these subjects as the domain of just a special few. And finally, if we want to take advantage of some of the opportunities that we have to influence the rest of the world, and I would say responsibilities as the sole remaining superpower, we have to insure that we speak one of the true universal languages, and that is the language of science. So, we depend on our education system for our future and we ask this system to produce, basically, three different groups of people.

First are the scientists and engineers who do the research in the universities, in national labs and in industry. They make discoveries and then turn these discoveries into products and other advances for society. But it's more than just scientists and engineers. Everyone in the work force needs an education in science and math and technology. Whether you're in the executive suite or on the machine shop floor these days it's hard to find a workplace that isn't influenced, I would even say dominated, by technology, and that influence is only getting greater. And then finally, every citizen needs some science background to make educated decisions as both a consumer and a voter. So clearly, we have our work cut out for us as a nation and the problem seems to be pretty big. The recent TIMSS (Third International Mathematics and Science Study) study may not have come as a shock to you, perhaps to a lot of people, but it did seem to reveal some pretty serious problems, particularly in our 8^{th} and 12^{th} grade students who do not seem to be proficient in math and science, at least when compared to students from around the world. But it's not just our K-12 students.

Half of all Americans, in a recent survey, did not know how long it takes for the earth to orbit the sun. Even though the answer, 365 days or a year, has been known for a couple thousand years. A majority of recent graduates from a very prestigious university answered the question, "Why is it colder in the winter time?" with the answer, "Because the earth is farther away from the sun in the winter." Only a small fraction knew that it was because of the tilt of the earth's axis relative to the ecliptic. What's even more important is the ability to reason, to sort through complex problems and be able to ask the right questions to solve those problems, so science we feel is very important and should not be taught as a collection of facts and statistics. What we need instead is to communicate that science is a mode of thinking and that it's pursued through inquiry and in some ways it's a game we play with nature where the scientist seeks to unlock the secrets that nature holds. It's not easy to do. It requires a certain amount of cleverness but it's tremendously exciting and we need to communicate that to the students. So it truly is about learning how to learn.

So we must teach this. Especially if we are going to impart to young people the excitement that science and its pursuit involve. Children are naturally inquisitive, we know this. What we need to do is harness that natural curiosity and not squelch it with a mountain of memorization. We need to show that science and math can be fun.

Now having said that, I think it's important to recognize that we must take care not to imply that science and math education is optional. That somehow it's just for the gifted. That it's just the realm of the nerds. That it's boring and that you have to be a special person to understand it and I don't think that this is a baseless concern because science illiteracy has really become almost acceptable; some would even say fashionable. Most of you, maybe even all of you, are scientists so I suspect that many of you have familiarity with the following circumstance; you meet someone at an informal social event, like a cocktail party, and the conversation at some point turns to what you do. You say you're a physicist, or a mathematician, or a biologist and there are a couple different reactions. One of them is to say, "Oh," and usually those people just kind of walk away after a little while. The second one is people who say, "Oh math (or physics or whatever) that stuff is too hard! Numbers, equations, way over my head." Now that's a pretty standard reaction. Imagine if the situation was reversed. You meet someone and ask them what they do and they say they teach English. Can you imagine what the response would be if you said, "Books, words, omigosh, that's just way beyond me!" That might seem an extreme example but it truly reflects that we hold science and math to a different standard in our educational system. We think that that's a dangerous long-term philosophy.

So where do we start? Well, K-12 education is really important and it will be an area of continuing focus beyond the scope of the policy study that we're doing right now, but its impossible to disconnect education and science policy completely so we have outlined a number of issues that we think ought to be addressed in this area.

First are curricular issues. We must teach science as an inquiry based, hands on experience. We must teach students to question and then figure out how to answer their own questions. That type of experimentation is truly the essence of science. We also have to get away from what was revealed in the TIMSS study, or at least has been quoted by the director of the TIMSS study, as the mile wide-inch deep curriculum where students are taught an amazing number of different things but apparently don't learn a tremendous amount about any one thing.

We must also focus on the teachers. We need teachers who truly understand and appreciate the subjects they teach. A number of teachers, even at the high school level, have not even had a course in the subject they teach. Now many of them become extremely good teachers by learning this material through a lot of hard work and perseverance of their own, but we think we ought to bring more of those with backgrounds in science and math into the classroom. This may require some changes in the credentialing process to allow those who spent time getting their degrees in science and math to get a teaching credential more rapidly. This is especially true when we're talking about scientists at the Ph.D. level. When I was in graduate school I knew a number of students who would have been very interested in going back into the K-12 classroom and teaching science. The problem was, at least in California, that you were required to go back and get a teaching credential, which meant maybe a couple more years of schooling. That's not attractive to someone who just spent six or seven years in a graduate program. So, we think we have to reach out to people who have an affinity for and an aptitude for teaching but who have backgrounds in math and science.

Now we can't only focus on the teachers. We also have to address the issue of the students. We simply must demand more of students. As parents, and as a society, we must get away from the notion that avoiding science is ok. We should ask our high schools to ask students to take more science so that they are exposed, not just perhaps to biology and maybe chemistry, but biology, physics, chemistry; all of them and in more depth.

And finally the last category, and I think you'll like this, is education research. The amount we spend on education research as a function of the total amount we spend on education in this country is minuscule. If we ran a company with that type of investment in research the company simply could not continue. We've got to do more in terms of that investment.

Now everything I've focused on so far has been directed towards K-12. I do think a lot of the same issues apply at the undergraduate level, which at least in Congress the sense is that we do pretty well. At the graduate level, again, the sense in Congress is that we're doing great: because we produce so many Nobel laureates and because graduate students from foreign countries flock to our programs everything must be great. We don't completely agree with that. We do think there are some structural problems we need to address within graduate education and within undergraduate education, and both those areas have been getting a lot more attention lately from organizations like the NSF.

Now, the report that we're going to issue in September is going to address a lot more than education, so I wanted to tell you a little bit more about the other areas we're focusing on.

First I'll give you some background. Why do we need a new science policy? Why should we have a science policy? Well, we've been operating the scientific enterprise largely on autopilot. That is, there is no single accepted science policy framework in this country, other than perhaps one that was written over fifty years ago. I'm referring of course to the Vannevar Bush document that was written at the very end of World War II, *Science: the Endless Frontier,* which in many ways is still referred to as the nation's science policy. Bush's document was seminal and it was beautifully written and we don't want to imply today, or at any other time, that the science policy study report that we are working on will be somehow the second coming of Vannevar Bush. We believe the scientific enterprise has changed so much and become so vast and diverse that a Bush-like report truly isn't possible today.

Well, what did Bush do? During World War Two he ran the Office of Scientific Research and Development, which was aimed at bringing scientists together to use what they knew to build weapons, basically, to help us win the war, and they did a good job. Vannevar Bush was one of the major organizers of the Manhattan Project, bringing about the atomic bomb. Radar was developed largely through the Office of Scientific Research and Development as well as some lesser-known things like proximity fuses that never the less were instrumental in winning the war. So towards the end of the war, President Roosevelt asked Bush to help him figure out how we could continue the success of the Office of Scientific Research and Development in peacetime. And as an aside, perhaps, when I say that President Roosevelt asked Bush, apparently that's not exactly true. According at least to Bush's biographer (Zachary, 1997), Bush himself penned the letter that was attributed to President Roosevelt asking him to look at it. He knew exactly what he should be looking at, and some would say he knew exactly what he wanted to find when he looked at it. Nevertheless, his central thesis in the report was that the federal government should fund basic research and its hard to believe today, in some ways, that someone would have to write that—that someone would do that as late as 1945—because we take that funding largely for granted. But prior to World War Two the government really funded very little basic research and most of what they did fund was agricultural research in the nation's land grant colleges. So we refer to the pre-World War II period as the first mega-era of science policy—when the science done was very good but it was done with very little federal funding.

Bush's report really ushered in the second era. All of a sudden we had federal funding on a much grander level than we'd had before. The National Science Foundation was set up. Not exactly as he'd intended it but that was in part because research fever had taken over. Bush had an extremely hard time convincing the armed services that they should make the investment in basic research, that it could help them win the war. By the end of the war his project had been so successful that the branches of the armed services were actually competing with each other to set up funding grant funding mechanisms to fund the best scientists in the nation. It wasn't just the military of course. The Atomic Energy Commission, which was the forerunner for the Department of Energy, was also in the research funding business and very importantly the National Institute of Health was set up at that time. So now, instead of the one central funding agency Bush had envisioned, there were a number of them. Science is now spread widely across the federal government.

Science did really well in the second mega-era. The cold war helped things along significantly. The competition with Soviet Union, particularly after Sputnik, had a major influence. Funding for science went way up because it became a national priority. So this second era was largely focused on military competition and you could say that it ended with the collapse of the Soviet Union.

Today competition is not so much militaristic as it is economic. We find ourselves in this third mega-era of science policy with no science policy. As George Brown, who is the ranking Democrat on the science committee said, we don't have a science policy. We have a budget policy. It's unfortunately, I think, quite true. Science decisions made, at least in the legislative branch, are made largely on the basis of appropriations decisions that are made every year. There is no coherent policy guiding the enterprise. Now it's easy to think that we're flush because times are great, budget surpluses are on the horizon and so funding really isn't that much of an issue, but it still is and the overhead that I have illustrates, I think, an important point. What you see on these transparencies is a division of federal spending—the three different categories—between 1962 and 1996, which is the last year that we've calculated this for. The first category is entitlements, which is shown in blue, and that includes of course welfare, Medicaid, Medicare, and social security. In green is interest on the federal debt and in red is discretionary, which includes defense. Discretionary being every other aspect of the government besides the entitlements and the interest on the debt. So what you can see is since 1962 entitlements and interest were about 1/3 of the total budget. By 1976 that had grown to just over half and as of just a couple years ago entitlements and interest on the debt were 2/3 of the entire budget. Now that's the portion of the budget that Congress has to pay out every year. They don't discuss it. They don't get to sit around and decide if they should cut any of that funding or not. They have to pay it, so everything else that comes out of the federal government's budget, and that includes everything, funding for the arts, funding for science, running the government itself and defense, which takes up about half of that red portion, comes out of that last third and just to give you some idea of how science truly is at risk of getting squeezed from the federal budget, consider the budget for the entire National Science Foundation. It's about the width of the black line that separates the two different pieces of the pie.

We've got to get control of entitlements if we want to affect funding for science. Our resources will never be unlimited and so we have to set some priorities. That is one of the goals of our science policy. Budget pressure is therefore one issue that we have to address. A second is education, which I've already discussed. But finally there is a broader issue of how we get the most out of the scientific enterprise that is extremely diverse and in which the relationships between various players are very complex. There are really three major players in this enterprise: government, universities and industry. Government is involved because they fund much of the research but also because the government does research in our national labs and in government agencies such as the EPA. Universities play a major role. They turn out our future scientists and engineers. They also generate much of the research. Industry, where you have scientists and engineers working to develop new products, is also an extremely important player in this enterprise. We need to better define the interactions that go on between these three different players in the science and engineering enterprise. Some of the questions that we're dealing with on this level are how do we define good interactions; and once we do how do we stimulate them?

I'm just going to mention briefly one specific type of partnership that we are focusing on. We think it's going to be extremely important in the coming decades: international collaborations. The scientists have always collaborated across borders. We all know that, but for large-scale science projects it's becoming more and more necessary to have international participation. The demise of the Superconducting

Supercollider may be one example of the need to get buy-in and funding from a larger number of nations than just the U.S.

Now there are a couple, at least, different international scientific collaborations going. Our goal is to look at these different on-going projects and take the good elements and take the bad elements and figure out what types of criteria we need to set for these partnerships. So I'll just contrast two. One is CERN in Geneva. It is widely recognized as a very effective international partnership. In contrast, we have the international space station, which is having some serious problems. We've got to address some of the issues that we are facing with the international space station if we're going to get effective international participation and if we're going to convince Congress that it should fund these collaborations.

Returning to the bigger picture. One of the major things that we'll focus on is the need to ensure that we continue to develop new ideas through research. We need to continue our investment in basic research. An investment that opens up new doors of knowledge and expands frontiers. I don't use the term investment loosely. Research funding is an investment in the true sense of the word in that we get back more than what we put in. The difficulty of course is in communicating this message to the public and to Congress because the payoffs often don't come until far downstream from the initial investment and you can rarely trace a breakthrough back to a single scientist, but we must stress the message and we will stress the message in our report that science pays off. It's not just about gaining knowledge. It's about our future and our economy.

Second, we have to make sure that the new findings that scientist make get used, that we develop them, that they become new products that help us do things in new ways and that they help us make decisions. A number of decisions that are made by the federal government are influenced by science and we need science to inform us.

So this largely falls to the private sector. In here we get into, again, some complicated relationships and there are a number of different issues that we're looking at. One of course is funding, but intellectual property, the different ways in which scientists cross borders between public sector research and private sector research is extremely important. So what we're trying to stress is that we're looking at the big picture. We're not going to write a document that will outline exactly how we need to approach each and every one of these problems but we want to stress the fundamental framework, the importance of science in society.

Now before I close up here I'd like to make one last comment, and this follows up a little bit on what you heard about in the last session when you were discussing how to communicate your community's needs to the National Science Foundation. The recommendation was to get in touch, to keep in touch, to make phone calls, and I'd like to stress to you in closing that that also applies to Congress. Remember it's Congress that appropriates money every year for the National Science Foundation. You would be, I think, well advised to make those contacts to your congressman as well. It's not as difficult or as remote a possibility as you might think. It's true that if you call up any congressional office you'll talk to a staff person like me and if you tell them that you're with such and such an organization and you'd like to come talk about physics education research you may or may not get interest from the staffer. You'd get interest from me but not necessarily from every other staffer in Congress. But if you call up and say you're a constituent of Congressman X and you'd like to come in and talk about physics education research, I guarantee you will get an appointment. Maybe not with the Congressman, but you will talk to a staff person and that's extremely important. So I would encourage all of you to make that connection. Not necessarily as a society but as individuals. It really will pay off. The persistence that's involved in educating Congress about your needs, about the importance of what you do, is critical.

Question/Answer session:

<u>Q</u>

I'd like to make a couple comments. First, in the presence of some people from NSF, I'd just like to say on behalf of our community to you who are in Congressional offices that I'm incredibly impressed by the efficiency with which the National Science Foundation is able to work. They run an unbelievably lean shop and they work very hard. They think very competently. The meetings that they run and the panel sessions are incredibly well run. I am overwhelmed with admiration for how well the operation is run. The other comment I'd like to make is that all of us share these concerns about science education and science literacy, but we have to be a little bit careful in being sure that our bases are valid. There was a very interesting article in *Science Magazine* casting question on the TIMSS study, for example, showing that despite all the rhetoric about how it is very carefully controlled across cultures, that is very difficult to do. There are things like differences in ages of two and three years in the students who were taking the same test, so there were some valid questions raised about how valuable this is. Such things lead to my final comment, which is that the United States is an unbelievably vital place. We are brimming with creativity and excitement, and it is just an incredible society to live in. We must be doing something right, and I have wondered whether maybe if you measured 30 year olds instead of 17 year olds they would see a different comparison. Not just because we have very good graduate students—not everybody goes to graduate school—but is it possible that we have young people going through an extended childhood where students' creativity wasn't squashed. We have the case of the Japanese scientist who asked the American, "How do you teach creativity?" The American thought and said, "I think we're less efficient in stamping it out." One has to somehow explain why we are doing so well on so many fronts. Not just living off our own capital, because there are enough people doing pioneering things. It is a little puzzling why we have these comparisons saying how awful things are, at the same time that we have this vital society.

<u>Sharon Hays</u>

Yes, that point has been raised and it is valid. Clearly we ought not to restructure our entire education system just so we can do well on international tests and assume that that will solve our problems, but I do think that when the U.S. places dead last in a discipline from among these different nations that we have to question whether we ought to re-examine things. There is some level of basic knowledge that we should expect of our students. In response to the first part of your comment about NSF, again that's an important message for legislators to hear. I don't know how many of you are aware there was just an amendment recently for the NSF's reauthorization which sought to get rid of their entire funding increase, because they were funding science that sounded really crazy and kind of stupid, things like ATMs and billiards. It turned out of course that billiards referred not to the game of pool but to some pretty interesting and important physical components, and that ATMs had absolutely nothing to do with automated teller machines. So educating Congress is just as important, I think, as educating the citizenry. They are the citizenry. They are representatives.

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As an AAAS fellow, did you just kind of fall into the planning policy situation? What exactly did you propose to do research in?

Sharon Hays

The AAAS Congressional Fellows Program has been around for about 25 years. It takes Ph.D. scientists, and the idea is to get them working in a congressional office. I went through the selection process to get the fellowship. Then what they basically do is turn the fellows loose on Congress. We can knock on any door we want to, and work in any office where we can convince them that they should let us work. We come to work in Congress free because we're paid by the fellowship program, so that helps, but actually it doesn't help that much in the sense that space is the critical resource in congressional offices. The fact that you're free doesn't help if they don't have anywhere to put you. Anyway, it's a mutual selection process. You go through interviews again with the different congressional offices, and I consider myself extremely lucky to have ended up working for Congressman Ehlers, because his study just happened to take off right at the time that I started in his office. So, I did not necessarily propose to work on this study, although that influenced my decision to work for the Congressman.

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Congress, as we all know, is mostly made up of lawyers, God help us, and while they may believe that science is good for the country, most of them don't understand terribly much science themselves. So we've got a cultural attitude in this country which for various reasons is anti-intellectual, and it is fashionable to be scientifically illiterate. We have political discourse that is often dominated by religious groups, which are hostile to science. With all that in mind, and as a scientist who is in a unique position to observe Congress, you may be able to answer this question: if Congress passes a science policy will it be a science policy that we the scientists are going to like to have?

Sharon Hays

Remember that you have a scientist, in Mr. Ehlers, writing it. A scientist who's been listening to the scientific community throughout this. But keep in mind when you see this report that it is written largely, or at least in part, to educate Congress.

Yes you're right, scientific illiteracy in Congress is about the same as it is across the nation, so we don't have a trivial project here. But one of our goals is to influence the way that science is thought of within Congress.

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You mentioned curricula and students and teachers. The National Science Academy published a book a couple of years ago called *Learning, Remembering and Believing.* It was a report of one of their committees, and in the epilogue it said that they had noticed a phenomenon in which they would go around and talk to people at all kinds of institutions and the people would agree that the things which were being proposed were very good and should be done, but then they would give all sorts of institutional barriers to doing those things. The organizational barriers and institutional barriers to reforms, I think, are another factor that has to be put into that equation.

Sharon Hays

That is a good point. Thank you.

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About the pie charts that you showed, and making sense of the idea that what's left over is the shrinking red discretionary slice. For all I know, in 1962 that was $30 per American and now its $30,000 per America because we're so wealthy. Can you give any sense of whether the pie has actually shrunk?

Sharon Hays

That's an important point. The pie has gotten bigger. That's why we haven't felt the crunch, perhaps, in the way that the charts would illustrate, but I think it is very important to note that the days of the pie getting bigger, at least from taxes, are probably over, and that is how the pie has gotten bigger in the past. Yes, a thriving economy helps create a bigger pie, which means that there is more money to go around. One overhead I didn't show is that if you extrapolate out (this is sort of done tongue in cheek) but if you extrapolate out in terms of the growth of entitlements and interest on the federal debt relative to the entire budget, sometime in about the year 2012 entitlements and payments on the debt take up 100% of the federal budget. Now obviously we're not going to let that happen. That can't happen, but it illustrates that this growth, even if the pie gets bigger, is still serious.

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I'm just curious. You said that most of your policy focuses on K-12 and that you were reasonably confident that our undergraduate federal programs were doing well, but you thought that there were some structural problems. I wonder if you could elaborate on what you think some of those structural problems are?

Sharon Hays

Our report, because the K-12 issue is the subject of on-going study, will only address it somewhat superficially, just because we plan to continue that study. We'll actually talk about graduate education a little bit more. While it is true that we have what has been called, and I think fairly, the world's best system for educating graduate students, and we do turn out extremely good scientists and engineers, one problem that we have to address is the fact that fewer American students seem to be interested in pursuing those types of degrees. That is completely masked by the fact that we attract so many students from foreign countries that we don't notice that there is any depletion in the ranks of our graduate students, but I think that we have to ask the question of how much growth can the overall enterprise stand, and how do those types of issues, and I'm referring here mostly to the fact that when you go through an academic science department you're trained largely for a career as an academic researcher, and as we know those positions are limited and make up only a fraction of less than 50% of the final destination of most students in graduate school. We have to ask how those statistics are affecting the desire of young Americans to pursue careers in education in math and science. I think what happens at the graduate level has some effect on the undergraduate level. If you're not going to go into graduate school or medical school then you really don't need those extra courses in math and science, and that's how we end up with students, for example at the school that I went to which is a pretty good school, taking competing for courses physics without math. That's how they got their math education as an undergraduate. I think that is a concern.

Reference

Zachary, G. P. (1997). *Endless frontier: Vannevar Bush, engineer of the American Century*. New York. Free Press.

[The National Science Policy Study was endorsed by Congress in the fall. The following comment was placed on the AIP's website soon after the endorsement.]

House Approves Ehlers' Report -- With Some Reservations

FYI Number 148: October 28, 1998
The American Institute of Physics Bulletin of Science Policy News

Before adjourning this month, the House of Representatives endorsed the "National Science Policy Study." For 40 minutes, Members considered House Resolution 578, stating that the report "should serve as a framework for future deliberations on congressional science policy and funding." There was some dissent, notably that of Rep. George Brown (D-CA).

In the aftermath of the report's September release there seems, among many, general agreement that while it touched on many important ideas, it did not go into specifics. The report's author, Rep. Vern Ehlers (R-MI) acknowledged this in his House floor comments, saying the report "does not explore any particular issue in great depth. It is instead a broad-brush view of the entire science and engineering enterprise." "The work of addressing specific science policy issues will have to come later.... It is my hope that we will do so in the next Congress."

Science Committee Chairman James Sensenbrenner (R-WI) did not comment on the report's approach. He did say, importantly, that "the clear message of this report is that, while not exactly broke, America's science policy is nonetheless in need of some pretty significant maintenance." "In my view what makes this report different from other science policy reports published by various groups over the years, some of them very good, is the Committee on Science's intention to act on its recommendations in future oversight hearings [and] in legislation. Indeed this report should not be seen as the end, but rather the beginning of a long process that will involve Congress, the Executive Branch, the States, universities and industry all working together."

Sensenbrenner included, for the record, full statements from OSTP Director Neal Lane and NSF Director Rita Colwell. Lane said, "In general, I find the Committee's report to be harmonious with the President's established science policy goals," while Rita Colwell commented, "I am particularly pleased that the report emphasizes the critical role of federal support for fundamental research, and especially for merit based investments in university research."

There was not universal approval of the report. Rep. Eddie Bernice Johnson (D-TX) speaking for herself and three colleagues, said the report "lacks significant input on issues of major concern." Their greatest concern was "the role of under represented populations in the fields of science and technology...." Ehlers said he appreciated and agreed with many of her comments, saying that S&T education is "extremely important to this country."

Brown was far more critical. He charged that the report "still satisfies mainly the needs of the status quo," although he later added, "I like the report as far as it goes." Continuing, Brown said the report "is very acceptable to the research universities of this country and to those who benefit from the present establishment of science. They like the idea of the Congress committing itself to provide more money for what they are already doing, and they will be glad to spend that. That is not the problem. The question now is what social purpose are we serving through the expenditure of that money?" "We need to look for new ways of answering the question, for what purpose are we supporting this very large scientific establishment that we have created."

So how should this report, and the resolution the House passed endorsing it, be viewed? Perhaps the most optimistic statement is that of Chairman Sensenbrenner: "the Nation's scientific enterprise is too important to our future to be left on auto pilot. In adopting House Resolution 578 and endorsing the National Science Policy Study the House will be sending an unmistakable signal that America's scientific enterprise will no longer be taken for granted in the Halls of Congress, and the real work will begin of turning the ideas in this report into sound policy that is good for science and good for the nation."

Richard M. Jones
Public Information Division
American Institute of Physics
fyi@aip.org
(301) 209-3095

One Physics Ellipse, College Park, MD 20740-3843
Email: aipinfo@aip.org
Phone: 301-209-3100; Fax: 301-209-0843