WOOD SCIENCE AND TECHNOLOGY—PAST, PRESENT, AND FUTURE

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It's a bit difficult for six people to address the same subject without introducing a certain level of redundancy and I'll try to avoid saying again some of the things that have been said so well already. I was asked to discuss the challenges facing existing university programs in wood science and technology with respect to the issues that have already been raised. I think you can only do that by examining, first of all, the role of the university and the role of the university's various complements. So, the role of the university is, as it has often been described, the preservation of knowledge, which involves the teaching functions, and extension of knowledge, which involves the research function. That's why universities are in existence. They're normally organized at the large research-oriented universities (the kind that house most of our programs in wood science and technology), and they're normally organized in two separate and distinct pieces. A half of the university often is organized according to disciplines, and these departments that emphasis such things as mathematics, chemistry, physics, economics, sociology, and so on are conglomerated into some kind of a whole called the College of Arts and Sciences, or Literature and the Sciences, or something of that sort. The other half of the university is ordinarily made up of a whole group of professional schools and colleges that are mission-oriented, not discipline-oriented. Our programs are ordinarily residing in that part of the university and it's important to understand where those programs are located.

Within this taxonomy, wood science and technology programs most commonly are a part of a mission-oriented forestry school or college or department. And they normally make up a relatively small part of that school or college or department, at least in terms of the size of the faculty and the number of students. Now a separate program (and we'll consider wood science and technology in that category) within the university is normally judged with respect to its importance in terms of the unique contribution that it is viewed as making to the university's mission—preservation of knowledge and the extension of knowledge. I think the important thing to know here is that, in general, it is "What is the university's view of the contribution of that unit to its major role?" not, "What does the outside world think of the role of that unit in the university?" I think some of the things that have happened in the past ten or fifteen years that have surprised people generally in our profession came about because they thought universities looked at units the same way they did, and unfortunately it isn't true.

Now historically the role of wood science and technology in the universities has developed in what seems to me to be two major phases, and I believe it is currently entering a third phase. Wood science and technology by some label was a part of forestry education in the United States from its very beginning. I think it was pointed out earlier in the program that it wasn't given that title, but that

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many of the first universities in the country to teach forestry about the turn of the century have, as a major part of their program, forest products or some aspect of what we now would call wood science and technology. Our university, where instruction started in 1907, had forest products as one of three major subject matter areas that we taught.

The first phase of the development of forest products or wood science and technology within any university setting studied wood as a very plentiful and diverse material, and as a natural resource. Emphasis in looking at this material was on such things as its botanical structure, its basic physical and chemical properties, and the variability in those things that sometimes "frightened" people who looked at what came out of our natural forests. Technology in the beginning of wood science and technology education was relatively simple and, by today's standards, extremely wasteful. Not a lot of attention was paid to technology compared to an understanding of the material.

The second phase of wood science and technology development brought major perturbation as it came with a screaming crescendo during World War II when all of a sudden changes for those in wood science and technology were demanded. Suddenly, it was necessary to develop more sophisticated technologies. For those of you that either go back in memory or read a bit about World War II, you may recall that much was made of the shortages we had in aluminum and the shortages we had in iron and steel and other major materials. But the fact of the matter is, the amount of wood that was used during World War II, the limited amount of wood that could be used—for the construction of airplanes and gliders and boats and so on—that wood was in shorter supply than any other *single* major material used during the war. So we had to develop technologies that would allow us to use that material to do different kinds of things. The synthetic resin adhesives were suddenly dumped on an industry that had been using glue made out of blood and starch and soybean and casein. All of a sudden it was necessary to go in the factories and control their drying in order to get aircraft material that was acceptable. Some of the people in this room participated in massive shill certification programs that went on then.

The post-World War II era was a continuation of the development of some of this improved technology with a substantial element of emphasis on product development. In my view, we are now entering phase 3 in the development of wood science and technology, and I think it's the most challenging of all. The source of the phase 3 challenge I think has already been mentioned here a number of times. We're now dealing, not with an abundance of variable resources that we can use wastefully, but increasingly with a scarce resource and one that is likely to become even more scarce as time goes on. We're not dealing with a very inexpensive or cheap resource that we can afford to waste but one that is becoming very expensive, and is likely to increase in its cost as time goes on. Then we have all of the impact of the energy problems that confronted us a long time ago but were simply made visible by the Arab oil embargo.

Well, if we're going to get into this business, and somebody is, whether it's the wood scientist and technologist or someone else, the problems are going to be dealt with and solved; and it's already been suggested here by a number of speakers that it may well be the engineers or scientists of some other ilk that do the job, but if wood science- and technology-trained people are going to do it,

they've got to look at a number of very critical problems. Some of them weren't all that critical ten or fifteen years ago.

First of all, it seems to me that people in this profession have to begin to worry about how much raw material they have. That means that you're going to have to invade the domain that up to now has been almost an exclusive property of a forest economist and administrationist. Some of my best friends are forest economists and administrationists; but I must say that from a standpoint of material supply, they really haven't done us very well. We still measure growth in terms of normal yield tables, and as Steve Spur likes to say: "That's the same way, same kind of thing as going out on the great plains of the midwest counting the buffalo and making some judgment about how many beef cattle you can raise on that same land." In our inventory work, we work with volume tables that yield still, almost invariably, a single product based at a time when very few people take one product out of a tree. And when we're dealing with the pieces of the tree, the log, we use log rules whose origin is lost in antiquity. Most of them are over a hundred years old; if you look at them critically, they're sort of a crude simulation model based on utilization criteria that went out of date sometime in the early 30s; and yet we allow our supply of raw material to be defined in this way. I think we should get on the ball. This is a role that wood scientists and technologists can play, and add to the general spectrum of competence in an area where it's badly needed.

How do we allocate resources? Well, I mentioned the measurement first because we're not going to be able to allocate very well until we're able to measure and quantify what we've got. Then we need to be able to allocate those resources to various uses, and we have rather poor tools for doing that. Finally, having allocated the resources, how do we improve yields? We've got even poorer tools for doing that. Frank Guthrie mentioned an emphasis they placed in the warehouse on measurement on how you quantify the material you're working with. I think it's a group like this, wood science and technology, that can make a major effort to improve activities in this area and find a very important role for themselves individually and collectively.

Well, in addition then to finding out what it is we have that we can use, the second major quality that I think is going to categorize phase three is the substitution problem. Increasingly we're going to be faced with the necessity of substituting renewable for nonrenewable resources. In spite of the fact that most of us grew up in a climate in which we were fighting the reverse substitution all the time, when we have a kind of mental set, we worry about the substitution of wood by other things, and in the long run in the future there will be less and less of that. It gets inevitable and it has very little to do with what we're going to do in wood science and technology.

We've got the contribution that wood can make to the solution of some of our long-term energy problems. These have already been alluded to and I won't expand on them or duplicate what other people have said, but there are two areas in which we can be concerned here, in which wood scientists and technologists or somebody else is going to be able to make a major contribution. One is the direct use of wood for fuel. All of us know that wood burns. That's been evident for a long, long time. We aren't terribly good at burning it to convert it into

processed energy that we can use, and there's a good reason for that. Years ago when we used lots of wood for fuel and manufacturing operations, we really didn't need or want an efficient power plant, and as a matter of fact, we would have been in trouble if we had had one because the power plant was used for two purposes, one to produce processed energy and the other to incinerate stuff we weren't going to use otherwise. If the power plant had been too good, we'd have been up to our ears in waste and we'd have had to spend money getting rid of it in some other way. That isn't the case anymore. So we've got to look at wood for fuel through an entirely new set of glasses.

Then there's the matter already brought up today, the advantage wood has as a renewable resource deriving from the photosynthetic reaction that gives it a major role in conservation of energy, particularly the energies that come from fossil fuels or other major nonrenewable resources.

Okay, those are some of the ways in addition to those already suggested to you that wood science and technology, however it's defined, is going to have to make an impact. Now, I don't know who's going to do that. I don't know whether it's the mechanical engineers or the electrical engineers or the chemists or the mathematicians, but somebody is. The wood scientists and technologists in our universities ought to be able to do this easier and better than other folks, because that's their mission. It's pretty much up to the profession and the industry and government and the universities and their faculties as to whether that happens within the domain of wood science and technology.

What the present programs in wood science and technology in the universities are going to do, again, I don't know, but there are positive and negative values associated with them. When we're talking about present programs, I'm using the criteria that we used in CORRIM when we examined not the new programs referred to earlier that have emerged where there is an emphasis on undergraduate education, but we were looking at the number of universities that had made substantial investments in the kind of physical facilities required to do significant work, research and teaching in wood science and technology, all the way across the board from the baccalaureate to the doctorate, and we concluded that the number of those institutions had decreased rather than increased over the past several years. Now we've got a smaller base to operate from if we're talking about institutions with programs of that magnitude, but if one believes evolution, we may have the fittest. Hopefully that's the case, so that the ones that are left maybe have the best chance of moving ahead and meeting the challenge that certainly does lie ahead. If existing programs in wood science and technology are to meet this challenge, it's got to be done within the framework of the university itself; it is necessary to respond to what the university thinks is important and to respond in a way that's unique. If we're just duplicating and creating another mechanical engineering part—department—and putting a different label on it, we aren't going to get very far. Most universities already have one. So, we've got to have a program whose contribution is sufficiently unique to justify the allocation of resources by the university to its continued sustenance. It *must* have a fairly high priority, because the lower priority items are falling by the wayside.

Now if we're going to move into phase three and do things somewhat differently with respect to wood science and technology, we have not only the problem of

maintaining the programs already in existence, we've got to create some change, and change is expensive and that's even harder to accomplish than just holding on by your teeth. You've got to get some reallocation of resources.

What is the climate in the universities today with respect to the maintenance of programs of this sort and particularly with respect to the growth of programs of this sort? Well, a good many universities are in a no-growth posture, and the ones that aren't yet there are getting there pretty rapidly. This is in response to the slacking in the people of college age, the numbers of people of college age that are in the population at the present time. It's in response to the fiscal problems states have in support of their higher education. It turns out that wood science and technology programs are in state-supported institutions. So, we're sitting in a no-growth posture and we want to grow. That isn't easy. That means that if we're going to build programs in wood science and technology, it has to be at the expense of something else. That doesn't frighten me as an idea, but it isn't all that easy. We're in a stage where there is increased accountability within every university unit for what it's doing. Now, some increased accountability has been very healthy in universities, a good thing for us, but some of us are concerned that we spend so darn much time these days accounting for what we're doing that we haven't got very much time to do it, and that's a problem.

Another problem that I think the nonuniversity people in the field may not recognize that is very real and is a function of the no-growth posture is the procedures for faculty development. In many universities today, and I think the number is increasing, the pattern of faculty development is sort of a steady-state proposition. Professor X, who is a full professor, arrives at the age of 65 and he retires. Now we can't go out and find ourselves an accomplished individual who has had lots of experience in order to take Professor X's position; we've got to go into a graduate school, get a bright brand-new Ph.D., and put him in as an assistant professor. That's a fine thing to do if you keep this steady-state up long enough; you end up with a faculty where none of them have ever been out where they're sending their students—haven't had experience. Now, this isn't a trivial problem, and many of us in the field of technology are arguing bitterly with our administrations that we can't survive in the long run with this kind of posture. But I point out to you that this has been the long-term tradition in fields like history, or economics or English, or even chemistry, physics, or math. Outnumbered as we are on our faculties, sometimes we find it difficult to explain to them that what will work in history won't work in forestry or engineering or wood science and technology.

Well then, the current programs in wood science and technology in the short run have to carry the burden. In a no-growth situation, with the kind of expenses involved in introducing new programs of the sort that we are talking about, of the dimensions we're talking about, there aren't going to be very many new ones produced very rapidly. So, we've got to live with what we have for the most part, in the short run at least.

There is an analogy in the kind of problem we are facing in the wood science and technology area with the field of mining and metallurgy, which went through this procedure a number of years earlier. It used to be that most universities, at least in the West, had schools of mines. They were big and flourishing and active,

had good-sized faculties, and they produced large numbers of students. They went through a long period when mining schools disappeared gradually, while no one was looking. Ours did at the University of Washington, and a number of others did. Then all of a sudden the nation found itself in a dilemma with respect to nonrenewable resources. It needed help in fuel, and where were the people that were producing petroleum engineers? It needed metallurgists, and where were the mining schools that were producing metallurgists? This problem got sufficiently critical that the national government viewed it as important to move into and in effect made the judgment that the remaining schools of mining and metallurgy were a national resource that had to be protected rather than just something that the individual university could deal with willy-nilly. The result was that the federal government through a variety of its agencies (the National Science Foundation, the former Atomic Energy Commission, presently under the Department of Energy) established nonrenewable material laboratories, funded on a continuing basis by the federal government simply to maintain that resource and to assure itself that the same thing wasn't going to happen to the remaining organizations that had happened to most of their peers. In the CORRIM Study we suggested that the same thing ought to be done with respect to the renewable materials programs. There has been a bit of interest in this from the National Science Foundation and a little from the Energy Department, and not much action, and maybe there won't be; but the analogy is there, and the problem may be quite similar.

If we're going to develop increasing programs in wood science and technology, there needs to be much more cooperation with federal agencies involved in this area—the Department of Agriculture and the Forest Service, and particularly the Forest Products Laboratory, the Department of Energy, the Department of State, the National Science Foundation, and so on. I have to say to my good friends from the Forest Service that up to this point we're getting a lot more action out of the rest of the federal agencies than we have out of the Forest Service, and I know that that isn't the fault of the people sitting in this room. But I think most of us know that we get calls pretty frequently these days in wood science and technology from the Department of Energy and even from the State Department.

We need to go back to what Walt Smith and I were talking about at breakfast this morning, a kind of exercise we used to go through, where once a year we sat down together for a day or two. The Forest Service looked at its needs and we looked at ours, and we came up with some small but significant programs that had a real impact on the development of many of the strong programs in wood science and technology that exist today.

Well third, we need the support of the industrial constituency, the people that employ our graduates. You've already seen from the pie charts where they go. If industry believes that it is important to have people trained to solve many of the problems that are emerging in phase 3, and if industry believes that there is a good chance that those problems might be solved and the technical people developed in the programs of wood science and technology, either as they exist now, or changed, then it needs to support the universities trying to do this. There is a good analogy here too. The pulp and paper technology programs are a good example of what can happen in situations where the industry feels a need and it

goes to the university to solve that particular problem. In all the attrition that has taken place in the departments of wood science and technology in the United States, to the best of my knowledge, not a single one that has had a pulp and paper technology heavily supported by the pulp and paper industry has ever been in jeopardy. As a matter of fact, I'll go even far enough to say that in a few cases, those programs, I think, have carried some of the other wood science and technology activities on their backs. There are examples of the success of this operation if you look in other disciplines. The health sciences, medical schools, and dental schools represent relatively small numbers of people on our campuses, but the kind of support that in general has been provided to the health science mission-oriented schools and colleges by the profession, by the medical profession itself, and by its counterparts in the government has given them a very, very strong position on the campus. One can say precisely the same thing about law. The legal profession and its support of the law schools on campuses have made a great difference in the viability of those schools and universities. Now there is no way that those of us in forestry, particularly people in wood science and technology, are ever going to vote very much stock in our universities on a one-man, one-vote basis. At our university we have an enrollment of 32,500 students, and we say grace over about 800 of them in the College of Forest Resources and something less than 100 of those are in the field of wood science and technology. You can figure how much stock I vote when they start counting heads, and I don't think we're unique in this respect. It's necessary in small professional areas in the university to have the support of a constituency outside of the university if the enterprise is going to survive, and I'm not talking about just walking down and putting bucks on our desk. There are lots of ways that a university unit can use support and needs support other than a check.

In summary, let me say two or three things. First, I think there is a great challenge in the area of wood science and technology. I think we are entering a new phase, an important phase where the opportunities are great. I don't know whether the programs in wood science and technology are going to pick up those opportunities or not. Someone else may do it. I'm a born optimist, and I guess I think we probably will, but there is certainly no guarantee of that. If we do, it's going to be because there has been a wise and careful response from our faculty in that area, a willingness to examine the needs for change and change things in the right direction. It's going to be because some of the universities, hopefully the ones that have continued to do so, will support this as an important part of their way of pursuing their educational goals. It's also going to be because the constituency, the profession itself, and the people that the profession serves undertake to support the programs with considerable vigor.

THE PANEL-AUDIENCE DISCUSSION SESSION

When the six speakers had completed formal presentation of their papers, they served as a panel in the exchange of ideas and information with the audience. This was an open forum in which the panel and members of the audience participated under the guiding influence of the moderator, Dr. Helmuth Resch.

The written record of the session that is presented here is a shortened and edited version transcribed from the recording tapes. A serious effort was made to preserve the intended direction and meaning of the oral presentation. However, if I am guilty of gross omissions or misrepresentations of material, I sincerely apologize.

It is fitting and proper to extend a hearty "thanks" to the members of the panel, the audience, and Helmuth, for a job well done. The ideas and viewpoints presented are timely and stimulating. I consider it fortunate that we can retain this part of the program as archival material.

Respectfully,
ROBERT ERICKSON

Chairman, Annual Meeting Program
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