FOREST PRODUCTS RESEARCH AND IUFRO

HISTORY AND POTENTIAL

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As awareness of the importance of the world's forest resources to human society and the natural environment grew during the 19th century, forestry researchers intensified their efforts to find ways to conserve that resource. Toward the end of the century, foresters from several research stations in Europe began meeting and corresponding to compare notes on research techniques and standards. Those informal contacts led to the establishment at Eberswalde, Germany, in 1892 of the International Union of Forestry Research Organizations (IUFRO). Today IUFRO is a union of over 700 research organizations worldwide and has a research scope much broader than those early foresters could conceive. Division 5 (Forest Products) of IUFRO is one of eight such divisions and is an integral part of the international approach to cooperative research on the management and preservation of the world's forest resources. It was not always thus. This article will review IUFRO's work in forest products, its origins, its history, its current status, and its future opportunities and potential.

Forest products research is critical to the social and economic well being of the world's peoples, because there are continually increasing demands on a steadily decreasing resource. During the last half of the 20th century, world population increased from 2.7 billion to just over 6 billion – more than double (Fig. 1) (19). Annual world production of industrial roundwood and fuelwood increased from about 1 billion m^3 of each to about 1.7 billion m^3 (Fig. 2) (3). The latest figures on the world's forest cover show that in 1995 there were about 3.5 billion ha of forest, both natural and plantations. During the 5 years between 1990 and 1995, that area decreased by 56 million ha worldwide, a loss of 65 million ha in developing countries and a gain of 9 million ha in the developed countries. The good news is that productivity of the wood industry, in terms of output per unit of material input, has been steadily increasing (Fig. 3) (8). These are U.S. figures, which is all we have available, but the industry in other parts of the world has also demonstrated increased efficiency in material use. No one can prove that this is due to IUFRO, but it seems certain that the kinds of research generated in the many working parties of Division 5 and its effective application must have played a strong role in this payoff of improved utilization.

George Noel Gordon, Lord Byron, one of our most respected and quoted writers of two centuries ago, in his epic work *Don Juan* says "All human history attests that happiness for man – the hungry sinner! since Eve ate apples, much depends on dinner." (1). We have learned that forest products provide the pay off – the dinner – that is both incentive and energy for forestry and that research in forest products is basic to

that essential function. As the world's appetite for wood products increases, research on all aspects of forest products will play an even more important role. In turn, the role of IUFRO will increase substantially as teams of specialists from many disciplines are assembled to identify and solve major research issues and problems.

United Nations

While silviculturists in central Europe were beginning to gather to compare notes on procedures and analytical techniques, researchers in forest products were also working in many parts of the world to confront the growing awareness that the forest resource was not limitless and needed to be conserved and used wisely. They were finding ways to improve the economics of wood use. This applied to construction, tool making, transportation, packaging, derivation of chemical products, and many other applications. The research was accelerated early in the 20th century and into the middle of the century by the heavy demand for efficient wood use both in the general economy and in World War I and World War II, as well as in other wars that raged in the world. At the end of World War II, the establishment of the United Nations provided a forum for bringing together efforts that would encourage world stability and peaceful development. The high degree of significance given to effective utilization of forest resources provided a common ground for scientists in many parts of the world.

The Food and Agriculture Organization (FAO) of the United Nations included a Forestry and Forest Products Division, which set up technical committees in 1947. Among these was a subcommittee on wood chemistry, with members from at least 10 countries. This group broadened its consideration to other aspects of wood utilization as well. Like the small group of foresters who formed IUFRO, this group concerned itself with standardization of terminology, methods of testing, and specifications for international collaboration. Meetings in New York, Appleton, Wis., and Geneva, Switzerland, helped the group share scientific concerns and progress (2).

A United Nations Scientific Conference on the Conservation and Utilization of Resources met at Lake Success, N.Y., in 1949. In its forest resources section, it dealt with seven areas of forestry, two of which were forest products related: 1) logging and sawmill techniques; 2) preservation and chemical utilization of wood. Participants included several who were later active in IUFRO such as Alfred Stamm, Fred Simmons, and Edward G. Locke (18).

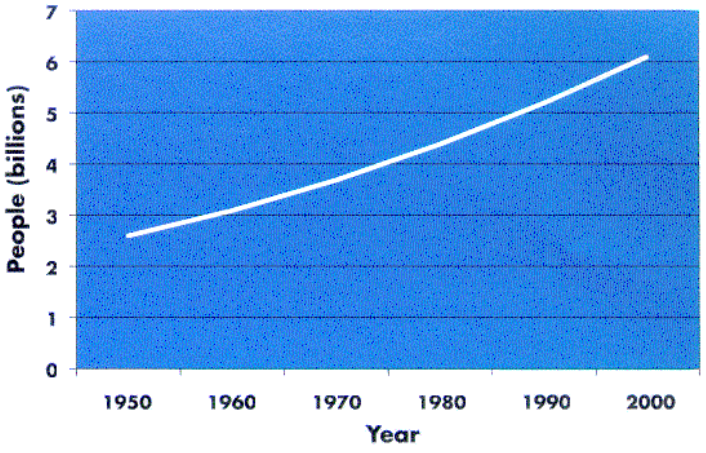

Figure 1. World Population 1950-2000 (19).

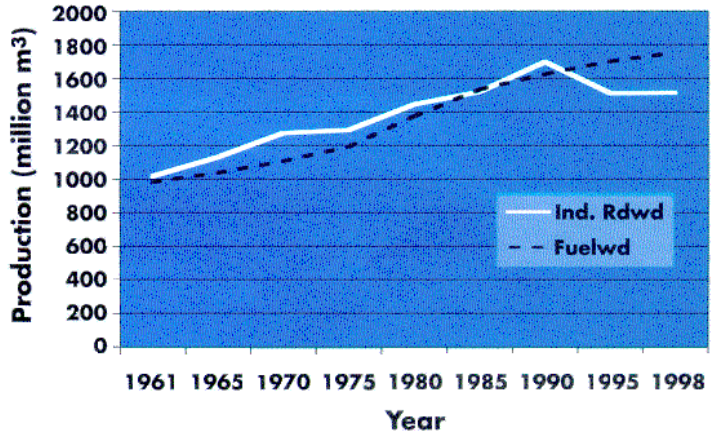

Figure 2. World Production of Industrial Roundwood and Fuelwood 1961-1998 (3).

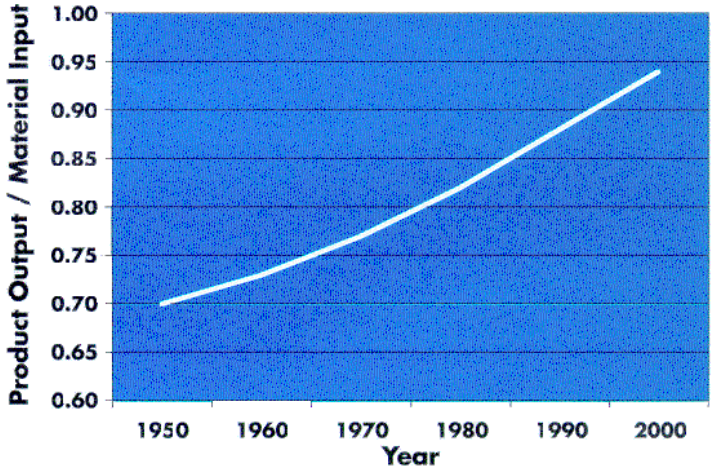

Figure 3. United States Wood Industry Productivity 1950-2000 (8).

Section 41

As the need was recognized to bring forest products research more closely into the IUFRO family, leaders of forest products research in FAO were urged to encourage researchers to become involved in IUFRO. This was begun at the XI IUFRO Congress in Rome in 1953 as Section 41, Mechanical Conversion of Wood. Papers were presented on basic aspects of ring width/wood quality relations and physical properties of wood (9).

At the Seattle World Forestry Congress, leaders of Section 41 were encouraged to broaden and strengthen the work of the section in response to increasing needs for forest products research. Consequently, at the XIII IUFRO Congress in Vienna in 1961, the program was broadened to include the full range of forest products research. The initial emphasis was on three fields: 1) wood quality, macro and micro; 2) sawing and machining; and 3) performance of wood in fire (4).

At that time, FAO was still concerned with forest products research and it remains active in wood technology today. However, following a joint meeting of Section 41 and the FAO Conference on Wood Technology in Madison, Wis., in 1963, FAO elected to emphasize its primary mission of work with developing countries (5).

The scope of the section's program broadened further when a Section 41 meeting in Melbourne, Australia, in 1965 brought together working groups on wood quality, mechanical conversion, performance of wood in fire, wood physics, wood and tree chemistry, wood protection, mechanical properties of wood, and structural utilization of wood and wood products. By that time, the effort was becoming truly international as scientists from 15 countries discussed progress and priorities in forest products research and agreed on approaches an&techniques. The name of the section was then appropriately changed to "Forest Products" (10).

Division 5

The rapid growth in member organizations and research scope of IUFRO led to a complete restructuring in the 1960s (11). Out of this came Division 5, Forest Products, with subject groups S5.01 Wood Quality, S5.02 Wood Engineering, S5.03 Wood Protection, and S5.04 Wood Processing. This structure was adopted at a Pre-Congress meeting in Madison and at the XV IUFRO Congress in Gainesville, Fla., in 1971. Also added then were two project groups, P5.01 Properties and Utilization of Tropical Woods and P5.02 Terminology (Table 1) (6,7,17). An All Division Meeting in South Africa in 1973 provided an opportunity to smooth out the structure and establish working relationships. These were evident in a full array of activities at the XVI IUFRO World Congress in Oslo, Norway, in 1976. It is interesting that this early structure of the division had a working party S5.01-07 (Quality of Plantation Grown

Table 1.— STRUCTURE OF DIVISION 5, 1972 (12).

Coordinator: H.O. Fleischer (U.S.)
Deputy: B. Thunell (Sweden)

S5.01-00 Wood Quality
- 01 Normal wood formation
- 02 Significant variations in normal wood formation
- 03 Secondary wood changes
- 04 Effect on properties of genetic factors
- 05 Desired properties for end use
- 06 Bark properties and utilization
- 07 Quality of plantation-grown wood

S5.02-00 Wood Engineering W
- **01 Mechanical properties**
- **02 Structural utilization**
- **(met as one ad hoc group on "Time and moisture effects")**

S5.03-00 Wood Protection
- 01 Protection of solid wood
- 02 Protection of particleboard
- 03 Protection of wood in storage
- 04 Performance of wood in fire

S5.04-00 Wood Processing
- **04 Slicing and veneer cutting**
- **05 Panel products**
- **06 Drying**
- **07 Gluing**
- **08 sawmilling and machining**
- **09 Pulp and paper**

P5.01-00 Properties and Utilization of Tropical Wood
- 01 Collection and assembling of sources of information
- 02 Characteristics and properties to be evaluated
- 03 Systems of information exchange
- 04 Industrial use of tropical timber

P5.02-00 Terminology

Table 2. — STRUCTURE OF DIVISION 5, 1976 (12).

Cooridinator: W.E. Hillis (Australia)
Deputies: J.G. Sunley (U.K.)
R.W. Kennedy (Canada)

S5.01-00 Wood Quality
- 01 Normal wood formation
- 02 Significant variations in normal wood formation
- 03 Secondary wood changes
- 04 Effects on properties of genetic factors, environment, and forest practices
- 05 Desired properties for end use
- 06 Bark properties and utilization
- 07 Quality of plantation-grown woods

S5.02-00 Wood Engineering
- **03 Time and moisture effects**

S5.03-00 Wood Protection
- 01 Protection of solid wood and wood-based materials
- 03 Protection of wood in storage
- 04 Performance of wood in fire
- 0.5 Biodeterioration of wood

S5.04-00 Wood Processing
- **04 Slicing and veneer cutting**
- **05 Panel products**
- **06 Wood drying**
- **07 Wood gluing**
- **08 Milling and machining**
- **09 Pulp and paper**

P5.01-00 Properties and Utilization of Tropical Woods
- 02 Characteristics and properties to he evaluated
- 03 Systems of information exchange
- 04 Collection and assembling of sources of information
- 05 Industrial use of tropical timbers

Table 3. — STRUCTURE OF DIVISION 5, 1986 (13).

Coordinator: R.L. Youngs (U.S.)
Deputies: W.G. Kauman (France)
H. Schultz (F.R. Germany)

S5.01-00 Wood Quality
- 01 Formation of wood
- 02 Natural variations in wood quality
- 04 Biological improvement of wood properties
- 0.5 Wood properties desired by end users

S5.02-00 Timber Engineering
- 01 Mechanical properties
- 02 Structural utilization
- 03 Time and moisture effects

} Usually met as one

S5.03-00 Wood Protection
- 01 Protection of solid wood and wood-based materials
- 02 Protection of particleboard and composite products
- 03 Protection of wood in storage
- 04 Performance of wood in tire
- 05 Biodeterioration of wood
- 07 Preservation processes
- 08 Natural durability

S5.04-00 Wood Processing
- **06 Wood drying**
- **07 Adhesives and wood gluing**
- **08 Milling and machining**
- **10 Production systematics**
- **11 Wood-based composite products**

P5.01-00 Properties and Utilization of Tropical Woods

P5.03-00 Energy and Chemicals from Forest Biomass

P5.04-00 Production and Utilization of Bamboo and Related Species

Wood) (Table 2) that disappeared later, but is now a topic of great concern. Before the Oslo Congress, a working party on pulp and paper was identified in S5.04, but discussion with Scandinavian pulp and paper scientists discouraged its continuation on the grounds that such scientists were well represented and integrated by associations already established within the pulp and paper industry. Revisions in S5.03 reflect changes in research interests and needs, as well as the active program of the International Research Group on Wood Preservation, with which there was close association and overlapping membership and objectives.

As the Division continued to expand its activity through subsequent congresses in 1981 (Kyoto, Japan), 1985 (Ljubljana, Yugoslavia), with intermediate All-Division 5 Conferences in 1980 (Oxford, U.K.) and

Table 4. — STRUCTURE OF DIVISION 5, 1989 (14).

Coordinator: R.L. Youngs (U.S.) **Deputies: A.R. deFreitas (Brazil)** **H. Schultz (Germany** **F.O. Tesoro (Philippines)**
S5.01-00 Wood Quality 01 Formation of wood 02 Natural variations in wood quality 04 Biological improvement of wood properties 05 Wood properties desired by end users
S5.02-00 Timber Engineering
S5.03-00 Wood Protection 01 Protection of solid wood and wood-based materials 02 Protection of particleboard and composite products 03 Protection of wood in storage 04 Protection from fire 06 Biodeterioration 07 Preservation and processes 08 Natural durability
S5.04-00 Wood Processing **06 Wood drying** **07 Adhesives and wood gluing** **08 Milling and machining** **10 Production systematics** **11 Wood-based composite products**
P.5.01-00 Properties and Utilization of Tropical Woods
P5.03-00 Energy and Chemicals from Forest Biomass
Production and Utilization of Bamboo and Related Species
P5.05-00 Tree Ring Analysis
P5.06-00 Forest Products Marketing

Table 5. — STRUCTURE OF DIVISION 5, 1991 (15).

Coordinator: A.R. deFreitas (Brazil **Deputies: C.G. Sales (France)** **J.A. Youngquist (U.S.)**
S5.01-00 Wood Quality 01 Formation of wood 02 Natural variations in wood quality 04 Biological improvement of wood quality 05 Wood properties desired by end-users
S5.02-00 Timber Engineering
S5.03-00 Wood Protection 02 Protection of particleboard and composite products 03 Wood in storage 04 Protection from fire 05 Biodeterioration 07 Preservation and processes 08 Natural durability
S5.04-00 Wood Processing **06 Wood drying** **07 Adhesives and wood gluing** **08 Milling and machining** **10 Production systematics** **11 Wood-based composite products**
P5.01-00 Properties and Utilization of Tropical Woods
P5.03-00 Energy and Chemicals from Forest Biomass
P5.04-00 Production and Utilization of Bamboo and Related Species
P5.05-00 Tree Ring Analysis
P5.06-00 Forest Products Marketing
P5.07-00 Non-Wood Forest Products **01 Environmental aspects of maple syrup production** **02 Medicinal and aromatic plants**

1983 (Madison, Wis.), two additional project groups were added to provide a focus for research in Energy and Chemicals From Forest Biomass (P5.03) and Production and Utilization of Bamboo and Related Species (P5.04) (Table 3) (13). A new working party in S5.04 signaled the emergence of a major research focus on composite products, a field which had been developing for more than 30 years by that time. As we moved into the Ljubljana Congress in 1985 and the Sao Paulo Conference in 1988, new research emphases were indicated by two more project groups: Tree Ring Analysis (P5.05), which reflected new efforts in dendrochronology, and Forest Products Marketing (P5.06), which recognized the emergence of this field as one critical to effective utilization of forest products by bringing together producers and consumer needs

Table 6. — STRUCTURE OF DIVISION 5, 1998 (16).

Coordinators: C.G. Sales (France)
J.A. Youngquist (U.S.)
Deputies: C.H.H. Wang (Taiwan)
A. Winkler (Hungary)
J.A. Youngquist (U.S.)
C.G. Sales (France)

5.01.00 Wood Quality
01 Formation of wood
02 Natural variations in wood quality
04 Biological improvement of wood properties
05 Wood properties desired by end-users

5.02.00 Timber Engineering
01 Nondestructive evaluation of wood and timber

5.03.00 Wood Protection
04 Protection from fire
09 Wood durability

5.04.00 Wood Processing
06 Wood drying
07 Adhesives and wood gluing
08 Milling and machining
10 Production systematics
12 Surfacing and finishing
13 Industrial engineering and operations

5.05.00 Composite and Reconstituted Products
01 Lignocellulosic-based composites
02 Recycling and recycled products
03 Wood/Non-wood combinations
04 Modification of lignocellulosics

5.06.00 Properties and Utilization of Tropical Woods
01 Utilization of forest products from dry areas
02 Quality teak timber from plantations
03 Improving the utilization of plantations of Eucalypts

5.07.00 Energy and Chemicals from Forest Biomass
01 Fundamentals of wood carbonization

5.08.00 Production and Utilization of Bamboo and Related Species
01 Building with bamboo

5.09.00 Tree Ring Analysis

5.10.00 Forest Products Marketing

5.11.00 Non-wood Forest Products
02 Medicinal and aromatic plants
03 Edible products from the forests
04 Mushrooms growing in the forest

5.12.00 Sustainable Production of Forest Products

(Table 4) (14). Organizing for the Montreal Congress in 1990 and the Nancy Conference in 1992 recognized the field of research in Non-Wood Forest Products (P5.07), a very old field, but one in which activity was beginning to attract worldwide attention (Table 5) (15).

The Congress at Tampere in 1995 saw a comprehensive review of the division structure that recognized the insignificant differences between subject groups (S-) and project groups (P-) and those designations were dropped. The reorganization of Division 5 also recognized the role of Industrial Engineering in Wood Processing (5.04.13), focused attention on research in Nondestructive Evaluation of products and materials (5.02.01), provided a central point for the rapidly growing field of Composites research (5.05), and drew new attention to Bamboo as a building material (5.08.01). All of this built on the basic division framework established in the early days (Table 6) (16). This is the structure of the division around which the Conference in Pullman, Wash., in 1997 was built and which exists today. As a result of that meeting, a new research group, Sustainable Production of Forest Products (5.12), was established. This new group was formed as the concept of ecosystem sustainability climbed to the top of the forest management agenda. It also reflected the realization that sustainable forest management practices must be developed to provide for the increasing demand for supplies of fiber and other forest produm as we move into the 21st century.

Where We Stand Now

As we look back on the half-century of IUFRO's involvement in forest products research, we see several trends that have led us to where we are now and indicate where we might go in the future. The Forest Products Division is now one of the largest in IUFRO, with 12 subject groups and 25 working parties. This reflects a great breadth and depth of science and technology that can be focused on meeting people's needs for products from the forest resource. Broad geo-

graphic involvement brings together researchers from all parts of the world. Each researcher is particularly concerned with local problems, but can also bring a unique perspective to both global problems and those that are local in other places, We have an ability to communicate that we could not even dream of a decade ago. However, this ability varies greatly among nations and institutions. There is a strong commitment to collaboration and collective action; however, there is wide variation in the ability to act on that commitment. A common awareness exists that effective use of forest products is a key to sustainability of the forest resource and to its ability to meet the needs of society.

The program of Division 5 has now broadened to recognize new needs for research on forest products as scientists in various parts of the world have sought a forum for sharing ideas, notes, and accomplishments. The results have been many: 1) new knowledge of wood quality factors; 2) new approaches to the efficient use of wood as an engineering material; 3) effective processing methods to deal with the growing diversity of resources, processing conditions, and product needs; 4) effective, environmentally friendly methods of wood protection; 5) new concepts related to composites of wood and other materials; 6) methods for dealing with the growing trade in tropical woods; 7) more efficient use of wood for energy; 8) better understanding of the availability and uses of non-wood forest products; 9) improved use of bamboo and rattan; 10) new advances in growth ring analysis; 11) broader understanding of marketing techniques to effectively match products to consumer needs; and 12) ways to incorporate all of this into the sustainable development and management of forest resources.

Future

We face new challenges as we consider the future of IUFRO's involvement in forest products research. No major problems are purely technical and disciplinary – they are social, economic, psychological, and traditional. As we look to the future, we face new social, economic, environmental, and technical needs, with new technology and scientific advances to strengthen the work. An increasingly diverse resource and rapidly growing dependence on plantations leads to new considerations of wood quality and characteristics and factors that influence them. New opportunities for efficient structural use to meet human needs for homes and other buildings call for creativity in wood engineering. Service conditions and environmental concerns call for new approaches to wood protection that are economical, safe, and environmentally acceptable. The emergence of a diverse resource and the need for resource conservation demand new approaches to processing. Special consideration of resource and social problems of the developing world call for new attention to the use of tropical woods. Composites offer new creative opportunities for the use of residues and diverse resources, including plantation timber, to meet human needs effectively, often in combination with other materials. Non-wood forest products from the same forests as wood products are an increasing element in the socio-economic structure of regions and communities, along with opportunities to use rattan and bamboo. We are beginning to deal effectively with marketing as the means to see that forest products are appropriately related to the needs of consumers.

As we consider the challenges and the future of forest products research, here are some points we should consider as we plan for what will be reported at the XXII IUFRO Congress and beyond:

1. Develop depth and disciplinary strength within our groups and working parties, aggressively joining with others in this and other Divisions to focus on solutions to problems.
2. Actively plan and implement joint efforts with specialists from different fields to identify and solve forest-related problems.
3. Develop planning and management techniques that are uniquely adapted to voluntary organizations.
4. Strengthen channels for communication and for transmitting and discussing information.

Spectacular opportunities and challenges lie ahead in terms of the need for wood science and technology to provide a basis for the more effective development and use of forest products. The results of our work must meet increasingly urgent needs as world population draws near 6 billion people – all dependent in some way on effective use of the forest resource. This becomes more urgent as the resource on which they depend declines in amount and quality. This is our challenge as we look ahead to the real meat of our activity: meeting the needs of increasing numbers of people while utilizing fewer resources and dealing with higher costs and increasingly urgent consideration of environmental effects, other forest uses, and the social and economic well-being of those people.

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