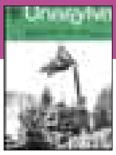

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The promise of technology

F.F.P. Kollmann

TECHNOLOGY is the scientifically-based representation of working procedures and expedients which increase the value of raw materials at the disposal of mankind. Technology is a typical human activity based on intelligence and common sense. Even the highest developed animals which form societies and build complicated nests are doing this, influenced by instinct and not by intelligence. Technology either changes the form and shape of raw materials — as, for example, of wood by sawing, planing, molding, routing, turning, sanding, or of metal by rolling, forging or stretching — or it leads to a chemical change in the raw materials — for example, by fermentation, dyeing or bleaching. In this respect a distinction must be made between mechanical and chemical technology.

This is a world of rapid technological changes which greatly influence the economies of industrialized countries. Doubtless there is a promise of technology or, shall we say, a challenge of technology. Most people assume that technological changes have improved working conditions by eliminating the most dirty and menial services, by shortening working hours, and by creating a continuous supply of better and new products. Modern technology is closely connected with automation: to some extent this is followed by fear and concern that technological progress may cause unemployment.

But this fear is not justified. In the United States the Commission on Technology, Automation, and Economic Progress reporting to the President and Congress stated that "technology eliminates jobs, not work."

Technology in all its consequences means a persistent change and even a replacement of technical phenomena. Modern traffic began with the invention of the steam locomotive by Stephenson. He was the first to use smooth rails and he constructed the steam locomotive in all its essential parts. Nevertheless, the steam locomotive is now being more and more replaced by the electric or diesel engine. A few years ago it was a world of electronics characterized by electronic valves but now, with solid-state physics, transistors have outmoded the inventions of the very recent past. Heavy metals like steel and cast iron are being replaced by aluminum, and several plastics are being substituted for aluminum itself.

F.F.P. Kollmann, of Munich University, Germany, was president of the International Academy of Wood Science when this paper was written. It was presented at the sixth World Forestry Congress (Madrid, Spain, 1966), whose theme was "The role of forestry in worldwide economic change".

The replacement or substitution of wood by other materials is also obvious in some fields. The promise of technology seems to be against the further application of wood in many kinds of building construction, in mining, for railroad ties and in aircraft construction, for instance.

Wood has some unfavorable properties. It can be attacked by wood-destroying fungi and insects, it is combustible, and its dimensional stability is low as compared to that of inorganic materials. But modern technology has provided remedies to overcome these disadvantages. Wood preservation guarantees long life for wooden parts even under unfavorable conditions of service, and treatment with fire-retardent chemicals can make wood and wood-based materials almost noninflammable. Solid wood — after drying at high temperatures and impregnation with some artificial resins — plywood, laminated woods and particle board have a reduced absorption capacity and therefore a higher dimensional stability.

New technology as seen from the point of view of the wood industry: panel products, which today account for more than half of world sawnwood production, as well as the use of waste products such as sawdust.

In the past, technology was the science of the conversion of one raw material. From this point of view technology consisted of many branches devoted to various materials. The promise of technology was restricted to metallurgy, woodworking, manufacture of textiles, for example. In the modern industrialized world, technologies are highly differentiated and mutually dependent.

The diversity of interwoven technologies is a characteristic of modern industrial economy. Input/output analyses in this respect are most instructive. Consider the production and delivery of any industrial product to its final market. Thirty years ago the output of furniture merely required the input of raw material, some components, and few services. Within the last two decades, nonmaterial or general inputs have remarkably increased.

These general inputs are characteristic of today's technologies. They mean higher consumption of energy — partly caused by increased mechanization of the productive processes — improved communications, adequate packaging: and trade, reliable maintenance construction, finance, insurance and other business services, use of business machines, information activity. The whole industrial system has become more complex and the co-ordinative functions have become more important. In the past, single kinds of materials determined the aspect and economy of various industries. There were industries where metals, stones, glass, wood, rubber, leather, natural or artificial fibers and plastics dominated. But this classical dominance of particular materials has given way to increasing diversification of materials used in each industry. Furniture consists not only of wood but also of metals, plastics, glass, textiles and glues. A competitive refinement in the properties and qualities of materials used is evident.

Forest products utilization is essential for the preservation of forests. In the atomic age and for highly industrialized societies, forests are a prerequisite for wealth and comfort. Forests regulate climate and watersheds, impede erosion, form centers of recreation and preserve wildlife. Technology applied to forest products is in part highly developed and partly underdeveloped.

Sawing, for instance, is an antiquated technique. The gang saw, converting revolutions into strokes, is a very primitive machine. The optimum cutting speed in sawing wood is about 60 m/sec (i.e., speed at which cutting teeth revolve) but the average cutting speed of heavy-duty gang saws is restricted to 6 m/sec. Gang saws, Otto engines, and even diesel engines do not meet the requirements of modern technology. The power of the modern gang saw has been increased to its limit. Further technical development cannot be expected, so the problem of yield cannot be solved. Sawing by gang saws, band saws, and especially by circular saws means the production of kerfs. The material removed from the kerfs is sawdust. The average yield in converting round logs into lumber amounts to 70 percent when using gang saws, and to only 55 percent when using circular saws. Sawdust is a real waste, being short-grained and more or less disintegrated. It is therefore not suitable for raw material for the pulp and paper industry, or for the manufacture of fibreboard or particle board. There is a catalogue of possible ways to utilize sawdust. In this long list, no method solves the problem on a large scale. Thus, combustion at low efficiency is still the rule; here exists not the promise but the failure of technology.

Theoretically there are two ways to solve the problem. The first is the utilization of the sawdust. Perhaps in the future new chemical processes will allow the conversion of sawdust into attractive products. We know that cellulose can be transformed into sugar, but the product is more expensive than sugar made from cane or beets. This is especially valid for proteins produced from cellulose-sugars with the aid of special yeasts. Besides, cellulose forms only about 50 percent of the wood substance which contains 35 percent or more lignin. The economical utilization of lignin in great chemical industries is urgently required, but as yet there is no promise of quick success.

The second possible solution of the sawdust problem would be a complete change of sawing technology or, speaking more correctly, woodcutting technology. The width of the saw kerf cannot be reduced beyond a certain limit since any saw blade needs a minimum thickness with respect to its strength and stiffness. Circular saw blades which are too thin have a tendency to flutter which not only increases the width of kerf but reduces the surface quality which subsequently has to be improved by planing. Instead of less, more residues will occur. By slicing or peeling the wood, it is possible to avoid any sawdust or chips at all. These techniques are the basis for the economic production of veneers, plywood, and laminated boards. Thin boards of solid wood can also be manufactured by slicing or cutting. Large-sized thick boards or planks cannot be obtained by simple cutting operations.

Completely new suggestions for separating solid wood without residues have therefore been made and already partially tested. In the U.S.S.R. and later in the United Kingdom, a steel wire oscillating rapidly in its longitudinal direction was used as cutting tool for wood. The application of a needle-thin, high-pressure water jet is another idea. First experiments were promising. The application of the laser technique in wood-cutting is a third possibility. In the United States, even the use of high-energy electronic rays has been discussed. The picture of a completely automatic mill cutting logs without waste and meeting highest quality requirements can be imagined.

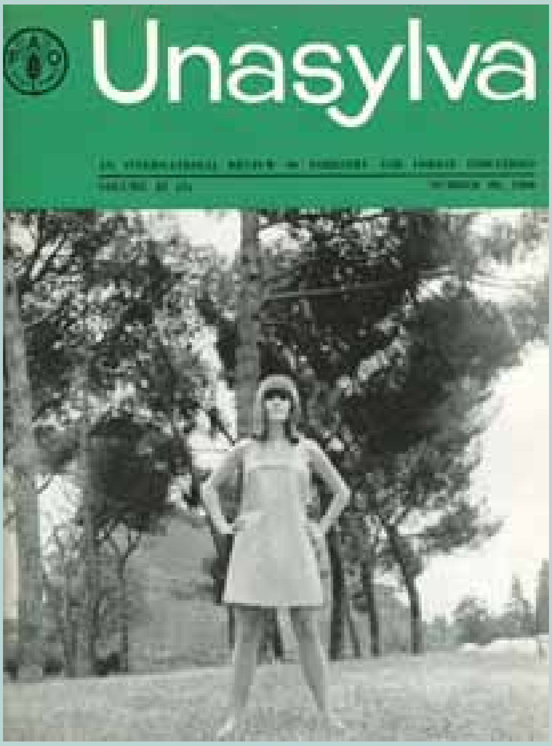
The present-day sawmiller may be disconcerted by the possibilities of technology in the atomic age. Up to now most forest products industries are still awaiting the promises of technology and their realization.

In this connection, one question is justified: What is meant by "the promise of technology?" In the introduction, the term technology was defined. Technology is the expression and manifestation of advanced technical activity. Maybe one day, even in the near future, robots will be the bearers of technology. But, like most sophisticated electronic computers, robots working automatically are nothing but technical slaves. They are and will remain forever slaves of mankind; man's spirit, his endeavor, his will, and his program guide and control all these servants of technology.

From this point of view, the promise of technology is the creed for the technical genius of mankind. In other and more simple words, we cannot expect to reap what we did not sow. An example may clarify this truism.

Since about the middle of the last century the idea of creating "artificial boards," replacing solid wood and converting wood wastes into valuable sheet-like materials with even improved properties, is to be found in many patents. Nevertheless, the technological know-how was not available,

A fashion of the times



The cover of Unasylva 89, 1968, insists, *"No, we have not taken leave of our senses. This dress modelled by a member of FAO's Division of Forestry and Forest Industries, is made of a material in which wood is the basic component. With a small addition of artificial fibers to improve the strength, paper for such dresses is generally made on common types of paper machines. The production of paper dresses may alter the prospect of new world-wide markets for a wood product."* However, after a brief moment of fashion, the paper dress never really caught on.

appropriate procedures and expedients — such as special machines and artificial resin glues — were lacking. The promise of technology was a presentiment, the necessary genius had not yet appeared. The promise of technology is directed to technical progress which is the basis of the valuation of any invention.

The concept of using sawdust for the production of particle board was near at hand but misleading. It was the completely new idea of producing cutter-type "engineered" splinters and flakes with well-determined geometrical properties as raw material for particle board which was required. After that, further ideas, no less bold in character, were necessary for starting the particle board industry. After particle preparation, screening or classifying and drying must be carried out. Both operations are combined in the most recent suspension driers. Continuous-type blenders for rapid and uniform distribution of the binder (most frequently using urea-formaldehyde and phenol-formaldehyde resins) had to be developed. Sophisticated installations for forming the mat had to be created. Prior to pressing, the surfaces of the mat are moistened. The moisture content of the particles, which is higher in the deck layers than in the core, guarantees the following advantages: smoother surfaces, higher bending strength, short pressing cycles due to improved heat transfer.

The continuing development of the particle-board industry in the world is a fascinating example of the impetus of well-co-ordinated technologies. Once again, and with special evidence, we can see that the promise of technology is a challenge to the human genius.

The diversity of interwoven technologies characterizes the board and related industries. Particle-board plants are attached to plywood factories. An increasing proportion of the total production of particle boards is veneered or overlaid with plastic sheets. One inventor of the extrusion process combined the production of his board with the manufacture of prefabricated houses.

Interwoven technologies are also marked by the combination of various materials. This fact has been mentioned in connection with the manufacture of modem furniture. More interesting and striking are sandwich constructions. Here we are really faced with the promise of technology. During the second world war a military multipurpose aircraft, the de Havilland Mosquito, was most successful. The wings and fuselage of the plane were constructed in sandwich-shells. Rather thick balsawood core layers were sheeted on both sides with highly tensile Oregon pine veneers. Such sandwich boards and shells are specifically very light, but rigid and stiff. Due to the "skin-effect" their resistance to buckling is extraordinary. Sandwich constructions allow a combination of woods with metal sheets, plastics and impregnated paper, with textiles, glass fibers and honeycombed layers, and so on. Sandwich constructions have a wide field of possible uses in lightweight engineering, for example, in radar towers, gliders, and the bodies of cold-storage wagons.

Modified woods include other interesting products, such as Kompreg, a high-density impregnated wood with mechanical properties similar to those of light metals, and Staypak, produced by compression without any impregnation. Egon Glesinger, later director of the Forestry and Forest Products Division of FAO, in 1949 wrote in his book *The coming age of wood* the following: "Combining the inherent natural virtues of wood with the tailormade qualities of synthetic plastics, the modified woods come closest to achieving the qualities of hardness, strength, moldability, elasticity, and resistance to fire, vermin, and decay projected for the ideal material."

Finally, it should be stressed that the promise of technology is directed toward the creation of integrated forest industries.

An ideal chart of integrated forest industries would show a network of mills and plants utilizing wood of all kinds and qualities including forest wastes and producing end products of high value. For such integrated forest industries, the reprocessing of residues generated by each process and utilized by the following one is also typical: Egon Glesinger showed such a chart of plants for the production of lumber, veneer, fibreboard, wood alloy, pulp, rayon, plastics, wood sugar, alcohol and lignin fuel.

In 1949, particle board had hardly any importance. Today its manufacture would obtain a dominant place in the chart, whereas lignin is still regarded as the "enigmatic key to wood chemistry" in the future. The promise of integrated forest industries is that they "add up to a sum greater than its parts."

The promise of technology in forestry and forest products utilization means that wood becomes exclusively a raw material for mechanical and chemical processes but will no longer serve as fuel. The forests as permanently self-renewing sources for one of the most reliable raw materials offer a brighter future for mankind on condition that the human genius redeems the promise of technology. For this brighter future and for technical progress, the interdependence of interwoven technologies and integrated industries is essential.

The world will become more and more co-operative and integrated, inspired by ideals of international peaceful co-operation and competing in scientific endeavor. This is "the promise of technology."

FAO and Russian forest inventory

In 1965, *Unasylva* reported on technical assistance that the Union of Soviet Socialist Republics (USSR) – an FAO founder but never a full member of the organization – provided to FAO in organizing forest inventory training:

> "THE U.S.S.R., through its technical assistance program, co-operated with FAO in 1963 in organizing a training center on the planning and execution of forest inventories over extensive forest areas, by means of aerial photography and other similar techniques. The course, which lasted two months, was organized at the Forest Research Institute of Leningrad and at Sochi on the Black Sea coast. Twenty foresters from an equal number of developing countries participated." (from *Unasylva*, No. 77, 1965, "Aerial photography for forest inventory")

Some things have not changed: forest inventory continues to be a major concern in Russian forestry. The Russian Federation became a member of FAO in April 2006 and attended the FAO Committee on Forestry (COFO) for the first time in March 2007. At COFO, the Russian Federation requested FAO assistance in the establishment of an international training and development centre for forest monitoring and assessment, which it envisages as an important implementation tool for the FAO Global Forest Resources Assessment (FRA) and international conventions (e.g. on biological diversity and climate change) and processes (e.g. related to forest law enforcement and governance). FAO is now providing forestry assistance to the Russian Federation in the development of a national forest inventory.


Aerial photography for forest inventory