FORESTRY SCIENCE PHOTO STORY

'SHIGOMETER' — new tool for forestry

NOTICE TO PUBLISHERS

Information in this news bulletin may be reprinted. Please give appropriate credit. Additional information or photographs may be obtained from: **Information Services** Tel—(Area Code 215) 597-3728.

NORTHEASTERN FOREST EXPERIMENT STATION • UPPER DARBY, PENNSYLVANIA 19082

NATIONAL FOREST SYSTEM • COOPERATIVE FORESTRY • FORESTRY RESEARCH • FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

Left, a drill hole prepares the way for the Shigometer probe; center, the Shigometer

How do you find out what's happening inside a tree? Why, with a Shigometer, of course.

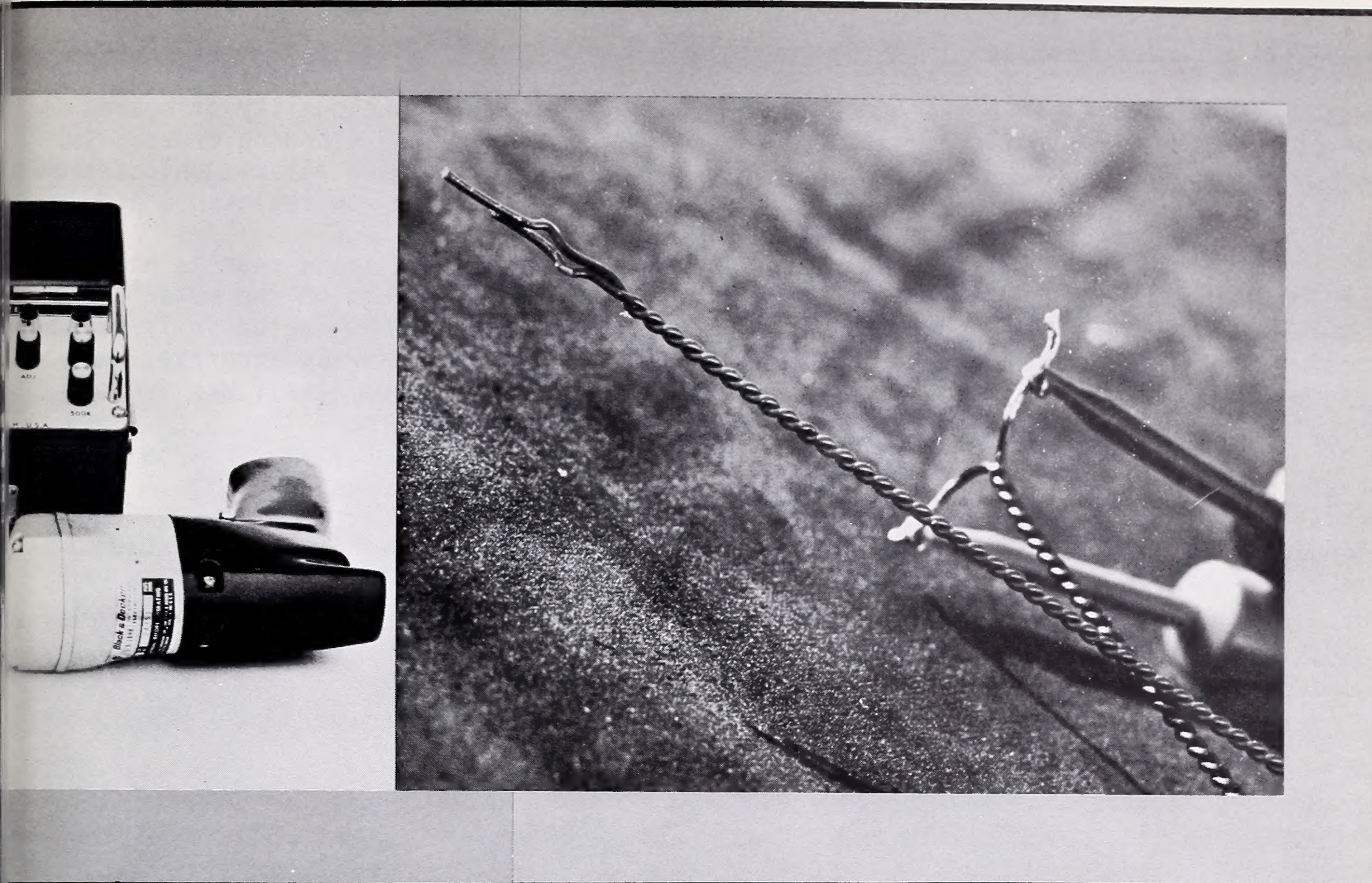
A Shigometer? If the term leaves you puzzled, it wouldn't be unusual since, as yet, what a Shigometer is and does is not common knowledge.

In spite of its modest public image the Shigometer is emerging as a unique and practical instrument. To the industries and groups involved in timber growth and utilization, its signifcance could be enormous.

The Shigometer is a device that detects decay in living trees and utility poles. Too often decay becomes evident only after it results in external damage. With the Shigometer, decay can be pinpointed in its earlier stages, saving the time, expense and frequent failure involved in more extensive late treatment, or the damage that results from no treatment at all.

We've all seen cracked or split utility poles along the highway, and felt fear in driving by. Hidden decay poses a threat to maintenance workers or repairmen who regularly climb utility poles. That tree in your yard that looks in perfect health....inside it may be rotted, making the tree more susceptible to damage. The Shigometer could help to eliminate such hazards. It could also help to save labor and waste in wood products industries.

The Shigometer, once called a "Wood Tissue Integrity Meter", is the result of seven years of collaboration by a number of professionals in fields ranging from botany to electrical engineering. It takes its name from one of its originators, Dr. Alex Shigo, plant pathologist with the Forest Service's Northeastern Forest Experiment Station at Durham, N. H. The probe for the meter was developed by Dr. Shigo's father, Alex Shigo, a craftsman from West Mifflin, Pa.



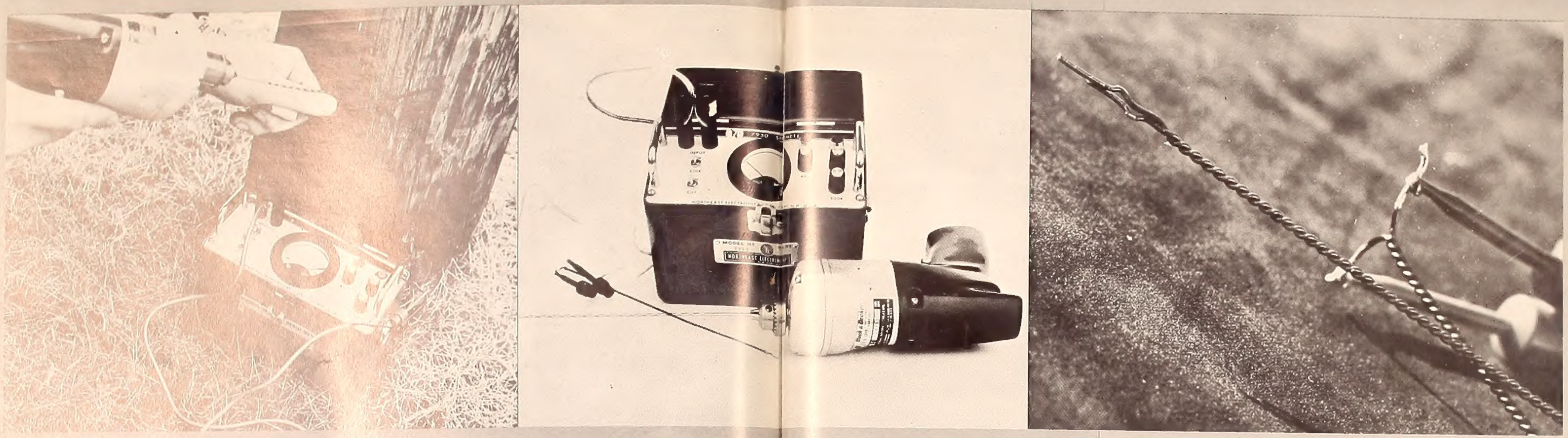
ortable drill, drill bit, probe and meter; right, close-up of the twisted wire probe.

From the beginning, the project has depended on cooperation between the Forest Service, the University of New Hampshire and Northeast Electronics, Concord, N. H., a subsidiary of Northern Telecom, Inc., Boston, Mass. Dr. Richard Skutt, Ronald Lessard and Dr. Terry Tattar, all present or one-time associates UNH, contributed to early theory and construction of the meter, which was miniaturized by UNH graduate student Arun Taneja. Northeast Electronics Vice President Harold Wochholz and Project Engineer Thomas Dors played key parts in developing experimental models for field use.

Today's Shigometer, now in production at Northeast Electronics, uses a pulsed current to measure the electrical resistance of a segment of wood. Decayed wood - wood that has been invaded by bacteria and fungi - shows much less resistance to the current than sound wood.

The reasons for this can be traced to the succession of events that lead to decay and the accompanying changes in the composition of the wood. Microorganisms - bacteria and fungi - enter a living tree through wounds caused by any disturbance of the tree's outer protective layer of bark. Branches broken in the wind, insect bore holes, a scrape left by a car fender - all are potential breeding spots for microorganisms. Wood that is already dead, such as a utility pole, is open to decay at any time under the right conditions of temperature, moisture and state of preservation.

As decay progresses, a number of changes take place; most notable chemically are an increase in moisture and mineral content. At the atomic level, this amounts to a greater concentration of cations, which are highly mobile, positively charged particles or groups of particles and excellent conductors of electricity. The Shigometer is sensitive to any amount of ionization, so that it can detect both incipient and advanced decay and discoloration.



Left, a drill hole prepares the way for the Shigometer probe; center, the Shigometer kit: portable drill, drill bit, probe and meter; right, close-up of the twisted wire probe.

How do you find out what's happening inside a tree? Why, with a Shigometer, of course.

A Shigometer? If the term leaves you puzzled, it wouldn't be unusual since, as yet, what a Shigometer is and does is not common knowledge.

In spite of its modest public image the Shigometer is emerging as a unique and practical instrument. To the industries and groups involved in timber growth and utilization, its signfcance could be enormous.

The Shigometer is a device that detects decay in living trees and utility poles. Too often decay becomes evident only after it results in external damage. With the Shigometer, decay can be pinpointed in its earlier stages, saving the time, expense and frequent failure involved in more extensive late treatment, or the damage that results from no treatment at all.

We've all seen cracked or split utility poles along the highway, and felt fear in driving by. Hidden decay poses a threat to maintenance workers or repairmen who regularly climb utility poles. That tree in your yard that looks in perfect health....inside it may be rotted, making the tree more susceptible to damage. The Shigometer could help to eliminate such hazards. It could also help to save labor and waste in wood products industries.

The Shigometer, once called a "Wood Tissue Integrity Meter", is the result of seven years of collaboration by a number of professionals in fields ranging from botany to electrical engineering. It takes its name from one of its originators, Dr. Alex Shigo, plant pathologist with the Forest Service's Northeastern Forest Experiment Station at Durham, N. H. The probe for the meter was developed by Dr. Shigo's father, Alex Shigo, a craftsman from West Mifflin, Pa.

From the beginning, the project has depended on cooperation between the Forest Service, the University of New Hampshire and Northeast Electronics, Concord, N. H., a subsidiary of Northern Telecom, Inc., Boston, Mass. Dr. Richard Skutt, Ronald Lessard and Dr. Terry Tattar, all present or one-time associates UNH, contributed to early theory and construction of the meter, which was miniaturized by UNH graduate student Arun Taneja. Northeast Electronics Vice President Harold Wochholz and Project Engineer Thomas Dors played key parts in developing experimental models for field use.

Today's Shigometer, now in production at Northeast Electronics, uses a pulsed current to measure the electrical resistance of a segment of wood. Decayed wood - wood that has been invaded by bacteria and fungi - shows much less resistance to the current than sound wood.

The reasons for this can be traced to the succession of events that lead to decay and the accompanying changes in the composition of the wood. Microorganisms - bacteria and fungi - enter a living tree through wounds caused by any disturbance of the tree's outer protective layer of bark. Branches broken in the wind, insect bore holes, a scrape left by a car fender - all are potential breeding spots for microorganisms. Wood that is already dead, such as a utility pole, is open to decay at any time under the right conditions of temperature, moisture and state of preservation.

As decay progresses, a number of changes take place; most notable chemically are an increase in moisture and mineral content. At the atomic level, this amounts to a greater concentration of cations, which are highly mobile, positively charged particles or groups of particles and excellent conductors of electricity. The Shigometer is sensitive to any amount of ionization, so that it can detect both incipient and advanced decay and discoloration.

This is not the first time that such equipment has been developed. It is, however, the most successful attempt. The Shigometer manages to be simultaneously inexpensive, durable, portable, accurate and easy to operate.

How does it operate? The principle is simple, and revolves, again, around the cations that concentrate in decayed wood and the decreased resistance that results. To measure these changes, a probe of two twisted copper wires is inserted into holes drilled in the tree. The probe, attached to the Shigometer by a length of flexible cable, is entirely insulated except for the tips, which are curved into a bell shape. When the exposed probe tips enter the drill hole their sides press against the walls of the hole, so that the pulsed current is passed from meter, through one wire, into decayed - or healthy - wood. The current then returns to the meter through the other wire. Readings are made on 1000-ohm scales on the meter.

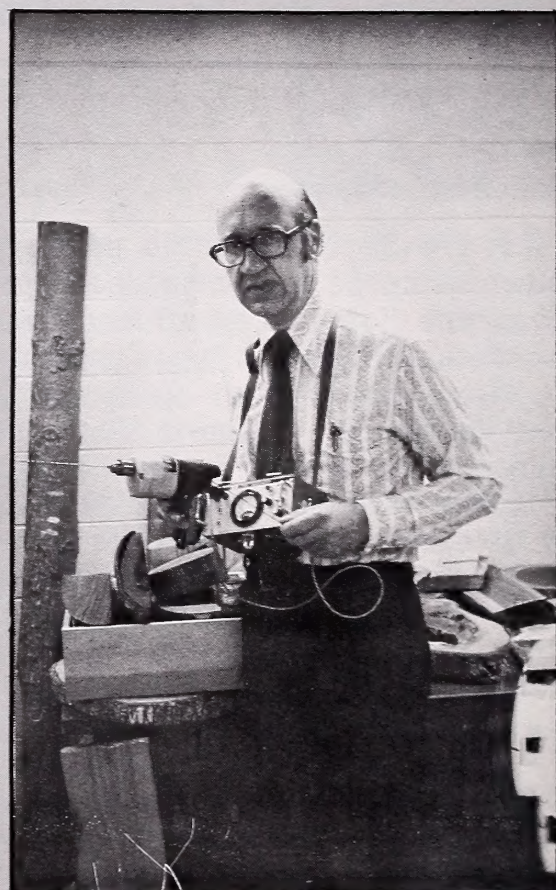
A forester operating the instrument will push the probe slowly into the hole. If the needle on the meter begins to drop abruptly, indicating a drop in resistance, he will retract the probe slightly and insert it again slowly to verify what he has just observed. Another check is made to determine the exact depth at which the abrupt change occurs. The probes are of two standard lengths, 20 and 30 centimeters long.

In measuring resistance, no absolute values were used, but patterns of resistance were recorded for each species and condition of work. For example, in red maple sound sapwood gave reading in the 200-500 K ohm range (K=1000). When the probe touched discolored wood, resistance dropped to 15-80 k ohms. Decayed wood showed as little as one K ohms of resistance. In the hollow center of the tree, readings again jumped to 500 or more. The researchers found that differences between sound and unsound wood were greater in living trees than in utility poles.

As for absolute values, scientists found some indications in the cambial tissues of a relationship between low resistance and high tree vigor, and higher resistance and low tree vigor. A major aim of many of the other tests was to find a way to predetermine from meter readings the quality of boards sawn from logs or standing trees. In general, a positive relationship seemed to exist between low resistance and low quality.

Weather conditions seem to have little or no effect on the meter's performance. Tests conducted in freezing weather were uniformly accurate, except when the wood itself was frozen, which was seldom more than 5 cm. into the tree. An excess of resin or moisture in wood tissues was also an obstacle to accuracy.

The Shigometer is being tested by 10 scientists in the United State and by scientists in Germany. New applications could possibly result, but according to past research, the Shigometer already has a promising future.



Dr. Alex Shigo, co-originator of this new forestry tool, demonstrates the ease with which the Shigometer can be carried into the field and operated.

Mention of companies in no way signifies Forest Service endorsement.