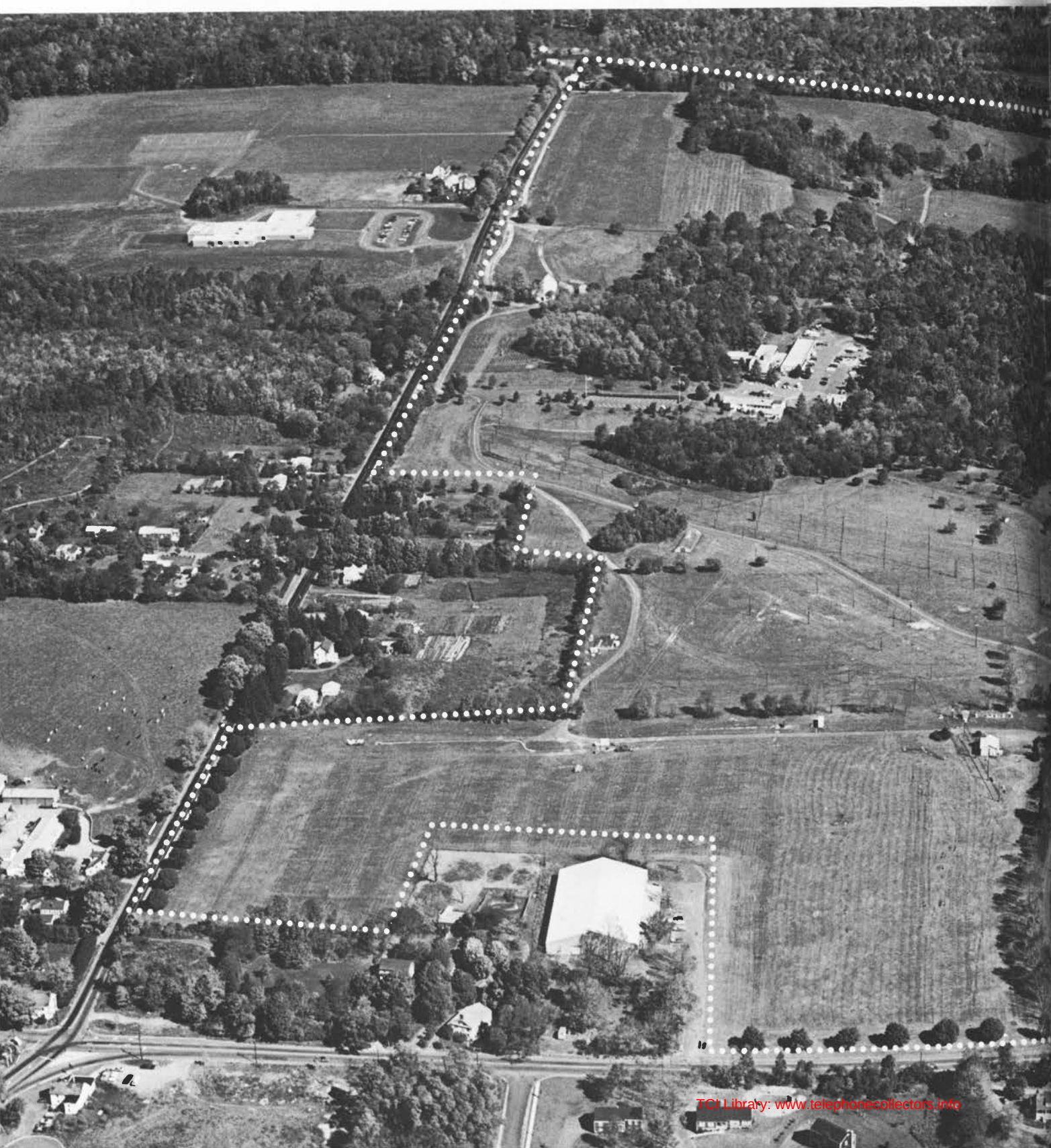
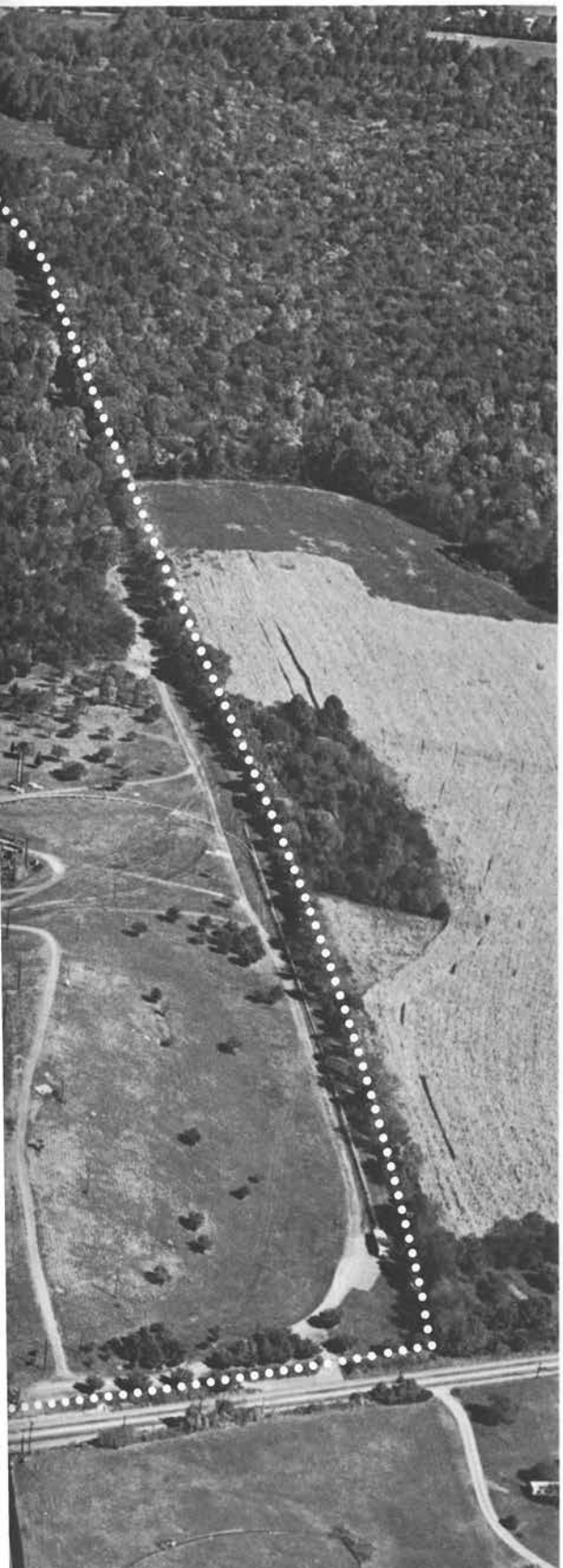
The Chester Laboratory



the 1970s

The open-air laboratory at Chester, N.J., is geared for practical analysis of telephone equipment prior to Bell System introduction. Installation, operating, and maintenance procedures can be evaluated under realistic field conditions.



ROBERT W. BLACKMORE

IN THE 1920S, when most telephone lines were aerial, wind and exposure to the elements were serious problems. So that the effects of the environment on outside plant could be studied, Bell Labs established a 13-acre field station on a windy, barren, and rocky hill in the Borough of Chester about 10 miles west of historic Morristown, New Jersey. The summit of this hill is 957 feet above sea level and affords a spectacular view of the Manhattan skyline some 36 miles to the east.

By the 1950s, the range of activities had expanded to include development of outside plant equipment, materials, and construction methods. The Chester field station was designated a separate laboratory. By 1960 additional property acquired had brought the total area to 210 acres—including swamps, ponds, spring-fed streams, rocky and wooded slopes, and 100 acres of open fields. With such a wide range of topography, prototype construction operations well over a mile in length can be conducted on most types of terrain likely to be encountered in the field. Trenches can be dug, roads torn up or tunneled under, sidewalk sections laid in fields, and telephone poles erected.

Today, an administration building and several other structures scattered over the property provide 45,200 square feet of office, laboratory, and shop space. Facilities include a high-voltage laboratory, a continuously recording weather station, environmental testing chambers, a fire-protection technology laboratory, well equipped machine and fabricating shops, and a fleet of vehicles and construction equipment.

The craftspeople and technicians in the

Topography. The 210-acre Chester Laboratory contains swamps, ponds, spring-fed streams, woods, and fields, as well as administration and laboratory buildings.

Chester Operations Group offer assistance to both resident and visiting technical personnel. Many of the visiting technical people are based at other Bell Labs locations but spend variable amounts of time at Chester, ranging from several days per year to several days per week. Resident personnel grew from three in the early '30s to over 80 in the late '60s, when ocean cable protection and the exploratory development of construction equipment were at peak activity. The number of resident personnel is currently about 50.

For all its isolation, Chester is close to the three major Bell Labs New Jersey locations. It is only a 30-minute drive from Whippany or Murray Hill and about one hour from Holmdel. The new AT&T and Long Lines locations at Basking Ridge and Bedminster are even closer, being well within a 20-minute driving range.

Activities, past and present

The Chester Laboratory has been the site of a diversified selection of technical projects which have not always been restricted to outside plant development. Two projects have left prominent features on the Chester landscape. The older of the two is the three-quarter-acre "pole farm," which dates back to early involvement in wood preservation technology. Now a Western Electric responsilbility, the installation is maintained by its Purchased Products Engineering Organization as a test site for wood preservatives. A second landmark is the dry-land cable ship "Fantastic," a giant steel structure resembling a roller coaster, originally constructed to permit evaluation of the cable and repeater handling and stowage facilities designed for the Cable Ship *Long Lines*, launched in 1963. This structure is now being used to check out the effects of cable ship handling routines on new lightweight repeater-multiplexer housings for ocean cable.

Other recent activities at Chester include the construction of a full-scale mockup for determining Sea Plow IV dynamic cable forces and an extensive field evaluation of the installation, maintenance, and repair procedures proposed for the WT4 millimeter waveguide system (see *Test Installation of Millimeter Waveguide*, RECORD, May 1974). In March 1975, Chester was the scene of a fire test of portions of a cable vault and main distributing frame.

A list of organizations participating recently in activities at the Chester Laboratory includes those responsible for telephone equipment building planning, telephone building engineering, millimeter wave systems, undersea cable and apparatus, and ocean systems. However, by far the greatest number of activities are in support of the Loop Transmission Division. They include effort in electromagnetic interference, electrical protection, below-ground installation of distribution apparatus, transmission media, and loop maintenance. A representative effort is in the distribution apparatus area and involves the new Rural Area Interface (RAI).

Rural Area Interface evaluation

The Rural Area Interface (RAI) is a terminal recently developed for a new planning concept known as RAND—Rural Area Network Design. This design, scheduled to be introduced into the Bell System this year, will reduce the operations, maintenance, and administrative costs of rural telephone service. The RAND concept depends on the RAI terminal to connect feeder cables from the central office to distribution cables for rural customers.

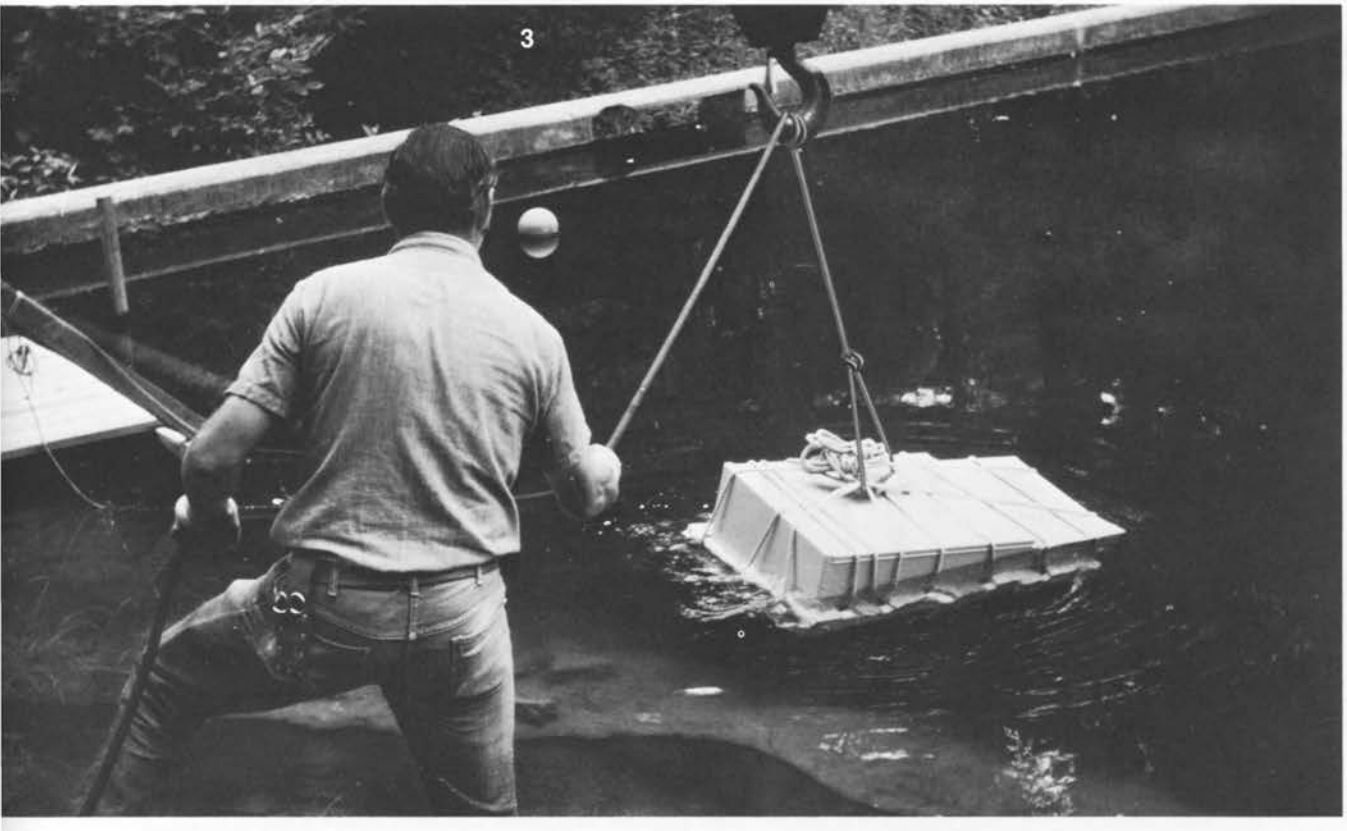
The RAI units are 3-foot-high metal cabinets that can be mounted outdoors along the rural route either on telephone poles or on concrete ground pads. The design is intended to make installation, termination, and maintenance faster and easier and to simplify loop record-keeping and administration.

The RAI hardware was subjected to a comprehensive evaluation at the Chester Laboratory in 1975. This evaluation differed from previous ones in at least two important respects. First, it covered all aspects of the product from the adequacy of shipping labels and packaging techniques, through all phases of installation, use, potential abuse, maintenance, and trouble shooting. Second, to provide a high degree of objectivity, the BTL design group responsible for the RAI hardware did not participate in the evaluation in any way.

Craftspeople from New Jersey Bell performed the normal activities while Chester Outside Plant Mechanics performed the stress tests. Six RAI units, five pad-mounted and one aerial, were utilized in the test program. They had been sent from the Western Electric manufacturing plant at Omaha, Nebraska through normal shipping channels.

The preconstruction evaluation was concerned mainly with the condition of the RAI unit as it might be received by the telephone

Stress. The Rural Area Interface (RAI) terminal for rural telephone networks was subjected to many grueling tests at Chester, among them: (1) simulated brush fire, (2) simulated wind-blown dust, (3) immersion in a pond to simulate severe water exposure. Tests such as these help to assure the designers that the equipment will withstand severe field conditions, and indicate where improvement may be needed.



line construction crew. It began with an examination of the package exterior for adequate identification and shipping information and for any evidence of damage in shipping and handling. Then the package interior was inspected for condition and completeness of contents, the presence of special tools and instruction sheets, a logical packing arrangement, and conformance of the unit to the latest drawings.

The stress phase involved subjecting the unopened package to rough handling shocks coupled with a simulated exposure to rain. The package was dropped on pavement from the height of a truck tailgate, rolled end-over-end across the pavement, and thoroughly soaked with a garden hose. After additional handling, the package exterior was inspected for legibility of external markings and the contents were examined for damage.

Evaluation

The construction evaluation was concerned with how well the RAI unit lends itself to construction activity. The fit of doors and piece parts, the operation of handles and latches, the adequacy of working room, the performance of special tools, and the existence of potentially injurious sharp edges or corners were all noted. Craftspeople installed pad-mounted and aerial units relying solely on the accompanying instructions. They prepared, formed, and terminated the feeder and distribution cables associated with the unit. They terminated cables on the 88-type connecting block of the units by hand seating as well as with the aid of tools.

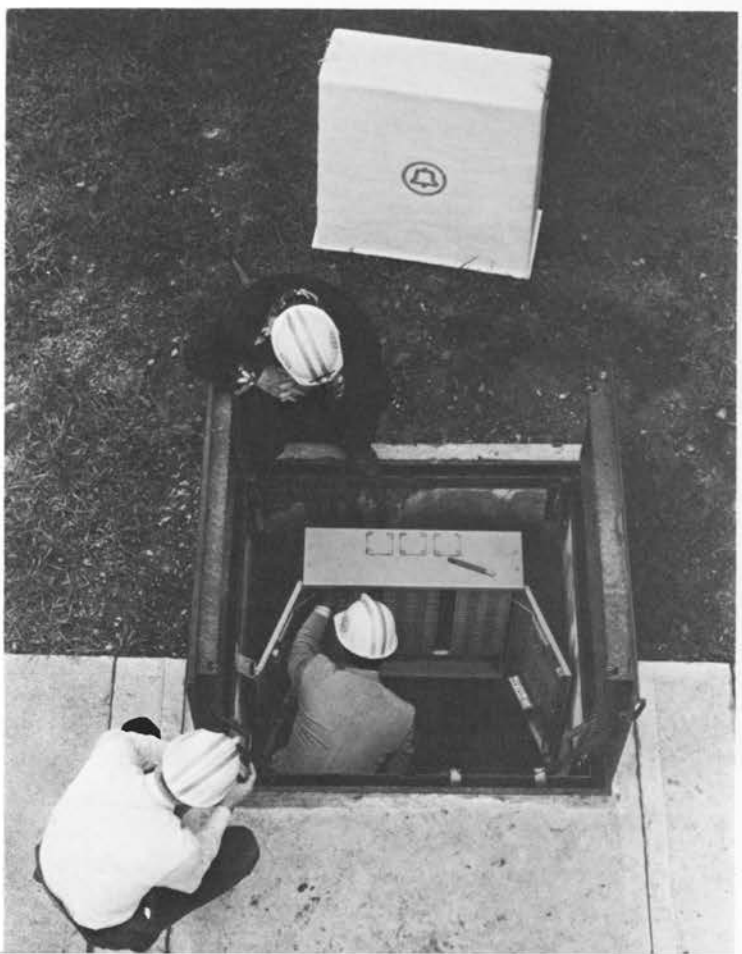
The stress phase of the construction evaluation included forcing cabinet entry with a screwdriver, and using excessive seating force on the 88-type connector blocks both at normal ambient temperature and at 30°F as well. To evaluate the corrosion and insulation-resistance problems that would be caused by a severe water exposure, one partially terminated unit was submerged in a pond for 72 hours and then left outdoors for three weeks with the doors open. Paint adhesion and insulation-resistance tests were made following this severe exposure.

For the service evaluation, New Jersey Bell Telephone installers handled 30 simulated service orders calling for bridging between feeder terminals and distribution terminals in RAI units. With a view to making the job faster, easier, and more accurate, Bell Labs engineers checked for compliance to written instructions, the adequacy of the techniques employed by the installers, and the number of potential faults introduced. They also observed the ability of the installers to detect troubles they had inadvertently introduced and evaluated their attempts to clear them.

The operational evaluation included investigations of weather-induced environmental effects, of the effects that are unique to the rural environment, and of the effects of concentrated (or accelerated) craft activity at the RAI unit. The effects of wind-driven rain and dust were simulated on open and closed cabinets with water and air hoses. These exposures were followed by tests of the insulation resistance and dielectric strength of the working circuits. Rural-environment exposures included subjecting the cabinet to pick and shovel blows, a simulated brush fire, and shots fired from a rifle and shotgun at various ranges (such things do occur). The stability of the unit on its base was evaluated by means of graduated impacts from a suspended 100-pound sandbag swung in a vertical arc.

Craft activity

The accelerated craft activity was simulated by repeated slamming of the cabinet doors and dropping of the splice rack against



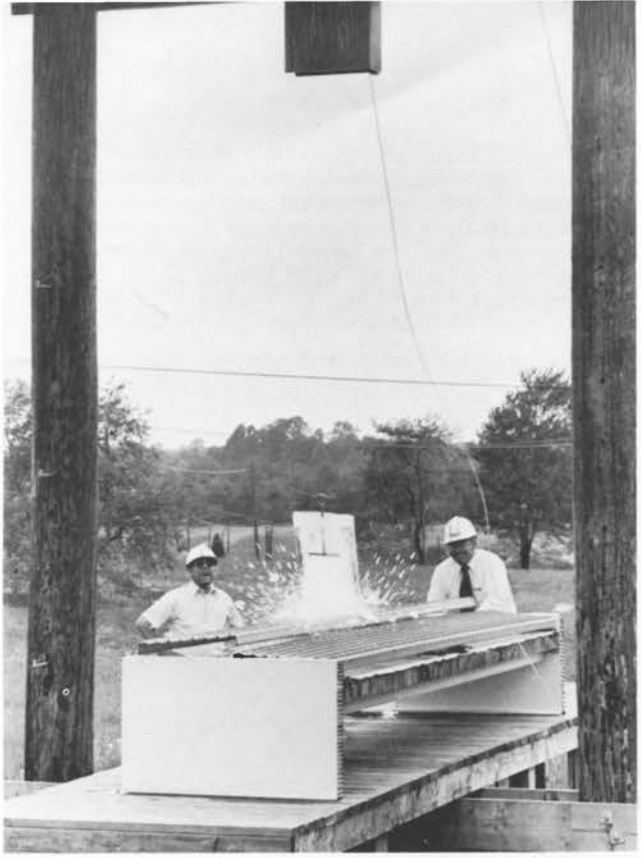
Out of sight. Visitors to Chester from Southern New England Telephone Company check a prototype "out-of-sight" interface (distribution apparatus) to evaluate working conditions and accessibility, prior to a field trial in Connecticut.

See-through. Chester people evaluate the performance of a "duct motor," a device that pulls a rodding line through a duct, the first step in installing cable in the duct. (1) Dave Gibson inserts the duct motor from a manhole. (2) Frank Fentzlaff (left) and Gibson observe the progress of the motor through a transparent duct.

its stops. Extensive cutover operations were performed, with tools and techniques intentionally used the wrong way.

To evaluate RAI maintenance procedures, New Jersey Bell installers performed troubleshooting and repairs. Troubles were "seeded" into a model loop consisting of two RAI units and a simulated central office. The effectiveness of the craftspeople in diagnosing, isolating, and correcting these artificially introduced troubles was observed and recorded. Interestingly, a trouble that was not intentionally introduced was discovered—the shorting out of a test cord in high humidity.

When the test program was finished, the test committee reassembled to consider their observations, those of other Bell Labs engineers who monitored the test, and the comments of the New Jersey Bell craftspeople on the RAI hardware they had installed, operated, diagnosed, and repaired. Problems were identified by the committee and they were then re-



Falling ice. A block of ice falls 50 feet onto a prototype roof shield, as Vinnie Di Lullo (left) and Don Graupner conduct a test to evaluate the shield's effectiveness in protecting repeater huts from ice falling from microwave antenna structures.

ferred to the appropriate design organization for correction.

Future Chester activity

A sampling of activities scheduled for the immediate future at Chester indicates a continuing concern for Bell System problems in many areas:

- In the Telephone Buildings and Equipment area, evaluations will be conducted on bracing systems designed to bolster telephone equipment frames against earthquake shocks. Full-scale sections of roof systems and shields developed to protect microwave repeater huts from ice accumulations falling from antenna structures will also be tested.
- New designs for undersea cables and associated couplings will be subjected to tensile loading typical of cable laying operations.
- The recently enlarged high-voltage facility will be used to evaluate the electrical safety and protection aspects of all types of telephone apparatus and equipment, ranging from that in the central office to that on customers' premises.

Focusing more specifically on loop plant activity, which comprises roughly half of all Chester effort, extensive programs are planned for the loop distribution apparatus area. Approval test programs similar to the one conducted for the RAI hardware are contemplated for other types of distribution apparatus. The loop plant construction and installation area will evaluate cable lubrication systems, and will investigate cable-placing dynamics, utilizing some of the many duct systems available at Chester. Studies will continue on ways of improving the underground plant environment, making use of manholes, handholes, and cable entrance facilities installed at Chester in a wide variety of soil conditions.

The Transmission Media Laboratory has an ongoing program of subjecting new and modified designs of cable and cable sheath to the rigors of plowing and duct-pulling routines. The Loop Maintenance System Laboratory will follow up its studies of gasoline contamination of the underground cable plant with an investigation of methods used to detect steam damage.

One basic trend is certain: there will be increasing emphasis on improving the reliability of the outside plant portion of the telephone system, since outside plant problems represent a significant expense in providing telephone service. More activity will be directed toward cost reduction in other aspects of the outside plant operation, and toward improved safety in all phases of system operation. And finally, it is certain that any area as labor-intensive as outside plant will see an increasing emphasis on human factors engineering considerations. The manner in which the Rural Area Interface approval test program was conducted exemplifies this shift of focus at Chester. □