Many of the day-to-day activities carried on at the Chester field laboratory are a reflection of the basic needs of the telephone industry.

Chester

The Outside Plant in Field Laboratory Form

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THE NETWORK OF CABLE AND WIRE which interconnects the central offices and the customers' telephone sets in the Bell System, together with supporting hardware, terminals, manholes and other equipment, is known as the outside telephone plant. These cables and wires—carried on pole lines, buried directly in the earth, or pulled into underground conduit "subways"—total about 360 million conductor-miles.

Assembly and interconnection of the component parts of this network on the site of their final location, and the fact that this construction is essentially all out-of-doors, constitute the major difference between outside plant and its companion components, station apparatus and central office equipment. Telephone sets and racks of transmission and switching equipment are, broadly speaking, produced on factory assembly lines and then installed, either in central offices or on the customers' premises. The outside plant utilizes factory built components, but these are trucked to the outdoor work site (which may cover a very large ground area), and there assembled by mobile crews of craftsmen using specialized tools and construction machinery.

A laboratory for the development of outside plant construction methods must afford a geographically typical, though miniature, sample of actual field conditions, in addition to providing the necessary office, indoor laboratory, and shop facilities. Above all, experimental outside plant construction needs space. The 212-acre field laboratory at Chester, New Jersey (about 50 miles west of New York City) satisfies the basic requirements, and it has become the center of the construction methods and equipment activities of Bell Laboratories' Outside Plant Laboratory as well as the home of important activities of the Submarine Cable Laboratory.

Much of this work is carried on by the Construction Methods Department, which works closely with the other seven departments of the Outside Plant Laboratory (three are at Baltimore, and four are headquartered at nearby Murray Hill). The goal of this cooperation is to ensure that the tools, materials, apparatus, and methods developed under the direction of the individual departments will present integrated and practical systems for construction and maintenance, before developments are released through the A.T.&T. Company to the Operating companies of the Bell System.

The Chester laboratory cannot, of course, duplicate every kind of terrain, climate, or construction situation encountered in territory served by the Bell System. But the available assortment of open fields, woods, rocky ground, and swamps provides a representative variety of environments, and the location is close to the headquarters of Bell Laboratories, the A.T.&T. Company, and the Western Electric Company.

Four Principal Technical Areas

At Chester, outside plant development work is carried on in four different technical areas. The first is that of construction methods. This area includes aerial and underground construction, the latter encompassing the current work on new materials and methods for conduit and conduit joining, and the fabrication of precast segmented manholes.

A second area involves the development of construction equipment such as cable plows, earth augers, boring devices, and similar machinery for the direct burial of cable.

A third area covers the development of automotive items. This work falls into two broad categories. One is the development of compartments and interior structures for the compact van-type vehicles now so widely used for cable splicing and installation. The other is the development of heavy duty power driven machinery carried by the Bell System's automotive construction fleet.

Finally, there is the exploratory work in the new soil mechanics laboratory. This work is aimed at determination of the parameters of various soils, and exploration of methods of cutting and penetrating soils which take advantage of new knowledge.

Chester enjoys many of the benefits of a full-fledged Bell Laboratories Branch Laboratory from the standpoint of staff assistance. There are secretarial, clerical, shop, and plant operations people who maintain the buildings and the 212 acres of fields and woodland, and who supply the general services essential to the successful operation of a remote location.

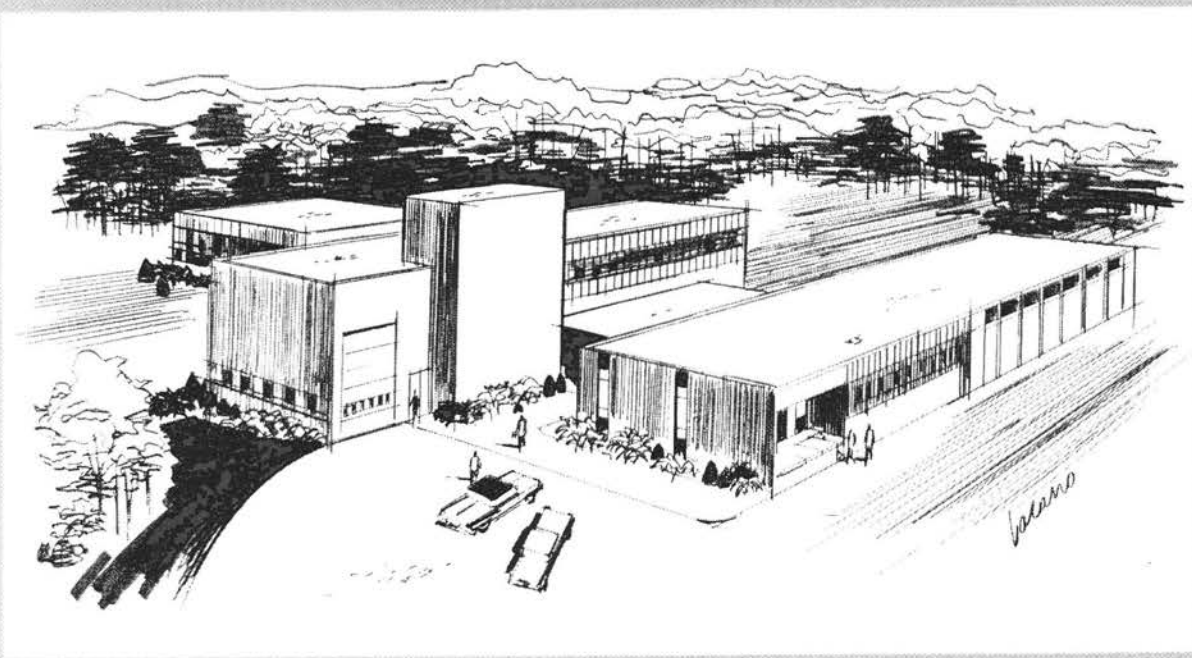
The interior compartmentation of Bell System trucks is designed and tested at Chester. A small space must be utilized as efficiently and conveniently as possible.

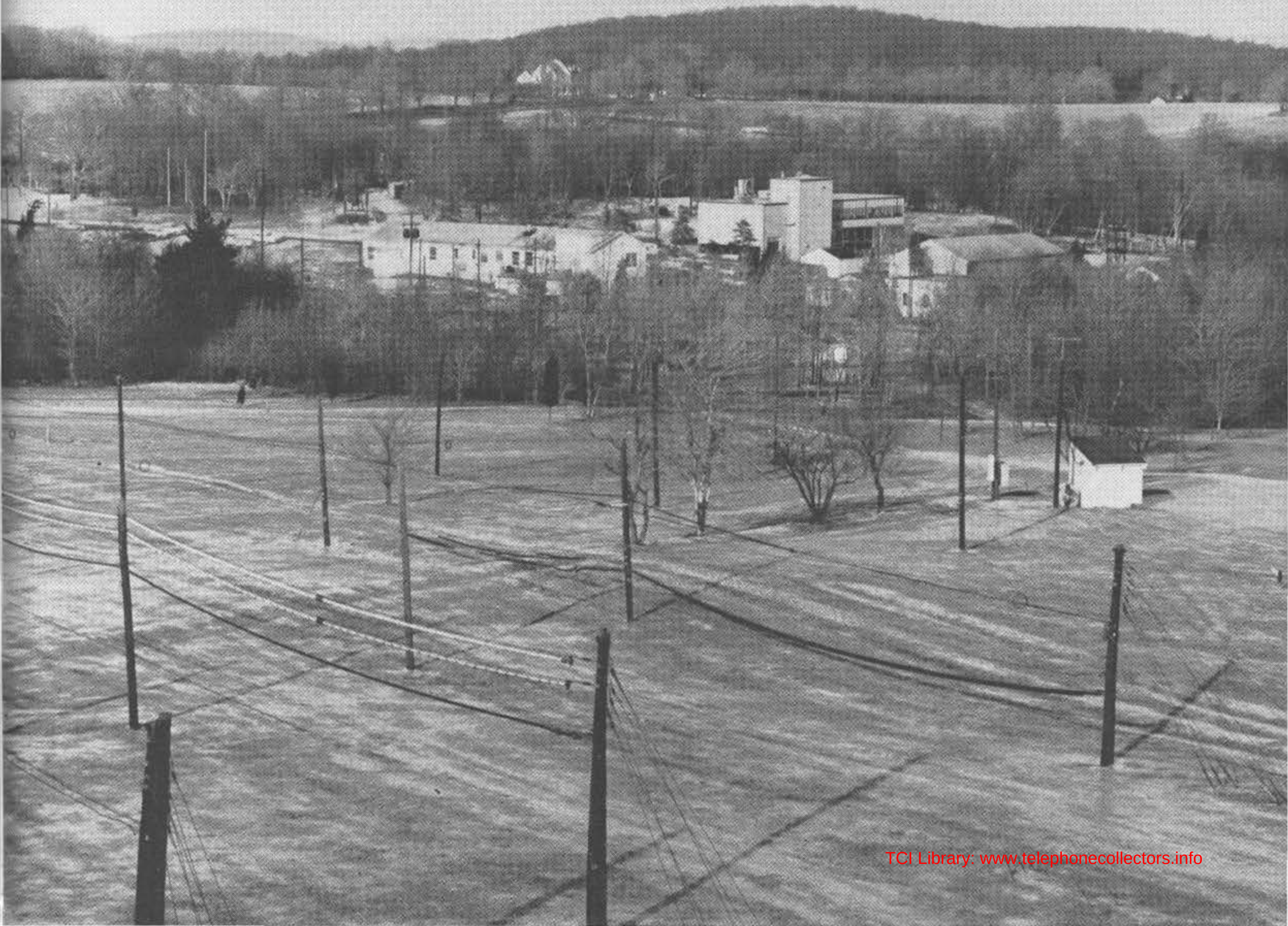
Self-Supporting Cable

An excellent recent example of the merits of collaborative interdepartmental effort in a well-equipped and well-staffed field laboratory is the case of the new self-supporting aerial cable (RECORD, *October* 1964). Self-supporting cable of the figure 8 design combines in a single manufactured structure the communications conductors of ordinary cable and the supporting steel strand required for pole line installation. This new structure has great potential in the direction of the ever-present goal in aerial construction—getting the cable in place on the pole line at lower cost. But the potential can be realized only by bringing the new tools, hardware, and related equipment, as well as the sequence of construction steps, together into an efficient and fully field-tested package.

The development of the self-supporting cable itself was done by the Outside Plant Laboratory group stationed at the Western Electric works at Kearny, New Jersey; the hardware and tool development activity was at Murray Hill; and new designs of cable terminals were initiated at the Baltimore Laboratory. The construction methods for installing the cable were devised at Chester. Finally, the separate but closely coordinated efforts of these various segments of the Outside

A cluster of buildings on the Chester property contains the necessary offices and indoor laboratory and shop facilities. An artist's rendering of the main building, as it will look when the current construction is complete, is shown in the inset.





Plant Laboratory were checked out by full scale experimental installations at the Chester laboratory, where the skills of the craftsmen and the tools and devices for performing aerial cable placement operations are fully representative of the conditions met in the field.

Precast Manholes

The precasting of concrete structures and delivery of them to installation sites remote from the point of fabrication is by no means new. But the proposal to insert a manhole fabricated in precast segments around an existing cable was quite a departure from normal practice. Some 60 of these precast segmented manholes will be installed at newly selected repeater points in the Rudolph-Dayton (Ohio) section of an existing L1-carrier coaxial cable system, part of which is scheduled to be converted to trial L4 system operation this year.

Here again the capability of doing experimentally the construction which would be required in the field was the "proof-of-the-pudding" essential to customer acceptance. The engineers and craftsmen at Chester had to do far more than design and fabricate the precast sections for assembly into a complete manhole. They had to prove it feasible and safe to backhoe an excavation of suitable size around a cable already buried or in underground conduit, to lower the manhole segments with a crane, to effectively surround the cable with a complete structure, and then seal the segments to produce a completely waterproof enclosure. This was obviously no job for an indoor laboratory bench. The practicability of this construction technique was convincing to the Long Lines engineers concerned only when the coordinated efforts of men and machines were demonstrated in a typical full-scale operation.

Cable in the Earth

The Operating companies of the Bell System are moving steadily in the direction of direct burial of customer telephone cable and wire plant. Burial of cable and wire is accomplished by either trenching or plowing. The former involves the actual removal of the earth by power-driven chain and bucket devices; the cable or wire can be placed in the trench simultaneously or later, and the removed fill is then replaced. Plowing, on the other hand, means a slot is cut in the soil to the desired depth by a plow share pulled through the earth. The cable or wire to be buried is threaded through the share and laid in the freshly-opened furrow. The disturbed surface is then smoothed down by other means. No major restoration of a removed fill is involved. Because of its much greater speed, plowing is preferred to trenching where construction conditions permit.

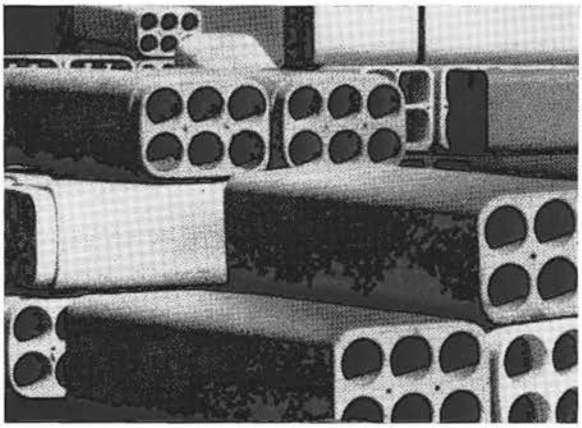
The importance of the drive toward underground and buried wire and cable plant was a major factor in the decision to build a Soil Mechanics Laboratory at Chester. This broad soil mechanics program envisages more sophisticated and economical machinery and construction methods for placing communications facilities in the earth.

Other Operations at Chester

Aside from the four major technical areas, many and diverse projects are carried forward at the Chester laboratory. For example, it furnishes the environment for much of the long-time weathering and outdoor exposure testing so necessary to materials studies. The pole farm, familiar to motorists in the Chester area, is an example of such work. The Chester laboratory first came into being because environmental problems which did not readily lend themselves to solution in an indoor laboratory appeared in the outside plant field many years ago. Environmental exposure is still an important reason for the existence of this outdoor laboratory.

The Submarine Cable Laboratory has three major experimental installations at Chester. The best known of these is the dry land cable ship, the *C.S. Fantastic* (RECORD, *May* 1963). The *Fantastic* was the experimental predecessor of the cable ship, *C.S. Long Lines,* which was launched early in 1963. The second, not so well publicized, is an underground ocean aging laboratory which duplicates the temperature and pressure conditions prevailing at ocean cable depths. This was recently modified to make possible the long time aging evaluation of the newer one-and-a-half inch submarine cable. The ocean cable burier is the third experimental installation. Research in this area is aimed at determining the feasibility of burying submarine cable in the ocean floor rather than simply laying it on the bottom.

The Chester laboratory currently is undergoing a $250,000 face lifting. A new office wing and new laboratory and shop areas are being added to the existing main building, which will then house under one roof the facilities now scattered among older and less efficient separate buildings erected at intervals since 1928. The result of this expansion will be a field laboratory even better equipped to achieve its major mission, the final proof testing, as systems, of the tools, apparatus, equipments, construction machinery, and construction methods developed for the Operating companies of the Bell System.



Cable plows, developed and tested at Chester, are used to bury cable, threaded through the share, directly in a furrow cut in the earth. Underground construction requires pulling cable through joined sections of conduit like those shown at the right.