then the cost and efficiency of manufacture are uneconomical. It is obviously impracticable to give to all of some two million transmitters a year a complete transmission laboratory investigation. A method of spot testing and checking must, therefore, be employed and a small part of the manufactured product intensively studied. What, however, are the relations between the part of the product so studied and the total part manufactured is a question of the mathematical theory of probabilities analogous to but as complicated as the problems met by life insurance actuaries. Fundamental studies of a theoretical character and careful and exhaustive analyses of large volumes of data are required in the consideration of these and related problems.

For a single example of the multiplicity of problems attacked by the research group consider the thermionic problem of the emission of electrons from a filament such as is utilized in a vacuum tube. In our modern theories the physical constants of filament materials are indications of the possible behaviors of the infinitesimal electrons of which the materials are composed. Such a study, therefore, as that of determining the relation between the total thermal emissive power of a metal and its electronic resistivity is one which is broadly fundamental to our Bell System applications of thermionics. The relation of such investigations to telephonic application are sometimes indirect and the investigations may serve merely to fill out a gap in existing scientific knowledge, on which broad knowledge, however, future developments must be based.

Of the work of the system group each development must fit with practical economy into the present highly coordinated telephone plant as well as anticipate the plant of the future. Manual and machine switching systems, local and long distance systems, circuits, power supply, and equipment, all present closely related or interdependent problems. Any development may later