

Abstracts of Technical Articles from Bell System Sources

*Electron Microscope Studies of Thoriated Tungsten.*¹ ARTHUR J. AHEARN and JOSEPH A. BECKER. Many past experiments have shown that the thermionic activity of a thoriated tungsten filament is determined by the concentration of thorium on its surface. This concentration is in turn determined by the rate of arrival and rate of evaporation of thorium. Typical published values of these rates are given in Fig. 1. An electron microscope used to obtain electron images of thoriated tungsten ribbons is described. Comparison with photomicrographs shows that the active and inactive patches composing an electron image agree in size, shape and number with the exposed grains of the tungsten. The electron microscope shows that thorium comes to the surface in "eruptions" at a relatively small number of randomly located points. From a comparison of photomicrographs showing thoria globules and electron images of thorium eruptions, it is deduced that *all the thorium in a globule comes to the surface when an eruption occurs*. Factors such as a high temperature flash and sudden heating and cooling of the filament affect the frequency of eruptions. Thorium eruptions are the only observed manner in which thorium arrives at the filament surface. They are repeatedly observed in the early stages of thoriation. Eruptions are not observed in the later stages of thoriation where conditions are unfavorable for their observance. Electron images of a Pintsch single crystal filament reveal alternate active and inactive bands parallel to the filament axis. Thorium eruptions occur only on the active bands. With a polycrystalline ribbon the surface migration of thorium from the eruption centers is isotropic; *with a single crystal ribbon there is a strongly preferred direction of migration*. X-ray analysis shows that the surface is a (211) plane and that *the preferred direction of migration agrees with the (111) direction in this plane*. During the process of thoriating a filament the relative emissions from different grains change by substantial amounts; in many cases the change is so great that the relative emissions are reversed. Measurements of work function differences between grains gave values ranging up to 0.6 volt.

*The Mechanism of Hearing as Revealed through Experiment on the Masking Effect of Thermal Noise.*² HARVEY FLETCHER. In an electri-

¹ *Phys. Rev.*, September 15, 1938.

² *Proc. Nat'l. Acad. Sci.*, July 1938.

cal conductor there is a statistical variation of the electrical potential difference between its two ends which is due to the thermal agitation of the atoms, including the electrons. This electrical noise is amplified by means of a vacuum tube amplifier and then converted into an acoustical noise by means of a telephone receiver held on the ear. When this noise is present it reduces the capability of the ear to hear other sounds. The intensity per cycle of the acoustical noise compared to the intensity of a pure tone which can just be perceived in the presence of a noise was determined experimentally using a group of observers. This relative intensity for a given frequency range was constant throughout a wide variation of intensity. However, its value does vary with the position in the frequency spectrum and it is the amount of this variation which enables one to calculate the relation between the frequency of the tone and its position of maximum stimulation along the basilar membrane. The results of such a calculation are given and shown to be in good agreement with determinations from animal experimentation.

*Transcontinental Telephone Lines.*³ J. J. PILLIOD. A fourth transcontinental line has just been created by the completion of four pairs of open wire between Oklahoma City and Whitewater, California. This open-wire line connects at its eastern terminus with the already existing toll cables from the east, and at its western terminus with a toll cable running into Los Angeles.

In a cross-section of the United States just west of Denver, there are now 140 through telephone circuits and about the same number of telegraph circuits carried by four open-wire routes.

The four new pairs which constitute the transcontinental line carry, in addition to the usual voice frequency channels, three channels of carrier. But their design throughout has been such that twelve additional carrier circuits can be superimposed upon the four channels now provided by each wire pair.

The wires of each pair are spaced 8 inches apart with the nearest spacing between pairs being 26" while crossarms are 36" apart. New transposition systems have also been used to further reduce crosstalk.

*Application of Statistical Methods to Manufacturing Problems.*⁴ W. A. SHEWHART. The application of statistical methods in mass production makes possible the most efficient use of raw materials and manufacturing processes, effects economies in production, and makes possible the highest economic standards of quality for the manufactured goods used by all of us. The story of the application, however,

³ *Electrical Engineering*, October 1938.

⁴ *Jour. Franklin Institute*, August 1938.

is of much broader interest. The economic control of quality of manufactured goods is perhaps the simplest type of scientific control. Recent studies in this field throw light on such broad questions as: How far can Man go in controlling his physical environment? How does this depend upon the human factor of intelligence and how upon the element of chance?

*Observational Significance of Accuracy and Precision.*⁵ W. A. SHEWHART. Two of the most common terms used in pure and applied science are accuracy and precision. When such terms are used, as in the specification of quality of manufactured products, it is desirable that they have definite and, in so far as possible, experimentally verifiable meanings. It is, therefore, important to determine how far one can go towards attaining this end by applying with rigor the principle that *only that which is observable is significant*. In the application of the concepts of accuracy and precision, it is customarily assumed that the available data constitute a random sample. Hence, the first step in attaining experimentally verifiable meaning of these terms is to choose an operationally verifiable criterion of randomness. One such criterion is the quality control chart. In order to give experimental definiteness to any *measure* of either accuracy or precision derived from a random sample, it is also necessary to specify the way any statement involving the measure may be experimentally verified. To do this it is necessary to make at least four empirical choices as to the details of taking and analyzing the data in the process of verification. Hence, it appears that the meaning of either precision or accuracy is verifiable. Hence, it appears that the meaning of either precision or accuracy is verifiable only in a limited sense subject in any specific case to the choice of empirical criteria of verification.

*The Time Lag in Gas-Filled Photoelectric Cells.*⁶ A. M. SKELLETT. In commercial gas-filled photoelectric cells there is a lag in response which becomes appreciable above frequencies in the neighborhood of 10,000 cycles. If this lag is due to the transit times of the ions across the cell, it should be possible to set up resonance conditions by varying the frequency of modulation of the incident light intensity. This has been accomplished in a cell of special design and the resonance conditions agree with the theory, thereby demonstrating that the transit time of the ions is the simple cause. The paper also discusses the flow of the ions and electrons across the cell and their impacts in relation to the flow of current in the external circuit.

⁵ *Jour. Wash. Acad. Sciences*, August 15, 1938 (p. 381).

⁶ *Internat'l. Projectionist*, September 1938; *Jour. Applied Physics*, October 1938.