Abstracts of Bell System Technical Papers Not Appearing in this Journal

Direct Determination of Hydrocarbon in Raw Rubber, Gutta-Percha, and Related Substances.[1] A. R. KEMP. Iodochloride in glacial acetic acid is shown to be a suitable reagent to determine the unsaturation of the hydrocarbon in rubber or gutta-percha. The influence of time, temperature, sunlight, and reagent concentration upon the reaction is shown.

Comparisons are made between iodochloride, iodobromide and bromine relative to their reactions with raw rubber and some of the terpenes.

Results of analyses of several rubber and gutta-percha samples are given.

The effects of mastication and heat upon the unsaturation of raw rubber are shown.

Microtomic Preparation of Soft Metals for Microscopic Examination.[2] F. F. LUCAS. This paper outlines the apparent limitations of polishing methods for preparing specimens of soft metals for metallographic examination. A microtome method has been developed and its successful application to the study of lead cable sheath alloys illustrated. Much time and labor are saved and results have been obtained which were impossible by polishing methods.

In lead-antimony cable sheath alloys a widened grain boundary phenomenon was disclosed by the new method and the probable nature of the structural changes determined. Changes in structure due to aging are shown and those which accompany thermal or mechanical treatment of the metal may be followed clearly.

Distribution of Energy in Worked Metals.[3] LYALL ZICKRICK and R. S. DEAN. The purpose of this paper is to give experimental results that seem to be in accord with the theory, that in the deformation of a crystal the energy supplied is distributed to the atoms of the lattice, probably by the forced formation of molecules.

[1] *Journ. Ind. and Engr. Chem.*, Vol. 19, p. 531, 1927.
[2] Institute of Metals Division, A. I. M. E., February 15, 1927.
[3] *Wire*, Vol. 2, p. 161, 1927.

Modern Developments in Inspection Methods.[4] E. D. HALL. This extensively illustrated article describes inspection methods as carried out at the Hawthorne plant of the Western Electric Company. The number of individual piece parts manufactured is more than 100,000 and the number of inspection gauges employed totals more than 25,000. Machine testing and gauging for certain parts is described and cost savings resulting therefrom are given. One of the machines described tests a porcelain protector block containing a carbon insert. The machine is adjusted to accept blocks from which the recess distance of the carbon lies between 0.0024 and 0.0032 inch and to reject, when the distance is 0.0023 inch or less or 0.0033 inch or more. The machine performs its operation at the rate of 2,800 blocks per hour. It is used to test about 4,500,000 blocks per year and represents an annual saving of approximately $2,500.

A Direct Comparison of the Loudness of Pure Tones.[5] B. A. KINGSBURY. The loudness of eleven pure tones was studied by adjusting the voltage applied to a telephone receiver to make these tones as loud as certain fixed levels of a 700-cycle tone. The average results of 22 observers, 11 men and 11 women, were arranged as contour lines of equal loudness through the normal auditory sensation area in terms of r.m.s. pressure in car canal as a function of frequency. Frequencies from 60 to 4,000 cycles were used and intensities from threshold of audibility to 90 T. U. above the 700-cycle threshold. It was found that if the amplitudes of pure tones are increased in equal ratios the loudness of low frequency tones increases much more more rapidly than that of high frequency tones. For frequencies above 700 cycles the rate is nearly uniform.

As a loudness unit the least perceptible increment of loudness of a 1,000-cycle tone was employed. In absolute magnitude this varies from level to level, but in the ordinary range of loudness it becomes constant. This unit takes into account the subjective character of loudness.

The variability of the data from which the averages were computed was separated into a factor expressing dissimilarity of ears and another expressing errors of observers' judgment. There was no level at which the variances were a minimum. Dissimilarity of ears causes more variation than errors of observers' judgment. The variances showed no significant sex difference.

[4] *Mechanical Engineering*, Vol. 48, p. 1435, 1926.
[5] *Physical Review*, Vol. 29, p. 588, 1927.

The Scattering of Electrons by a Single Crystal of Nickel.[6] C. DAVISSON and L. H. GERMER. Preliminary announcement is made in this note of the discovery that a beam of swiftly moving electrons in its reaction with a single crystal of nickel behaves in some respects as if it were a beam of wave radiation such as light or x-rays. As the speed of the electron beam is increased a series of critical speeds is found at which sharply defined beams of scattered electrons issue from the crystal. This is similar to what is observed when a beam of monochromatic x-rays is sent into a crystal—as the wave-length of the x-rays is decreased a series of critical wave-lengths is found at which sharply defined beams of scattered x-rays issue from the crystal. This x-ray phenomenon is quantitatively accounted for as due to the interference of waves scattered by the regularly arranged atoms of the crystal. In fact, it was this phenomenon discovered by Laue, Friedrick and Knipping in 1913 that established the wave nature of x-radiation, and it is from measurements based on this phenomenon that the lengths of x-ray waves are determined.

The analogous electron phenomenon is less simple, and yet it is simple enough and of such a nature as to leave little doubt that a beam of swiftly moving electrons is in some sense equivalent to a beam of wave radiation. The wave-length of the equivalent radiation can be measured, and is found to be in satisfactory agreement with requirements of the new theory of wave or undulatory mechanics: namely, that the wave-length of the equivalent radiation shall be equal to h/mv, where h represents Planck's universal constant of action, and mv the momentum of an individual electron.

Structure of a Protective Coating of Iron Oxides.[7] RICHARD M. BOZORTH. It is shown that the Bower-Barff protective coating, produced by the action of steam on iron at about 700° with subsequent cooling in air, is built up of layers of ferrous oxide, magnetite and ferric oxide, arranged in this order (the order of oxidation) upon the iron base. The thicknesses of these layers are estimated to be of the order of 10^{-2}, 2×10^{-4} and 2×10^{-5} cm., respectively. The data on which the above conclusions are based are the positions and intensities of lines on powder photographs taken with molybdenum, iron and copper $K\alpha$ X-rays. The iron and copper $K\alpha$ X-rays penetrate the coating to different depths and give information about different parts of its structure because their wave-lengths are, respectively, a little greater and a little less than the critical-absorption wave-length of the iron which forms the greater part of the coating.

[6] *Nature, 119,* 558 (1927).
[7] *J. Amer. Chem. Soc.*, Vol. 49, pp. 969–976 (1927).