

## Abstracts of Technical Articles from Bell System Sources

*Protection Features for the Joint Use of Wood Poles.*<sup>1</sup> J. O'R. COLEMAN and A. H. SCHIRMER. The paper reviews the historical development of joint use and the general results to date of studies of protective problems of lower and higher voltage joint use. The safety features are reviewed from the standpoint of (1) subscribers' premises, (2) employees, and (3) telephone plant. Characteristics of equipment of power and telephone plant as far as they relate to this problem are given. The various factors which determine magnitude and duration of the current and voltage in the telephone plant resulting from a contact with power conductors are discussed. Improved methods for obtaining safety under various conditions, where higher voltage joint use is found to be the best over-all solution, are described.

*High-Speed Motion Picture Photography Applied to Design of Telephone Apparatus.*<sup>2</sup> W. HERRIOTT. High-speed motion pictures are employed at Bell Telephone Laboratories as a visual aid in the study of problems associated with the design, manufacture, and testing of telephone apparatus. A new high-speed camera of the optical compensator type operating at 4000 pictures per second is described, and its application to the study of problems associated with telephone apparatus is discussed.

*Mass Ratio of the Carbon Isotopes from the Spectrum of CN.*<sup>3</sup> F. A. JENKINS and DEAN E. WOOLDRIDGE. With a source containing carbon enriched about ten times in  $C^{13}$ , the violet CN bands have been photographed with a dispersion of 0.63A/mm. Measurements are given of the lines of low rotational quantum number in the 0,0, 0,1 and 0,2 bands of  $C^{13}N^{14}$ , as well as of  $C^{12}N^{14}$ . The vibrational constants of the normal states of both molecules are accurately determined, and give a value of the isotope mass coefficient  $\rho = \omega_e^i/\omega_e$  of  $0.97898 \pm 0.00002$ , corresponding to a mass for  $C^{13}$  of 13.0088. This is in essential agreement with the mass-spectrograph value, and it is shown that the finer corrections to the isotope effect are negligible in this case.

<sup>1</sup> *Elec. Engg.*, March 1938.

<sup>2</sup> *Jour. S. M. P. E.*, January 1938.

<sup>3</sup> *Phys. Rev.*, January 15, 1938.

*Composition and Structure of Hevea Latex.*<sup>4</sup> A. R. KEMP. Data and present views relating to the composition and structure of the latex particles are presented. The number of particles in one gram of 40 per cent latex was calculated to be  $7.4 \times 10^{12}$  on the basis that they have an average particle mass of  $0.054 \times 10^{-12}$  gram (from the microscopic data of F. F. Lucas, page 146).

A study was made of the effect of several factors on the water content of rubber in pressed coagulum from fresh and treated latices. The average value for the water of retention of rubber coagula from fresh latex was found to be about 11 per cent, increasing to about 22 per cent in the case of old latex and deproteinized rubber from alkali-treated latex. This water appears to be held mechanically in the colloid hydrocarbon structure of the latex particles.

The particle structure of sheet rubber is discussed and it is suggested that plasticization by milling involves the conversion of the gel hydrocarbon shell on the rubber particles to sol rubber through oxidation.

*Ultraviolet Microscopy of Hevea Rubber Latex.*<sup>5</sup> FRANCIS F. LUCAS. Samples of bulk rubber latex received in sealed cans from two sources have been investigated by means of the ultraviolet microscope. The advantages of the ultraviolet microscope are (a) an enormous increase in resolving power, (b) selective absorption of the ultraviolet light by many substances, and (c) the ability to section optically very small objects suited to the purpose.

Brief descriptions of the apparatus and technic are given. Artifacts have been minimized in the preparation of the slides. A multitude of particles bordering on colloidal dimensions have been clearly resolved. Particle size measurements, including complete tabular data and a particle size distribution curve for each specimen, are given. Approximately 90 per cent of the particles are 0.50 micron or less in diameter. The shape of the latex particle appears predominantly spherical, although elongated particles and irregular shaped particles are found. Optical sections in some cases show these to be groups of particles; two particles may coalesce to form one. Many of the smaller particles appear to lose their electrical charges and become attached to larger particles. Possible effects of ultraviolet radiation are discussed.

*Dielectric Losses in Polar Liquids and Solids.*<sup>6</sup> S. O. MORGAN. Dielectric loss is the energy dissipated as heat in a dielectric when it is in an electric field. Losses due to dipoles represent only one of a num-

<sup>4</sup> *Indus. and Engg. Chem.*, February 1938.

<sup>5</sup> *Indus. and Engg. Chem.*, February 1938.

<sup>6</sup> *Indus. and Engg. Chem.*, March 1938.

ber of possible means by which energy may be dissipated in a dielectric; there may be losses due to free ions and also due to dielectric polarizations other than dipole polarizations. However, in many materials dipoles are an important source of loss; it is the purpose of this paper to consider some of the typical cases of dipole loss and to point out some of the relations between chemical composition and dipole loss which follow from the recent experimental and theoretical study of dielectric behavior.

*Order-Disorder Transformations in Alloys.*<sup>7</sup> FOSTER C. NIX and WILLIAM SHOCKLEY. An extensive résumé of a subject which is becoming of increasing interest to physicists and metallurgists. The article divides into two parts, forty pages being devoted to the theories of the order-disorder phenomenon, and twenty pages to experimental studies of superstructures.

*Thyratrons for Grid-Controlled Rectifier Service.*<sup>8</sup> G. H. ROCKWOOD. It is common knowledge that the output voltage of a rectifier fluctuates with changes in load current and supply line voltage. Frequently these fluctuations are so large that means must be used to correct them. This is particularly true when the rectifier feeds a load having a high back electromotive force and a small resistance, such as a storage battery. The facility with which the output voltage may be controlled by the use of thyatrons as the rectifying element has encouraged the design of tubes especially suited to this purpose. There is available a variety of circuits such that the output voltage of a rectifier may be made to obey any desired law. The successful application of these circuits depends upon the degree of reliability of the thyatron tubes used in them. To be most successful the tubes must possess certain characteristics. This paper gives a brief review of the operation of grid-controlled rectifier circuits, discusses the requirements which such circuits impose on the tube characteristics, and describes a particular type of thyatron with mercury-plus-argon filling which has proved especially useful in such rectifiers.

*Progress in Non-ferrous Metals and Alloys During the Past Few Years.*<sup>9</sup> EARLE E. SCHUMACHER and ALEXANDER G. SOUDEN. The purpose of this review is to present the more important advances in the non-ferrous field during the past few years, the topics discussed being classified broadly as fundamental and practical. The former

<sup>7</sup> *Reviews of Modern Physics*, January 1938.

<sup>8</sup> *Trans. the Electrochemical Society*, Vol. LXXII, 1937, pp. 213-224.

<sup>9</sup> *Mining and Metallurgy—Institute of Metals Division*, January 1938.

includes those studies that have done most toward developing the basic science of metals and alloys, and the latter includes technical developments and applications.

*Theory of Order for the Copper Gold Alloy System.*<sup>10</sup> W. SHOCKLEY. The theory of order and disorder, in the form used by Bragg and Williams, is extended to arbitrary composition of the constituent elements. The work is based upon the nearest neighbor interaction assumption of Bethe and the connection between the Bethe and Bragg-Williams theory is shown. In order to extend the Bragg-Williams theory to compositions other than 25 and 50 atomic per cent, new definitions of order are developed. The results are presented in terms of phase diagrams and curves showing energy vs. temperature, specific heat vs. temperature and state order vs. temperature. These results are of importance in giving a general picture of the order-disorder transformation for a wide composition range. They are not in detailed accord with experiment due to the rather idealized picture underlying the nearest neighbor assumption.

*A Theory of Noise for Electron Multipliers.*<sup>11</sup> W. SHOCKLEY and J. R. PIERCE. The noise in secondary-emission electron multipliers is considered from a theoretical viewpoint. The noise properties of a stage are correlated with its secondary-emission properties: the mean value  $m$  and mean-square deviation  $\delta^2$  of the number of secondaries per primary. If  $\overline{I_{p\Delta f}^2}$  and  $\overline{I_{s\Delta f}^2}$  denote the mean-square noise current lying in the frequency band  $\Delta f$  in the primary- and secondary-electron currents, then  $\overline{I_{s\Delta f}^2} = m^2 \overline{I_{p\Delta f}^2} + \delta^2 2e \overline{I_{p\Delta f}}$  where  $\overline{I_p}$  is primary direct current. This result is applied to many-stage multipliers. For  $n$  similar stages  $\overline{I_{s\Delta f}^2} = \overline{M^2 I_{p\Delta f}^2} + \delta^2 [M(M-1)/m(m-1)] 2e \overline{I_{p\Delta f}}$  where  $M = m^n$  is the over-all gain of the multiplier.

*Wave Guides for Electrical Transmission.*<sup>12</sup> G. C. SOUTHWORTH. The transmission of electric power at extremely high frequencies through rods or "wires" of dielectric and through metal tubes, without the usual return conductor, was predicted mathematically many years ago. Recently experiments have confirmed this theory. Wave guides offer the possibility of transmitting very wide frequency bands and consequently extremely large numbers of speech channels without the high attenuations encountered in radio; in fact, constantly decreasing attenuation with increasing frequency is predicted for one type of wave.

<sup>10</sup> *Jour. Chemical Physics*, March 1938.

<sup>11</sup> *Proc. I. R. E.*, March 1938.

<sup>12</sup> *Elec. Engg.*, March 1938.

Some of the properties of the waves and the apparatus used in studying them are described in this article.

*Recent Development in Hill and Dale Recorders.*<sup>13</sup> L. VIETH and C. F. WIEBUSCH. A new sound-on-disk recorder has been developed in which is used the principle of feeding part of the output of the system back to the input of the associated driving amplifier in properly controlled relationship. The use of this principle, which is widely used in feedback amplifiers, replaces the usual practice of providing dissipative elements for the control of an electrically driven vibrating system. Heretofore no practical application of feedback to electro-mechanical systems has been made, possibly because the requirements for stable operation of such systems are difficult of achievement. Through recent developments these requirements have been satisfactorily met. The new recorder is capable of recording on wax or direct-recording material without appreciable effect upon its characteristics, which include uniform response from 30 to 12,000 cps. and exceptional freedom from distortion. The recorder is extremely simple and affords easy means for field calibration from the feedback element, whose output is in direct proportion to the stylus velocity. These means also make available a monitoring voltage which, properly amplified, gives a precise aural picture of the stylus behavior during recording.

*Internal Friction in Solids—III. Experimental Demonstration of Thermoelastic Internal Friction.*<sup>14</sup> C. ZENER, W. OTIS and R. NUCKOLLS. In order to demonstrate the presence of thermoelastic internal friction, the authors measured the internal friction of a copper reed over a wide frequency range (50 to 4000 cycles/sec.). They obtained a maximum precisely at the predicted frequency. The observed variation of internal friction with frequency proves that, over a wide frequency range, the internal friction due to the flow of heat back and forth across a reed is of a larger order of magnitude than that due to all other causes. Independent experiments of Bennewitz and Rötger on wires of silver, aluminum, brass, steel, and glass are shown to furnish an equally striking demonstration of thermoelastic internal friction.

<sup>13</sup> *Jour. S. M. P. E.*, January 1938.

<sup>14</sup> *Phys. Rev.*, January 1, 1938.