Abstracts of Technical Articles by Bell System Authors

Paracon—A New Polyester Rubber.[1] B. S. BIGGS and C. S. FULLER. Paracons are high molecular weight linear polyesters which are soft enough to be rubbery and are capable of undergoing a vulcanization reaction. They are prepared by the condensation of dibasic acids with glycols or by the self condensation of hydroxy acids, and the name is intended to signify "condensation rubber." Paracon looks and feels like rubber, and in comparison with other rubbers it has some distinct advantages and some definite limitations. Its outstanding properties are oil resistance, high heat and light resistance, lack of odor and fast curing cycle. Tensile strength ranges from 1500 to 3000 pounds per square inch with elongations of 400 to 600 per cent.

Rubber pigments and compounding techniques may be used with it but vulcanization is accomplished in most cases by the action of benzoyl peroxide rather than sulfur.

Aside from its practical aspects the development of paracon is of theoretical interest because of the light it throws on rubber structure and the mechanism of vulcanization processes.

Unsaturation of Butadiene and Related Polymers as Determined by Iodine Chloride Addition.[2] A. R. KEMP and HENRY PETERS. This paper describes procedures which have been developed to determine the unsaturation of various butadiene and related polymers and copolymers, as well as mixed vulcanizates of Buna S and rubber. These methods are based on the use of *p*-dichlorobenzene as a solvent and iodine chloride as the addition agent, following the general technique employed in the standard Kemp-Wijs method for the determination of the unsaturation of natural rubber.

The ratio of butadiene to styrene in copolymers has been calculated from the iodine value and from the carbon-hydrogen ratio; however, the accuracy of these procedures is subject to several variables which are discussed.

Unsaturation data are presented on highly purified emulsion-type polymers of butadiene-isoprene and butadiene-styrene which agree closely with the presence of one double bond for each diolefin molecule present. The reaction rate of Buna S with halogens is shown to agree closely to that of natural rubber hydrocarbon.

Brittle Temperature of Rubber under Variable Stress.[3] A. R. KEMP, F. S. MALM and G. G. WINSPEAR. This paper supplies the need for a method to

[1] *Chem. and Engg. News*, June 25, 1943.
[2] *Indus. & Engg. Chemistry, Analytical Edition*, July 1943.
[3] *Indus. & Engg. Chem.*, April 1943.

determine the temperature at which rubber and similar materials fracture under variable bending stress. Although the brittle temperature is sharply defined under high-speed bending through a sharp angle, it is lower as the speed of application or the magnitude of the stress is reduced. In some instances decreases of more than 28°C. in brittle temperature resulted from reductions in bending stress such as might be encountered in service.

Vulcanized pure gum natural rubber and plasticized polyvinyl chloride-acetate copolymer showed the largest changes, whereas the compounded and vulcanized natural and synthetic rubbers involved in this study exhibited a reduction in brittle temperature from 5° to 10° C. in going from the highest to the lowest stress employed.

American Science Mobilizes for Victory.[4] ROBERT W. KING. There are no accomplishments of the Bell System in which its men and women take greater pride than those marking the continuous activities in developing and applying the art of communication.

The Bell Telephone Laboratories' accomplishments, reflected for decades in improved instrumentalities and systems for the transmission of electrical signals and speech, have been possible because vast resources of scientific knowledge have been devoted as part of the System's general responsibility to the public, to a broad and fundamental program of exploration, experiment and design.

Today the more than 6,000 members of these Laboratories are engaged on hundreds of development projects requiring research, invention and design, for the Army, the Navy, and the National Defense Research Committee.

That this should be both logical and inevitable will not surprise any one who considers the vital part played by communications in modern warfare. Rapid movement of troops and supplies over far-flung lines of action on land and sea and in the air are possible only when directed through effective communication systems. More and more the electrical transmission of intelligence is becoming the unifying influence pervading all branches of war organizations. It coordinates the movement of naval and aerial fleets; it enables infantry, tank columns and formations of aircraft to operate as a single unit. It shrinks a thousand-mile battle line to the compass of a single sector.

The article by Dr. King points out the place of independent military research, although its actual volume is less than that carried on directly by the Army and Navy. It also draws upon experience in industrial research to show that the sudden solution of war problems by appeal to science is scarcely to be expected.

[4] *Bell Tel. Mag.*, June 1943.

Filtered Thermal Noise—Fluctuation of Energy as a Function of Interval Length.[5] S. O. RICE. Let a source of thermal noise be connected to the input of a band-pass filter. Consider the energy which would be dissipated during the interval t_1 to $t_1 + T$ if the output current were to flow through a resistance of one ohm. When T is held fixed and t_1 regarded as a random variable, the resulting energies have a distribution whose average and standard deviation depend upon T. Here this dependence is studied. The standard deviation of the difference of the energies of two contiguous intervals, each of length T, is also obtained.

Ultra-Short Electromagnetic Waves. IV—Guided Propagation.[6] S. A. SCHELKUNOFF. Doctor S. A. Schelkunoff presented the material contained in this article as a lecture before the basic science group of the New York Section. He treated the subject in a "non-mathematical" manner. Certainly the electrical engineer will welcome any concept which allows an easier approach to the solution of certain problems involved in wave guides than the more complete equivalent field-theory method. In this fourth article in a series of six on ultra-short electromagnetic waves, Doctor Schelkunoff combines transmission-line theory with optical analogy and derives useful relations for both wave guides and cavity resonators. The three preceding articles appeared in the March, April and May issues of *Electrical Engineering*.

Variable-Frequency Bridge-Type Frequency-Stabilized Oscillators.[7] W. G. SHEPHERD and R. O. WISE. Results are given of a theoretical and experimental investigation into two types of bridge-stabilized oscillators incorporating a thermal device for amplitude control. One circuit employs only resistances and capacitances in the frequency-determining network and consequently is useful for low-frequency operation. The other circuit uses an inductance-capacitance network which is well adapted to the higher-frequency network. Conditions for optimum stability and the variation of the stability with frequency determined experimentally are found to be in general agreement with theoretical results.

Beyond the Ultra-Short Waves.[8] G. C. SOUTHWORTH. This article reviews briefly the work done many years ago by the pioneering physicists with the so-called electric waves as well as the more recent efforts by engineers to put these waves to practical use. It also describes some of the expedients and changes of technic used to overcome difficulties as this work progressed to

[5] *Jour. Acous. Soc. Amer.*, April 1943.
[6] *Elec. Engg.*, June 1943.
[7] *Proc. I. R. E.*, June 1943.
[8] *Proc. I. R. E.*, July 1943.

higher and higher frequencies. One, of fairly recent origin, is the wave-guide or hollow-pipe technic. The latter not only provides a simple and efficient way of propagating microwave power from one point to another but there have also grown from it some very interesting counterparts of the tuned circuits, the matching transformers, and the filters that have been in common use for some time at the lower frequencies. The possible bearing of this new technic on the future of electrical communications, as, for example, television, is pointed out.

The Impact of War on Long Distance Service.[9] MARK R. SULLIVAN. The article gives in narrative form much of Vice President Sullivan's testimony concerning toll board service before the Federal Communications Commission on December 16, 1942.

Increasing traffic and severe curtailment in additions to plant, make it progressively more difficult to maintain service performance at its usual level. In the last two years Long Lines toll traffic has nearly doubled, this increase being almost equivalent to the total level of business reached over a period of some 65 years. Plant materials available for telephone construction, on the other hand, have been sharply curtailed. Copper, for example, had been used in building telephone plant at the annual rate of more than 90,000 tons; now only about 8,000 tons are used.

The increased volume of long distance calls has been accompanied by increased complexities in the handling of calls; more attempts required per call, a greater proportion of person-to-person calls, and greater length of haul requiring more switching. Over all, the results still average well. However, not all calls fall on or near the average due to the uneven distribution of increased calling which has followed generally the path of war activity and varies tremendously in different localities. Just as growth in calling has not been uniform throughout the System, so has circuit congestion been most pronounced in cities most affected by war activities. A customer whose individual call is delayed well beyond the average may appraise the service by that call, even though he may realize that the average speed of all calls is much faster.

Despite the increased traffic volume, complexities and the shortage of facilities, there have been some truly notable achievements. Accuracy and speed of answer have suffered relatively little. Additions to the operating force of 150,000 were made in the past two years to handle the increased load and to replace losses. Operators, seasoned and new, have faced the challenge to the service and, true to the finest traditions of the service, are giving their best to a difficult job—willingly and cheerfully.

[9] *Bell Tel. Mag.*, June 1943.

Drying of Textiles.[10] A. C. WALKER. In 1937 a textile-drying research project was initiated by the United States Institute for Textile Research and supported by the textile industry, for the purpose of evaluating the effects of temperature and humidity on the physical and chemical properties of important textile fibers. The present paper gives a comprehensive report of the results obtained and points out the basis upon which the industry must proceed in problems relating to textile drying. In all cases, consideration should be given to the theories relating to the form in which the moisture is distributed within the fiber structure and to data of the type discussed by the author.

[10] *Trans. A.S.M.E.*, May 1943.