

Abstracts of Bell System Technical Papers Not Published in This Journal

A New Telephone Carrier System for Medium-Haul Circuits. R. S. CARUTHERS¹, H. R. HUNTLEY², W. E. KAHL¹, and L. PEDERSON¹. *Elec. Eng.*, **70**, pp. 692-693, Aug. 1951.

Low terminal costs and single-cable operation make this the first economically practical carrier system for medium-haul telephone circuits. Performance is not sacrificed for economy.

*A .15-Kw 500-Megacycle Grounded-Grid Tridode.** C. E. FAY¹, D. A. A. HALE¹, and R. J. KIRCHER¹. *Proc. I.R.E.*, **39**, pp. 800-803, July, 1951.

Short-Cut Method Aids Figuring Exhaust and Collecting Systems. W. H. FOGLE³. *Heating, Piping and Air Cond.*, **23**, pp. 75-78, July, 1951.

A simple, workable method of determining static losses in industrial exhaust and collecting systems is explained here by means of a sample problem and its step-by-step solution. The method might be described as an "averaging out" process, whereby all duct sizes and lengths are averaged out with the cfm and velocity to give a total linear footage of the average duct size and an average velocity.

*Arcing at Electrical Contacts on Closure. Part I. Dependence Upon Surface Conditions and Circuit Parameters.** L. H. GERMER¹. *Jl. Appl. Phys.* **22**, pp. 955-964, July, 1951.

In a low-voltage circuit the occurrence of an arc between approaching electrodes is dependent upon the nature of the surfaces and upon the circuit inductance. For carbon surfaces, or noble metal surfaces which have been "activated" by operation in various organic vapors resulting in a carbonaceous layer, the limiting circuit inductance is somewhat above 10^{-3} h, which is much higher than the limiting inductance for clean noble metal surfaces. This activation by organic vapors occurs for noble metals only and for certain vapors; for example, benzene derivatives. In the case of silver and benzene vapor, it has been shown that the activation is due to adsorption of benzene onto a greasy surface layer and its decomposition there by the heat of subsequent closures. A metal surface, which has been activated by organic vapor, remains active indefinitely if there

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is no arcing at the surfaces; but with continued operation and accompanying arcing, the activating material is burned away, and the surface returns to the inactive condition if no activating vapor is supplied.

Arc voltages, which are independent of current and of ambient gas, as far as tested, have been measured for a number of metals and for carbon; the arc voltage for carbon is quite erratic in the range between 20 and 30 volts, but for each of a number of metals the arc voltage is steady.

Arcing at noble metal surfaces, similar to that induced by carbonaceous material from organic vapors, can be produced also by insulating particles or insulating films. The active condition gradually disappears with continued arcing, unless there is a steady supply of insulating material to the surface.

The minimum arc current has been measured to be 0.6 amp for active silver and for carbon, and 0.03 amp for inactive silver. These are the currents at which an established arc is extinguished.

*Iron-Silicon Alloys Heat Treated in a Magnetic Field.** M. GOERTZ¹. *Jl. Appl. Phys.*, **22**, pp. 964-965, July, 1951.

Heat treatment in a magnetic field has been found effective for iron-silicon alloys between two per cent and ten per cent silicon, the highest maximum permeability being obtained at about 6.5 per cent silicon. In a single crystal of this composition, magnetized parallel to a (100) direction, the hysteresis loop is squared by the magnetic anneal and the maximum permeability is increased from 50,000 to 3,800,000, the highest value yet reported.

Domain Boundary Motion in Ferroelectric Crystals and the Dielectric Constant at High Frequency. C. KITTEL¹. Letter to the Editor. *Phys. Rev.*, **83**, p. 458, July 15, 1951.

*A Method for Determining the Propagation Constants of Plastics at Ultrasonic Frequencies.** H. J. McSKIMIN¹. *J. Acoust. Soc. Am.*, **23**, pp. 429-434, July, 1951.

A pulse technique particularly suited to dissipative materials is described for measuring attenuation and phase-shift constants of plastics, using either transverse or longitudinal waves in the frequency range of 5-50 mc.

A thin wafer of the material under test is placed between two identical fused silica buffers; and waves generated by quartz crystals at the ends of the assembly are transmitted simultaneously through the specimen in both directions. Comparison of transmitted and reflected components by means of a special balancing circuit provides information from which the complex propagation constant can be calculated, and hence dynamic rigidities and viscosities.

Illustrative data for polyethylene and Nylon are given.

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Some Antecedents of Quality Control. E. C. MOLINA⁴. *Ind. Quality Control*, **8**, pp. 10-11, July, 1951.

Traveling-Wave Amplifier Measurements. F. E. RADCLIFFE¹. *Electronics*, **24**, pp. 110-111, Aug., 1951.

Rapid sweep-frequency technique used at 4,000 mc can be applied to all broad-band amplifier measurements. Oscilloscope display shows transmission accurate to 0.1 db and return-loss values up to 40 db.

*Kirchhoff's Formula, its Vector Analogue, and Other Field Equivalence Theorems.** S. A. SCHELKUNOFF¹. *Communications on Pure and Applied Math.*, **4**, pp. 43-59, June, 1951.

*Remarks Concerning Wave Propagation in Stratified Media.** S. A. SCHELKUNOFF¹. *Communications on Pure and Applied Math.*, **4**, pp. 117-128, June, 1951.

*An Achromatic Doublet of Silicon and Germanium.** R. G. TREUTING¹. *J. Opt. Soc. Am.*, **41**, pp. 454-456, July, 1951.

The semi-metals germanium and silicon have high transparency and high refractive indices over a wide range of infrared wavelengths and are stable to normal atmospheres. Their relative indices and dispersions make achromatic combinations possible; and designs are given for axially corrected doublets of relative apertures f:2 and f:1. The optical homogeneity of the materials is discussed: compositional variations are not considered an optical hazard, but there is evidence of structural imperfections in some specimens whose effect on optical properties remains to be evaluated.

*On the Motion of Gaseous Ions in a Strong Electric Field. I.** G. H. WANNIER¹. *Phys. Rev.*, **83**, pp. 281-289, July 15, 1951.

This paper applies the Boltzmann method of gaseous kinetics to the problem of positive ions moving through a gas under the influence of a static, uniform electric field. The ion density is assumed to be vanishingly low, but the field is taken to be strong; that is, the energy which it imparts to the ions is not assumed negligible in comparison to thermal energy. Attention is focused upon the computation of velocity averages, and the drift velocity in particular, rather than a complete knowledge of the entire velocity distribution. It is shown in Sections C and E that the problem so formulated is completely soluble if the mean free time between collisions of ions and molecules is a constant; this is the case for the so-called polarization force between ions and molecules which predominates over other forces at low temperature. A method for obtaining averages to any desired accuracy in the general case is developed in Section D. The method is applied to the hard sphere model for the high field range and

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mass ratio 1. An application of the resulting formula (43) to experimental material has been published earlier.

Evidence for the Noncubic High Temperature Phase of BaTiO₃. E. A. WOOD¹. Letter to the Editor. *J. Chem. Phys.*, **19**, p. 976, July, 1951.

*Seven-League Oscillator.** F. B. ANDERSON¹. *Proc. I.R.E.*, **39**, pp. 881-890, Aug., 1951.

A bridge-type RC oscillator is described which is continuously adjustable over a frequency range of 20 cps to 3 mc in one sweep of a two-gang linear potentiometer control. Tracking requirements of the two-gang control are not severe. The output is available in four phases, and the frequency is an approximately logarithmic function of the linear potentiometer setting. Practical limits of the frequency range are tentatively 0.01 cps and 10 mc. Accuracy of setting of the order of one per cent is attainable with ordinary components. Frequency stability is of the order of 2 per cent per db of tube gain variation.

*Semi-Conductor Surface Phenomena.** W. H. BRATTAIN¹. *Semi-Conducting Materials*, H. K. HENISCH, ed., pp. 37-46. Proceedings of a conference held at the University of Reading (July 10-15, 1950) London, Butterworths, 1951.

Developments in the understanding and interpretation of phenomena occurring at the surface of a semi-conductor are reviewed. The development starts with the Mott-Schottky theory of the space charge layer. Bardeen's concept of a space charge layer due to 'surface states' explained the independence of rectification on contact potential and Meyerhoff's small values for the contact potential between n- and p-type silicon. Shockley and Brattain observed that this contact potential difference increased with impurity concentration. Illumination of a silicon surface produced hole and electron pairs in the space charge layer. The potential of the surface changed until the photocurrent was balanced by a conduction current. The relation between photo-current and potential change was of the same form as a forward characteristic for a rectifying contact. In an experiment similar to Becquerel's, using water as an electrolyte, the surface may be biased in the reverse direction. When so biased the response to modulated light gives the differential resistance of the space charge layer. This resistance increases rapidly with reverse bias and the time constant of the layer increases, both agreeing qualitatively with theory. This experimental method of measuring changes in surface potential caused by illumination permits determination of the properties of the space charge layer at the free surface of a semi-conductor.

*The Calculation of Traveling-Wave-Tube Gain.** C. C. CUTLER¹. *Proc. I.R.E.*, **39**, pp. 914-917, Aug., 1951.

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Essential information for calculation of traveling-wave-tube gain is summarized and condensed in this paper. The important relations are documented, presented in a concise form for simplified computation, and developed as a nomograph. The conclusions have been found to be in agreement with measurements on six different tube designs.

*Thermal Variation of Young's Modulus in some Fe-Ni-Mo Alloys.** M. E. FINE¹ and W. C. ELLIS¹. References. *Jl. Metals*, **3**, pp. 761-764, Sept., 1951.

*A Broad-Band Transcontinental Radio Relay System.** T. J. GRIESER¹ and A. C. PETERSON¹. *Elec. Eng.*, **70**, pp. 810-815, Sept., 1951.

Spanning the continent from coast to coast, this microwave relay system provides six channels, each of which can carry one television circuit or hundreds of telephone circuits. Some features of this vast network are described.

*An Improved Telephone Set.** A. H. INGLIS¹ and W. L. TUFFNELL¹. *Elec. Eng.*, **70**, pp. 770-775, Sept., 1951.

The familiar telephone set has undergone numerous changes which will provide better service at lower cost than do present models. Increased transmitting and receiving gain, better sidetone control, broader frequency response, faster dialing, simple ringing control, and a trim appearance are some of the features of the new design.

The Institutes for Basic Research—Their Contribution to National Strength. M. J. KELLY¹, pp. 11-23. *Applied Research is Not Enough*, (booklet). Addresses at the Dedication of the Institutes for Basic Research, The University of Chicago, May 16, 1951.

The Crystal Clock. W. A. MARRISON¹. *Science Marches On*, JAMES STOKLEY, ed., N. Y., Ives Washburn, Inc., 1951, pp. 303-309.

Observations of Zener Current in Germanium p-n Junctions. K. B. McAFEE¹, E. J. RYDER¹, W. SHOCKLEY¹, and M. SPARKS¹. Letter to the Editor. *Phys. Rev.*, **83**, pp. 650-651, Aug. 1, 1951.

*Experimental Radio-Telephone Service for Train Passengers.** N. MONK¹. *Proc. I.R.E.*, **39**, pp. 873-881, Aug., 1951.

Experimental public radio-telephone service for train passengers was inaugurated by the Bell Telephone System several years ago. Initial installations operated in conjunction with a series of urban mobile base stations. More recently, highway mobile systems have been used for this service, and this paper describes a typical train installation operating through a highway channel. All

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of these early systems utilized an attendant on the train. The cost of providing an attendant has, in some cases, been found excessive. Consequently, experiments have been initiated in which a coin box is used on the train. The arrangements for this purpose are also described.

*The Magneto-Resistance Effect in Oriented Single Crystals of Germanium.** G. L. PEARSON¹ and H. SUHL¹. *Phys. Rev.*, **83**, pp. 768-776, Aug. 15, 1951.

This paper describes an extensive study of the magneto-resistance effect in germanium as a function of crystal orientation. Experimental measurements establish the constants involved in the dependence of the effect on orientation of magnetic field and electric relative to the crystal axes. The measurements are internally consistent with existing phenomenological theory based on cubic crystal symmetry, in which terms involving the magnetic field to higher than the second order are neglected. It is shown that such deviations as do occur arise from higher terms in the field, since an extension of the phenomenological theory to the fourth order predicts their symmetry. Relations are established between the experimentally observed phenomenological constants and those constants appearing in existing magneto-resistance electronic theories. It is concluded that no electronic theory yet worked out is entirely consistent with experiment. The present electronic theories are special cases of a very general theory recently proposed by Shockley, and it is possible that agreement can be obtained as soon as the computational difficulties of the latter theory are overcome.

New Phenomena of Electronic Conduction in Semi-Conductors. W. SHOCKLEY¹. *Semi-Conducting Materials*, H. K. HENISCH, ed., pp. 26-36. Proceedings of a conference held at the University of Reading (July 10-15, 1950) London, Butterworths, 1951.

The semi-conductors silicon and germanium may be discussed as insulators the electronic structure of which is disturbed. Excess electrons, which act as negatively charged current carriers, may be present as may be 'holes' or places where electrons are missing from the valence-bond structure. Holes act as positively charged current carriers. In ordinary electronic conduction the flow of current carriers is substantially incompressible so that the density of carriers remains constant. When a new transistor phenomenon known as 'carrier injection' occurs, however, the total density of holes and electrons may be greatly increased and this modulation of the electronic structure may be used both for scientific investigation and for practical amplification. In particular, carriers may be injected at a predetermined time and place into a known uniform electric field and their transit time to another place accurately timed by detecting their arrival with a "collector" point. Drift velocities and mobilities may be measured precisely in this way with a directness unattainable by pre-transistor

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methods involving conductivity and Hall effect. These new experiments and their related theories may furnish a foundation for a new engineering science of transistor electronics.

*Domain Patterns on Nickel.** H. J. WILLIAMS¹ and J. G. WALKER¹. *Phys. Rev.*, **83**, pp. 634-636, Aug. 1, 1951.

Domain patterns have been observed on two single crystals of nickel cut in the form of hollow parallelograms. The length of the sides were parallel to the (111) directions in one specimen and to the (110) directions in the other. The crystals show domain structures with the three types of domain boundaries which are to be expected from a material having the directions of easy magnetization along the (111) directions. Domain boundary movement under the influence of an applied magnetic field was observed.

*Polymorphism in Potassium Niobate, Sodium Niobate, and Other ABO₃ Compounds.** E. A. WOOD¹. Bibliography. *Acta Cryst.*, **4**, pp. 353-362, July, 1951.

The first part of this paper presents the results of optical and X-ray studies of the perovskite-type crystals, potassium niobate and sodium niobate. Potassium niobate is orthorhombic at room temperature, changing to tetragonal at about 225°C. and cubic near 435°C. Sodium niobate is orthorhombic at room temperature, changing to tetragonal at about 370°C. and to cubic at about 640°C.

The second part of the paper discusses relations among the structures of the ABO₃ compounds.

*Subjective Sharpness of Additive Color Pictures.** M. W. BALDWIN¹. *Proc. I.R.E.*, **39**, pp. 1173-1176, Oct., 1951.

This is a report on the first numerical results to come from a laboratory experiment on the subjective sharpness of additive three-color pictures. The sharpness factor is isolated by using out-of-focus projection (of slides) instead of actual television transmission.

An observer's acuity for defocus is greatest for the green component and least for the blue component, in an additive three-color picture. When the same picture is reproduced in monochrome (white, red, green, or blue) at the same brightness, the observer's acuity for defocus is equal to that found for the green component.

*Frequency-Modulation Terminal Equipment for the Transcontinental Relay System.** J. G. CHAFFEE¹ and J. B. MAGGIO¹. *Elec. Eng.*, **70**, pp. 880-883, Oct., 1951.

To meet the exacting requirements of the new transcontinental microwave relay system, specially designed frequency-modulation terminal equipment was

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constructed. The terminal transmitter converts either message or television signals to a frequency-modulated signal centered on 70 mc and the terminal frequency-modulation receiver recovers these signals, thus providing a link between the relay system and other telephone facilities.

*Observer Reaction to Low-Frequency Interference in Television Pictures.**
A. D. FOWLER¹. *Proc. I.R.E.*, **39**, pp. 1332-1336, Oct., 1951.

This paper presents results of tests to determine how much low-frequency interference can be tolerated in black-and-white television pictures. Various levels of single low-frequency interference were superimposed on a locally transmitted television picture. Observers viewed the picture and rate the disturbing effect of each level of the interference. Ratings were made in terms of preworded comments ranging from "not perceptible" to "unusable." Interfering frequencies from 48 to 90 cycles per second were employed.

Just visible interference appears as a flicker. The rate of flicker is the difference between interfering and 60-cycle field frequencies. The most disturbing interference produced a flicker rate of 5 or 6 cycles per second. To be tolerated, peak-to-peak amplitude of this interference had to be 54 db weaker than the peak-to-peak amplitude of the television signal (including synchronizing pulse). For flicker rates of 0.5 and 12 cycles per second, the amount of interference which could be tolerated was larger by 14 and 3 db, respectively.

*Arcing at Electrical Contacts on Closure. Part II. The Initiation of an Arc.** L. H. GERMER¹. *Jl. Appl. Phys.*, **22**, pp. 1133-1139, Sept., 1951.

The capacity of the plates of an oscilloscope charged to 35 or 40 volts is discharged repeatedly by approaching electrodes of carbon, active silver, and inactive silver. Facts about the discharges, which are arcs of very short duration, are inferred from resulting open circuit potentials and calculated electrode separations.

The separation at the first arc varies in different experiments but corresponds on the average to a nominal electric field of 0.6×10^6 volts/cm for carbon or active silver and to 2×10^6 volts/cm for inactive silver. Each arc is initiated by a very small number of field emission electrons. The hypothesis that a single electron may perhaps be sufficient is consistent with observations at later stages of each closure when the electrodes are closer and the field much higher.

The earlier observation, that the potential across a short arc is constant and independent of current, is not true if the arc time is sufficiently short. For active silver a time comparable with 2×10^{-8} sec is required to establish the steady arc voltage characteristic of later stages of arcs which last longer than this. The initial time during which the potential is decreasing toward its final steady value is 100 times the transit time of a silver ion across the gap.

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Computation of Control Limits for p-Charts When the Samples Vary in Size. H. L. JONES⁵. *Ind. Quality Control*, **8**, pp. 26-27, Sept., 1951.

The Design of Switching Circuits. W. KEISTER¹, A. E. RITCHIE¹, and S. H. WASHBURN¹. N. Y., *Van Nostrand*, 1951. 556 pp. (Bell Telephone Laboratories Series).

This is the first published textbook in its field. It presents, first, the fundamental design principles of switching circuits composed of discrete-valued switching elements. Most of the discussion concerns two-valued elements, with greatest emphasis placed on electromagnetic relays. Chapters cover basic circuit paths, the logical interpretation of requirements, and the techniques of constructing networks to fulfill these requirements. The symbolic methods of Boolean algebra and its application to the design of combinational and sequential circuits is covered. Later chapters cover various unfunctional circuits such as selecting, connecting, translating, counting, and lockout. Final chapters discuss methods of synthesising unfunctional circuit building blocks into larger circuits and systems.

Measurement of the Elastic Constants of Silicon Single Crystals and Their Thermal Coefficients. H. J. McSKIMIN¹, W. L. BOND¹, E. BUEHLER¹, and G. K. TEAL¹. Letter to the Editor. *Phys. Rev.*, **83**, p. 1080, Sept. 1, 1951.

Interest in the properties of silicon single crystals arising from their use as semiconductors has led us to make measurements of the elastic constants of two single crystals. Measurements of velocities of propagation for both shear and longitudinal waves were made in the crystals as described in a recent paper by McSkimin. Frequencies in the range 8-12 mc/sec were used.

The three independent elastic constants were evaluated, a density of 2.331 (measured by pycrometer) being used. Data and formulas used are summarized in Table I. Two crystals were measured—as indicated—with data obtained from the larger one being used to determine the elastic constants. Check measurements were made for the smaller crystal; and despite the less accurate "pulse overlap" technique used for two of the measurements, velocity agreement to within 0.15 per cent was obtained.

Both crystals were of a high degree of crystalline perfection as shown by etching and X-ray tests.

Domain Wall Relaxation in Nickel. W. P. MASON¹. Letter to the Editor. *Phys. Rev.*, **83**, pp. 683-684, Aug. 1, 1951.

Phase Transitions in Ferroelectrics. B. MATTHIAS¹. National Research Council, Comm. on Solids. *Phase Transformations in Solids*. Ed. by R. Smoluchowski, J. E. Mayer, W. A. Weyl. N. Y., Wiley, 1951. 660 pp.

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Under the name ferroelectrics are classified those materials which exhibit dielectric anomalies phenomenologically similar to the magnetic behavior of the ferromagnetics. Perhaps it would have been more logical to use the term Rochelle-electrics, thus emphasizing the similarity in the dielectric behavior to that of Rochelle salt.

In this paper the known ferroelectrics are listed first, and then there follows a discussion of the various theories which have been created to explain them.

*Data on Random-Noise Requirements for Theater Television.** P. MERTZ¹. *Jl. S.M.P.T.E.*, **57**, pp. 89-107, Aug., 1951.

Provisional evaluation of permissible random noise for theater television is considered from several sources of information. These cover broadcast television experience and the graininess in motion picture film; the requirements deduced from the various sources generally agree. For broadcast television, a frequency weighting and limit on weighted noise power have been used. The finer picture detail of theater television presumes a lower permissible random noise. Changes in weighting curve are discussed. A limit figure of noise is suggested, which is comparable to graininess effects in motion pictures, though slightly more severe than present published performance on camera tubes.

*A Spatial Harmonic Traveling-Wave Amplifier for Six Millimeters Wavelength.** S. MILLMAN¹. *Proc. I.R.E.*, **39**, pp. 1035-1043, Sept., 1951.

This paper describes a traveling-wave amplifier in which the electron beam interacts with a spatial harmonic of an electromagnetic wave propagating along an array of resonator slots. The result is a considerable reduction in operating beam voltage for a given physical separation of the circuit elements. This type of amplifier operating at about 1,200 volts has yielded net power gains of about 18 db in the 6-mm wavelength region. A magnetic field of about 1,600 gauss is sufficient for proper beam focusing. Aside from small variations of gain with frequency that is caused by internal reflections, the bandwidth is of the order of 3 per cent.

*Form of Transient Currents in Townsend Discharges with Metastables.** J. P. MOLNAR¹. *Phys. Rev.*, **83**, pp. 933-940, Sept. 1, 1951.

The form of the current is calculated for a Townsend discharge stimulated by a pulsed light beam, with particular reference to the current component initiated by metastable effects. The calculation is directed particularly to the development of methods for quantitative interpretation of current patterns observed experimentally.

*Studies of γ -Processes of Electron Emission Employing Pulsed Townsend Discharges on a Millisecond Time Scale.** J. P. MOLNAR¹. *Phys. Rev.*, **83**, pp. 940-952, Sept. 1, 1951.

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The relative amounts of electron emission from the cathode in a Townsend discharge caused by ions, photons, and metastables have been studied experimentally for several cathodes in argon, using pulsed-light stimulation of the discharge. The current initiated by metastables exhibits a slow build-up and decay, thus permitting easy separation from the faster rising effects of gas ionization and electron emission by photons and ions. Time constant studies of the slow component yielded a diffusion constant for metastable argon atoms of $45 \text{ cm}^2 \text{ sec}^{-1}$ at one millimeter pressure. The efficiencies of electron emission by metastables and ions was found to be closely the same, while the quantum yield for photon emission was found to be generally smaller.

*Electrical Properties of $\alpha\text{Fe}_2\text{O}_3$ and $\alpha\text{Fe}_2\text{O}_3$ Containing Titanium.** F. J. MORIN¹. *Phys. Rev.*, **83**, pp. 1005-1010, Sept. 1, 1951.

Electrical conductivity, Hall effect, and Seebeck effect have been measured on two sets of polycrystalline samples of $\alpha\text{Fe}_2\text{O}_3$ and $\alpha\text{Fe}_2\text{O}_3$ containing from 0.05 to 1.0 atomic per cent titanium (n-type impurity). One set of samples contained 0.6 atomic per cent excess of iron (n-type impurity), the second set contained 0.6 atomic per cent deficiency of iron (p-type impurity).

The conductivity of pure $\alpha\text{Fe}_2\text{O}_3$ is independent of this amount of stoichiometric deviation. The slope of the log conductivity vs reciprocal temperature plot is 1.17 ev and the intercept at $1/T = 0$ is $2.1 \times 10^4 \text{ ohm}^{-1} \text{ cm}^{-1}$. Room temperature conductivity varies from $-10^{-14} \text{ ohm}^{-1} \text{ cm}^{-1}$ (extrapolated) for pure $\alpha\text{Fe}_2\text{O}_3$ to $0.3 \text{ ohm}^{-1} \text{ cm}^{-1}$ for $\alpha\text{Fe}_2\text{O}_3$ containing 1.0 atomic per cent titanium.

The measured Hall voltages seem to result entirely from magnetization of the samples, which are weakly ferromagnetic, and disappear above the ferromagnetic Curie temperature.

The temperature variations of the Fermi level are determined from Seebeck data. The temperature variations of carrier concentration are determined from Fermi level and of mobility from carrier concentration and conductivity for some samples. Carrier concentration results indicate that each added titanium ion donates approximately one electron to the conduction process. Mobilities are found to be less than $2.0 \text{ cm}^2/\text{volt sec}$, suggesting that conduction involves electrons in the d level of iron.

*Acceptance Inspection of Purchased Material.** J. E. PALMER³ and E. G. D. PATERSON¹. *Ind. Quality Control*, **8**, pp. 15-19, Sept., 1951.

This paper describes some of the principles and procedures employed in the inspection of purchased material in the form of components or finished products. The authors' experience has been largely with procedures used in the Bell System, and the illustrations have therefore been drawn from this source. It is felt, however, that considerations leading to the choice of specific inspection tech-

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niques will be generally applicable even though the number and volume of items purchased and the number of suppliers involved may in some cases differ widely. In this presentation, stress has been placed on a discussion of the broader gauge factors underlying the engineering planning of inspection procedures rather than on specific sampling and control techniques.

*Analysis of Audio-Frequency Atmospherics.** R. K. POTTER¹. *Proc. I.R.E.*, **39**, pp. 1067-1069, Sept., 1951.

Sound portrayal techniques used in studies of speech and noise reveal the structure of atmospheric disturbances well known to long-wave radio and ocean-cable engineers as "whistlers," "swishes," and "tweeks." It is suggested that renewed investigation of these effects, using modern analyzing tools, might yield information of considerable scientific interest.

*Reflection of Electromagnetic Waves from Slightly Rough Surfaces.** S. O. RICE¹. *Communications on Pure and Applied Math.*, **4**, pp. 351-378, Aug., 1951.

*Color Television and Colorimetry.** W. T. WINTRINGHAM¹. *Proc. I.R.E.*, **39**, pp. 1135-1172, Oct., 1951.

The high lights of the history of color measurement and of color photography are reviewed. Following this introduction, the principles of modern three-color colorimetry are developed from a hypothetical experiment in color matching. The conventional theory of "perfect color reproduction" by color television is built up from colorimetric background. Some of the difficulties to be expected in applying colorimetry to color television are brought out.

Finally, there is some discussion which tends to show that colorimetry may not be a sufficiently powerful tool to provide answers to all of the questions which will arise in the reproduction of scenes in color by television. The advantage of colorimetry as a background is indicated, however.

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