**April through June, 1961**

# IBM Technical Papers Published in Other Journals

**Angular Variation of the Magnetic Properties of Partially Aligned $\gamma$-$Fe_2O_3$ Particles,** G. Bate, *Journal of Applied Physics,* (Supplement) **32,** No. 3, 239S-240S (March, 1961).

Using a torsion balance magnetometer, measurements were made on oriented particles of $\gamma$-$Fe_2O_3$ covering a range of packing densities (5% to 60%). Microscopic examination revealed that the specimens consisted essentially of long chains of particles, parallel to the orientation field, with varying degree of cross linkages. Measurements were made as a function of the angle between the direction of the orienting field and the direction of the measuring field. The graphs of $H_c$ (the coercivity) versus angle showed a characteristic peak at about 50° while $H_r$ (the remanence coercivity) has its highest value at 90° to the chains and decreases with decreasing angle. Thus, the samples showed their lowest value of $H_c$ and highest value of $H_r$ at 90° to the chains. Torque curves for clockwise and counterclockwise rotation were obtained as a function of applied field. From these the rotational hysteresis was calculated and gave the maximum anisotropy field at 2,500 oe for each specimen. The integral $\int_0^\infty \frac{W}{I_s}\, d\left(\frac{1}{H}\right)$ was evaluated as 1.6 for the 20% specimen. Finally, agreement between these results and those predicted by current models of fine-particle behavior were discussed.

**Automated Intelligence Systems—Some Basic Problems and Prerequisites for Their Solution,** H. P. Luhn, *The Clarification, Unification and Integration of Information Storage and Retrieval Proceedings* (Symposium), Biltmore Hotel, New York City (February 23, 1961).*

Growing demands of communication within organizations call for automated intelligence systems to perform selective dissemination, storage and retrieval of information and associated services. A crucial problem concerns mechanization of present intellectual effort associated with characterization of information to be processed. Automatic indexing and abstracting methods employing statistically derived vocabularies of key words appear to offer a practical solution. Machine-readable texts of published literature need to be made available through publishers or machine text centers to provide current input. Technologically the ground work has been laid to start automatic systems today. Adjustability to changing conditions must, however, be a primary system design objective to prevent obsolescence.

* For period January 1 through March 31, 1961.

**Annealing Behavior and Temperature Dependence of the Magnetic Properties of Thin Permalloy Films,** Armin Segmüller, *Journal of Applied Physics,* (Supplement) **32,** No. 3, 89S-90S, (March, 1961).*

Permalloy films are evaporated in a vacuum of $10^{-5}$ mm Hg in the presence of a magnetic field to achieve a uniaxial anisotropy. All annealing treatments and magnetic measurements are performed simultaneously in a vacuum of $10^{-8}$ to $10^{-7}$ mm Hg. In a film never heated above the deposition temperature, the temperature dependence of the uniaxial anisotropy is stronger than in bulk Permalloy, and magnetic annealing changes the anisotropy even at temperatures below 350°C. These changes strongly depend on whether or not the magnetization is aligned in the hard direction during cooling. During annealing above 400°C the coercive force is increased, and subsequent magnetic annealing treatments exhibit kinetics similar to those of bulk material.

* For period January 1 through March 31, 1961.

**Atomic g Values for Neon and Argon in Their Metastable $^3P_2$ States; Evidence for Zero Spin of $_{10}Ne^{20}$†,** A. Lurio,* G. Weinreich,** C. W. Drake,*** V. W. Hughes,*** and J. A. White,**** *The Physical Review,* **120,** No. 1, 153-157 (October 1, 1960).

The gyromagnetic ratios of neon and argon in their metastable $^3P_2$ states have been measured by the atomic beam magnetic resonance method. The results are $g_J(\text{Ne}, {}^3P_2) = 1.500888 \pm 0.000005$ and $g_J(\text{A}, {}^3P_2) = 1.500964 \pm 0.000008$, in agreement with the less precise optical spectroscopic measurements. Theoretical values, including radiative and relativistic effects, are $g_J(\text{Ne}, {}^3P_2) = 1.50088$ and $g_J(\text{A}, {}^3P_2) = 1.50095$, in good agreement with the experimental values. In addition, the Zeeman transition frequency for neon has been measured as a function of magnetic field to obtain evidence that the magnetic moment of $Ne^{20}$ is less than $4 \times 10^{-4}$ nuclear magneton and hence that the spin of $Ne^{20}$ is probably zero.

† This research has been supported in part by the U. S. Air Force Office of Scientific Research.

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**Chto Takoe Transformatsiya? (What Are Transformations?),** R. B. Lees, *Voprosy Yazykoznaniya,* **10,** No. 3, 69-77 (June, 1961).

The motivations for and conception of the notion "grammatical transformation" in the works of Z. S. Harris are distinguished from those in the works of N. A. Chomsky. The latter's empirical conjecture that natural-language gram-

mars require a level of transformational rules is based upon the difficulty of formulating simple grammars to account for selectionally similar sentence types, for certain kinds of structural ambiguity, and for the constituent-structure of conjoined expressions. Several examples from Russian are given to illustrate these difficulties and to show how transformational rules, which serve to derive constituent-structure trees from underlying trees, can provide reasonable solutions.

**Comparisons of Four Types of Lexical Indicators of Content,** G. J. Rath* and T. R. Savage, *American Documentation,* **12,** No. 2, 126-130 (April, 1961).

An experiment was conducted to determine which of four types of lexical indicators of content could be utilized best by subjects to determine relevant from irrelevant documents and to answer a set of 100 questions. The results indicate that there were no major differences between the groups using complete text and abstracts to select relevant documents, but the group utilizing the complete text obtained a significantly higher score on the examination.

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**Compound Repetition in Oxide-Oxide Interactions. The System $Cs_2O$-$Nb_2O_5$,** Arnold Reisman and Joan Mineo, *The Journal of Physical Chemistry,* **65,** No. 6, 996-998 (June, 1961).

In order to test the predictions made in a previous paper, the mixed oxide system $Cs_2O$-$Nb_2O_5$ was investigated using differential thermal, X-ray and density analyses. Five compounds were identified in the region 0 to 66 mole % $Cs_2O$. Except for a compound melting congruently at approximately 27.7 mole % $Cs_2O(5Cs_2O \cdot 13Nb_2O_5)$ and 1415°, the remaining compounds, $2Cs_2O \cdot 15Nb_2O_5$, $Cs_2O \cdot 2Nb_2O_5$, $2Cs_2O \cdot 3Nb_2O_5$ and $Cs_2O \cdot Nb_2O_5$ melt incongruently at 1403°, 1153°, 972° and 857° respectively. The 2:15 and 5:13 compounds are isomorphic with the analogous rubidium compounds and the remainder are not. The trends observed in the lower weight members of the series have been found to continue. Thus the barely emerged compound $Rb_2O \cdot 4Nb_2O_5$ has no cesium analog, and the greatly submerged $4Rb_2O \cdot 3Nb_2O_5$ composition also fails to repeat.

**Critical Conditions for the Formation of Infinite Networks,** Allan Kahn,* *Journal of Polymer Science,* **49,** 283-286 (February 1961).**

In 1941 Flory published a series of papers on three-dimensional polymers in which he determined the critical conditions for the formation of infinite networks (gel formation) for a number of types of condensation reactions. Several other papers dealing with various aspects of gel formation have also been published. Flory, in discussing the condensation between two kinds of functional groups, limited his discussions to situations in which only one of the reactants ever had a functionality greater than 2. The extension to condensation reactions between two types of functional groups in which each reacting group has a functionality greater than 2 (e.g., glycerol and a tricarboxylic acid) is not obvious and has not previously been treated explicitly. We have, therefore, investigated the conditions necessary for infinite network formation for the condensation of a $g$-functional monomer with an $f$-functional monomer.

* Shell Development Company, Emeryville, California.
** For period January 1 through March 31, 1961.

**A Decision Logic for Speech Recognition,** W. C. Dersch, *Proceedings of the Symposium on Bionics,* September 13-15, 1960, (spring, 1961).

The study in speech recognition at the IBM Advanced Systems Laboratory in San Jose resulted in development of a portable speech-recognition device.

Preconceived ideas as to what measurements to make on the speech wave were carefully avoided. Instead, a machine concept of syllables, subsyllables, and words evolved which, in most cases, is quite different from the subjective human classification.

Words are measured for machine vowels (any sounds containing energy due to "voicing"), and machine consonants (speech sounds not containing voicing). These measurements are then arranged in order of occurrence, and are specially registered. Additional submeasurements on the machine vowels and consonants are made as necessary. Final selection is through a relay matrix.

Several speech-processing techniques which are believed to be new and important have been developed to classify the speech sounds into the machine code.

The test vocabulary consists of the ten digits spoken singly by a nominally trained speaker. For instance, the speaker must be reminded to sound the terminal "t" in the word "eight." An experienced speaker can be expected to have a score of 1 error per 100 pronunciations in the presence of ordinary room noise. A score of 6 errors per 100 pronunciations is considered poor.

**Directional Properties and Phase Relations of the Magnetotelluric Fields at Austin, Texas,** H. W. Smith,* L. Provazek,** and F. X. Bostick, Jr.,* *Journal of Geophysical Research,* **66,** No. 3, 879-888 (March, 1961).

Directional properties and phase relations of the variable electric and magnetic field components of selected data samples taken at Austin, Texas, are presented in the form of $X$-$Y$ plots. Power density spectra of component signals are shown, and data recording and analysis techniques are described and illustrated for the selected data samples.

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** Work done while at University of Texas.

**Designing NOR Circuits for Maximum Reliability,** K. M. Trampel, *Electronics,* **34,** No. 22, 46-48 (June 2, 1961).

This paper provides a basic understanding of transistor circuit design. The NOR circuit was selected because it is a fundamental circuit of transistor application and design. While not all-inclusive, the paper does provide an insight into the philosophy of designing transistor resistor-coupled circuits. To supplement the designer's knowledge of the NOR circuit, methods of logical applications are discussed.

**The Effects of Imperfections on the Superconducting Critical Temperature of Tantalum,** D. P. Seraphim, D. T. Novick and J. I. Budnick, *Acta Metallurgica,* **9,** No. 5, 446-452 (May, 1961).

The critical temperature for superconductivity in tantalum decreases with increasing concentration of nitrogen, oxygen or hydrogen. The magnitude of the effect may be correlated with the residual resistivity and thus may be interpreted as being primarily a mean-free-path effect, just as has been

found previously in substitutional solid solutions. Experiments with cold-worked tantalum indicate, however, that both the nature as well as the number of the defects which scatter the normal state electrons are of importance, since no significant change in $T_c$ was found in spite of the fact that the mean free path was decreased by an order of magnitude due to cold work.

**Energy Changes and Kinetics of Isothermal Ordering in $Au_3Cu$,*** F. M. d'Heurle† and P. Gordon,‡ *Acta Metallurgica*, **9,** 304-314 (April, 1961).

Energy changes during the isothermal ordering of $Au_3Cu$ have been studied by means of microcalorimetry at temperatures ranging from 70° to 230°C. The kinetics of heat evolution were correlated with the formation of superlattice lines in a sample annealed below the critical temperature. For an alloy containing 72.5 at. % gold the critical temperature was determined to be 212±1°C. The absence of a latent heat at the critical temperature is discussed, together with the thermodynamic degree of the transformation. From the heats experimentally observed, the difference of internal energy between an ideally disordered and a perfectly ordered sample is calculated. In quenched samples, ordering occurs rapidly during annealing at temperatures of 100°C or lower. It is believed that the high rates of ordering observed at such low temperatures are due to the presence of quenched-in vacancies.

* Part of a thesis submitted to the Illinois Institute of Technology by F. M. d'Heurle in partial fulfillment of the requirements for the Ph.D. degree. Sponsored by the Office of Naval Research.
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**Esaki Tunneling in the Presence of Magnetic Fields,** R. R. Haering and E. N. Adams, *Journal of the Physics and Chemistry of Solids*, **19,** 8-17 (April, 1961).

The theory for Esaki tunneling in the presence of a magnetic field is given for both transverse and longitudinal magnetic fields; it is shown that there are important qualitative differences between the two cases. Expressions are given for the normalized current $I(B)/I(0)$ in both field orientations in the limit of a strong magnetic field. It is found that oscillations of the de Haas-Van Alphen type are not to be expected.

**An Experimental Program for the Selection of "Disjunctive Hypotheses,"*** M. Kochen, *Western Joint Computer Conference* (National Joint Computer Committee), pp. 571-578 (May, 1961).

An algorithm for finding the characterization of a class of objects on the basis of a randomly ordered sequence of labeled individual objects—some members of the class, some not—is described. The class is characterized as a disjunction of terms, each term being a conjunction of attributes. "All red, round objects or all square, small objects" is an example. Mechanisms based on this algorithm are described in terms of such properties as the amount of storage available for recording instances and the number of instances which had to be examined until the class was first guessed.

* Paper presented at The Joint IRE-AIEE-ACM Computer Conference, Los Angeles, Calif., May 9-11, 1961.

**Fields External to Open-Structure Magnetic Devices Represented by Ellipsoid or Spheroid,** H. Chang, *British Journal of Applied Physics*, **12,** 160-163 (April, 1961).

The mathematical expressions for the field intensities external to spheroids or an ellipsoid with uniform magnetization are given. They are useful in predicting fields external to (a) open-structure magnetic devices such as metallic or ferrite films, twistors or splinters, and (b) spheroidal and ellipsoidal samples which are often used in magnetic measurements.

Curves are plotted to indicate the spatial variation of field intensity with the dimensional ratio of a spheroid as a parameter. In the region near the spheroid, field intensity is normalized against field intensity at the boundary. In the region far from the spheroid, field intensity is normalized against that of a dipole of the same dipole strength as the spheroid.

**First and Second Order Stress Effects on Superconducting Transitions in Ta and Sn,** D. P. Seraphim and Paul M. Marcus, *Physical Review Letters*, **6,** No. 12, 680-682 (June 15, 1961).

Measurements of the shift of the critical field, $H_c$, of single-crystal rods of Ta under uniaxial stress, near the critical temperature $T_c$ provide confirmation of a recent value of the first-order pressure coefficient, $(\partial H_c/\partial p)_{T_c}$ (for which many, widely discrepant results have been reported) confirm the absence of first-order shear effects in a cubic metal, as expected on general grounds, and provide a value of a particular combination of the three second-order critical field-stress coefficients for a cubic metal. Combined with recent measurements of the elastic constant discontinuity at the transition, and with hydrostatic pressure results, an estimate of the three individual constants can be made. Similar measurements on tetragonal Sn give new values of the two constants describing the highly anisotropic first-order effect. It is pointed out that certain first-order shear effects should be present in tetragonal Sn, and this is confirmed directly by torsion experiments on single-crystal rods.

**The Formation of Abstracts by the Selection of Sentences,** G. J. Rath,* A. Resnick, and T. R. Savage, *American Documentation*, **12,** No. 2, 139-143 (April, 1961).

Auto-abstracting techniques based on high-frequency words show an extremely small variation among themselves in the selection of sentences to form abstracts. Human selection of sentences, although less variable than chance expectancy, is considerably more variable than the machine methods. There was very little agreement between the subjects and machine methods in their selection of representative sentences.

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**Frequency Factors in the Thermally Activated Process,** R. Landauer and J. A. Swanson, *The Physical Review*, **121,** No. 6, 1668-1674 (March 15, 1961).

Discussions of the rate $\nu e^{-U/kT}$ for thermally activated processes are usually based on the phase-space distribution function for thermal equilibrium. Kramers has gone beyond this and for the particle in a bistable one-dimensional well has treated the relaxation to equilibrium as a Brownian motion problem in which the one-dimensional motion is

coupled to a reservoir through a viscosity. Kramers' arguments are readily extendable to many dimensions. In the overdamped case the reaction rate is reduced below the value derived from thermal equilibrium theory by the factor $\omega_s/\eta$, where $\omega_s$ is the angular frequency associated with the direction of steepest descent at the saddle point and $\eta$ the viscosity. In the underdamped case equilibrium theory is valid for many-dimensional systems, except for extreme degrees of underdamping.

**Free Oscillations of the Magnetization in Permalloy Films,** Peter Wolf, *Journal of Applied Physics,* (Supplement) **32,** No. 3, 95S-96S (March, 1961).*

Free oscillations of the magnetization are excited in magnetic uniaxial Permalloy films by a small dc step pulse field with less than 0.35 nsec rise time. This field is applied perpendicularly to the magnetization and in the plane of the film. The resulting damped oscillations of the magnetization are detected by a sampling oscilloscope and investigated between 500 Mc and 1200 Mc. The eigenfrequency is determined by a dc field parallel to the magnetization and by the orientation of the easy axis. The eigenfrequencies agree reasonably with the ferromagnetic resonance frequencies of the same films. The damping constants $\lambda$ evaluated from the decay time of the free oscillations and from the line width of ferromagnetic resonance also agree fairly well and are in the range from 100 Mc to 300 Mc. The experimental results are analyzed by means of the Landau-Lifshitz equation.

* For period January 1 through March 31, 1961.

**FRI—A Computer Study,** J. A. Harder, and R. L. Powers, *Electronic Equipment Engineering,* **9,** No. 6, 59-62 (June, 1961).

RF radiation from operating computers was studied with respect to electronic system compatibility. Study shows frequency range and intensity of radiation.

**Galvanomagnetic Effects in *n*-Ge in the Impurity Conduction Range,** R. J. Sladek* and R. W. Keyes, *The Physical Review,* **122,** No. 2, 437-442 (April 15, 1961).

Measurements of the magnetoresistance and magnetic field dependence of the Hall coefficient of several samples of *n*-type germanium in the impurity conduction range have been made employing magnetic field strengths up to 28 kgauss. The magnitude and the crystalline anisotropy of the magnetoresistance are interpreted in terms of the changes in the donor wave functions which are produced by the magnetic field. The field dependence of the Hall coefficient is interpreted as a magnetoresistance effect of the conduction band.

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**Galvanomagnetic Properties of *n*-Type $CdAs_2$,** A. S. Fischler, *The Physical Review,* **122,** II, No. 2, 425-429 (April 15, 1961).

Galvanomagnetic measurements on oriented, single crystals of *n*-type $CdAs_2$, a noncubic semiconductor, indicate the surfaces of constant energy to be ellipsoids of revolution, located along the symmetry axis of the crystal system. The ratio of electronic mobility is found to be $\mu_{\parallel}/\mu_{\perp} \sim 4$ from Hall and resistivity data. Magnetoresistance measurements confirm this conduction-band model and indicate the scattering to be due primarily to acoustical lattice modes with some degree of impurity scattering.

**How to Design the Soldered Electrical Connection,** H. H. Manko, *Product Engineering,* **32,** No. 24, 57-64 (June, 1961).

This article concentrates on the most difficult phase of the electrical, soldered connection—the designing of the connection—and gives a complete design procedure covering all types of solder joints. A straightforward design procedure is given herein to take care of the basic requirements of an electrical, soldered connection. All the standard types of solder joints are covered in this report.

**Hydraulic Logic: What's Its Potential?,** H. H. Glaettli, *Control Engineering,* 84S-86S, (May 1961).

Signal-level hydraulic switching devices offer a new tool from which to build logic networks. Speed is about the same as that of conventional relays, while a simple valve's logic power lies midway between that of transistors and relays. Although hydrodynamic and inertial effects cause problems, practical devices have been built and more are proposed. And the future looks bright since the use of plastic molding techniques to form multielement units promises lower production costs and higher switching speeds.

**The Hygroexpansivity of Tabulating Cards,** T. D. Callinan, J. S. Crimi, P. M. Schwartz and L. H. Wirtz, *TAPPI,* **44,** No. 6, 163A-171A (1961).

The hygroexpansivity of five tabulating card stocks have been determined over the relative humidity range 0 to 98%. A Thwing-Albert NBS Expansimeter was employed in the tests. Unbleached sulfate, semibleached sulfate and semibleached sulfite stocks were studied. Their chemistry, fiber distribution, and moisture adsorption isotherms were determined. The effect of humidity cycling on the hygroexpansivity coefficients was established. The anamolous decrease in dimensions which occurs at elevated humidities has been studied. The hygroexpansivity coefficient has been found to depend in part on the magnitude and relaxation times of strains which develop in the card stock during manufacture.

**An Indirect Chaining Method for Addressing on Secondary Keys,** L. R. Johnson, *Communications of the Association for Computing Machinery,* **4,** No. 5, 218-222 (May, 1961).

Methods for entering random-access files on the basis of one key are briefly surveyed. The widely used chaining method, based on a pseudo-random key transformation, is reviewed in more detail. A generalization of the chaining method which permits recovery on additional keys is then presented.

**Information Retrieval,** J. H. Veyette, Jr., *The American Behavioral Scientist,* **4,** No. 10, 15-20 (June, 1961).

The mass of information being published and the overlapping and interacting of scientific disciplines to create new technologies contribute to the current problem of information retrieval. The problem exists for the individual, the corporation, the nation, and has international significance as well. Information retrieval is defined and some difficulties associated with it are discussed. Two recent developments of IBM Research and experimentation are briefly described: Keyword-In-Context Index and Selective Dissemination of Information. Some characteristics of regional or discipline-oriented information centers linked together by a high-speed communication system are described.

**Information Theory,** H. H. Goldstine, *Science,* **133,** No. 3462, 1395-1399, (May 5, 1961).

A brief survey is made of the recent developments and the current status of information theory.

**Investigation of Production Requirements for Solderless Wire-Wrapped Electrical Connections,** S. Plasker, A. H. Wenner, and C. A. Selzo, *IRE Transactions on Product Engineering and Production,* **5,** No. 2, 17-28 (June, 1961).

A solderless wire-wrapped electrical connection consists of tightly wrapping solid bare wire around a stationary terminal to produce a durable pressure connection. To meet process requirements consistently, the many variables inherent in the solderless wire-wrapping process must be considered under the major variable factors involved in the process.

**Iterates of Conditional Expectation Operators,** D. L. Burkholder and Y. S. Chow, *Proc. Amer. Math. Soc.,* **12,** No. 3, 490-495 (June 1961).

Let $F_1$ and $F_2$ be two Borel fields and $X$ a random variable with $E(X^2)<\infty$. Put $X_0=X$ and $X_{n+1}=E(X_n/F_{n+1})$, where $F_{2n+1}=F_1$ and $F_{2n}=F_2$. Then $P(\lim X_n \text{ exists})=1$.

**Lattice Thermal Conductivity of Germanium-Silicon Alloy Single Crystals at Low Temperatures,*** Arnold M. Toxen, *The Physical Review,* **122,** No. 2, 450-458 (April 15, 1961).

Thermal conductivity measurements are reported for five single-crystal Ge-Si specimens containing 0 to 7.56 at. % Si. The measurements were made under steady-state conditions and cover the temperature range 2° to 50°K. The experimental results are compared to three theoretical models, those of Berman et al, Callaway, and Klemens; it is found that the data are best fit by Callaway's model. Good agreement between experimental results and theoretical models is obtained by postulating only three sources of phonon scattering in the specimens: three-phonon processes, isotopic point-defect scattering by the germanium and silicon atoms, and boundary scattering. However, evidence is presented that boundary scattering occurs not only at the external surfaces of the specimens, but also at internal surfaces associated with microscale fluctuations of composition of the type reported by Goss, Benson, and Pfann.

* The experimental work reported is part of a thesis submitted in partial fulfillment of the requirements of the degree of Doctor of Philosophy at Cornell University and was supported in part by a grant from the National Science Foundation.

**Low-Temperature Thermal Resistance of *n*-Type Germanium,** R. W. Keyes, *The Physical Review,* **122,** No. 4, 1171-1176 (May 15, 1961).

It is proposed that the scattering of phonons by donors in germanium at low temperatures results from the large effect of strain on the energy of an electron in a hydrogen-like donor state. A calculation of the thermal conductivity with this scattering mechanism is presented. Reasonable agreement with the following features of the observed thermal conductivity is obtained: the very large scattering power of donors, the difference between the scattering powers of antimony and arsenic, a temperature dependence of thermal conductivity stronger than $T^3$, and a dependence of the scattering on number of occupied donors rather than on the total impurity concentration.

**Magnetic Short Range Order and Specific Heat in Ferromagnets and Antiferromagnets,** J. S. Smart,* *Journal of the Physics and Chemistry of Solids,* **20,** Nos. 1/2, 41-49 (June, 1961).

The Oguchi method is extended to allow for both first and second nearest-neighbor interactions. The results are used to calculate the magnetic short-range order parameters and the magnetic specific heat above the transition temperature for both ferromagnets and antiferromagnets.

* Office of Naval Research Department, Washington, D. C. and IBM Research Center.

**Measurement of Hysteresis Loops of Thin Magnetic Films,** H. J. Oguey, *Fifth International Instruments and Measurements Conference,* Stockholm, September 13-15, 1960, Academic Press, New York and London, vol. 2, pp. 907-916, 1961.

For the low-frequency measurement of thin magnetic film hysteresis loops, the two main problems are the flux calibration and the sensitivity. The percentage of flux picked up by a flat, long coil is given here with an accuracy of 2%. The sensitivity is increased by a reduction of all possible disturbances, involving noise, unwanted coupling between driving and measuring equipment, and hum. A laboratory instrument is described permitting display of hysteresis loops at frequencies between 50 and 10,000 cps. The minimum detectable flux is about $5\times10^{-14}$ webers corresponding, for example, to the saturation flux of an Fe film of $2\times10^{-8}$ mm² cross section.

**Microwave Bistable Circuits Using Varactor Diodes,** C. L. Heizman,* *Proc. IRE* (Correspondence), **49,** No. 4, 829-830 (April, 1961).

Fast microwave switching circuits with switching times of the order of a few nanoseconds, have been built using varactor diodes. The circuits use the nonlinear capacitance and rectification properties of the varactor to generate a negative resistance. Similar negative resistance phenomena have been reported recently but they had been attributed to new high-frequency semiconductor phenomena.

**Miniature Hall Probe Maps Magnetic Fields,** D. D. Roshon, *Electronics,* **34,** No. 24, 68-71 (June 16, 1961).

A Hall effect probe is described which has proven suitable for mapping magnetic fields of small structures. Probes with sensitive areas as small as $0.0004\times0.0004$ inch have been constructed using evaporated films of bismuth. With suitable instrumentation, which is briefly described, fields as small as 0.01 gauss have been measured. The device has been used for examining the magnetic fields of components such as recording heads.

**Nuclear Magnetic Resonance of $Ni^{61}$ in Metallic Nickel,** L. J. Bruner, J. I. Budnick and R. J. Blume, *The Physical Review,* **121,** No. 1, 83 (January, 1961).

The nuclear magnetic resonance of $Ni^{61}$ in unenriched metallic nickel has been observed. The results provide the first ex-

perimental measure of the internal field at the nucleus in nickel. The resonance occurs at a frequency of 26.02 Mc/sec at room temperature, yielding an estimate of 170 kilogauss for the internal field.

**Nuclear Magnetic Resonance of $Fe^{57}$ in Unenriched Fe,** J. I. Budnick, L. J. Bruner, R.J. Blume and E. L. Boyd, *Journal of Applied Physics,* (Supplement) **32,** No. 3, 120S-121S (March, 1961).

The nuclear magnetic resonance of $Fe^{57}$ has been observed in iron specimens in the form of powders of various sizes, foils and whiskers. Our results are consistent with previously reported work of Gossard, Portis and Sandle on enriched iron, and with the work of Robert and Winter on natural iron. We find that the resonant frequency varies slightly among nominally pure iron specimens taken from different sources, suggesting that it is somewhat sensitive to impurity content. Prestrain of the specimen has a marked effect, the resonance in cold-rolled foil being very broad and weak compared to that observed in annealed foils. Observations of nuclear magnetic resonance in iron whiskers oriented both axially and transversely in the rf coil offer interesting confirmation of the domain wall enhancement mechanism put forth by Gossard and Portis. The temperature dependence of the $Fe^{57}$ resonance has been investigated in the range 77° to 785°K.

**Nuclear Magnetic Resonance in $(NH_4)_2(BeF_4)_x(SO_4)_{1-x}$ and Other Ferroelectric Systems,** Gerald Burns, *The Physical Review,* **123,** No. 1, 64-66 (July 1, 1961).

The temperature dependence of fluorine and proton nuclear magnetic resonance (NMR) in polycrystalline samples of the solid solution $(NH_4)_2(BeF_4)_x(SO_4)_{1-x}$ has been measured for several $x$. This solid solution is ferroelectric for high and low $x$ and is paraelectric in between. A sharp transition in the second moment of the $F^{19}$ resonance was observed and found to be independent of $x$, while the ferroelectric properties are dependent on $x$. The proton NMR showed the nonequivalence of the $NH_4$ groups, but again the temperature dependence could not be correlated with the ferroelectric properties. Thus, the ferroelectric behavior of this system cannot be associated with the appealing hypothesis of the freezing in of the vibrating $NH_4$ or $BeF_4$ groups. The temperature dependence of the proton NMR was also observed in the ferroelectric compounds $(NH_4)_2Cd_2(SO_4)_3$ and $NH_4HSO_4$. Similar conclusions can be drawn from these measurements as those given above. In some of the alums, the crystallographic phase transition is again not accompanied by any change in the proton resonance line. However, in $N_2H_5Al$ alum and $NH_3OHAl$ alum, there is a very abrupt change in the NMR line at the temperature of the phase transition.

**Nucleation Processes in Thin Permalloy Films,** S. Methfessel, S. Middelhoek, and H. Thomas, *Journal of Applied Physics,* (Supplement) **32,** No. 3, 294S-295S, (March, 1961).*

Normally, wall motion in thin Permalloy films starts from nuclei of reversed magnetization at the edges of the film, which are created by the demagnetizing field. Therefore, for the investigation of nucleation processes inside the film, the edge effects have to be suppressed. This has been done by two methods: The first is based on the use of inhomogeneous driving fields, and the second on the formation of a high coercive force barrier between the edges and the central area of the film. This barrier prevents the edge domains from moving into the central area. Depending on the maximum amplitude of the driving field, different modes of nucleation are possible, leading to different hysteresis loops. Since the domain nucleation must be attributed to a rotational process, the starting field is measured as a function of the uniaxial anisotropy field, which is changed by bending the film. The results agree with the dependence found by Preisach for Permalloy wires under stress.

* For period January 1 through March 31, 1961.

**On Lagrange Multipliers and Inequalities,** W. S. Dorn, *Operations Research,* **9,** 95-104 (January-February, 1961).*

Necessary and sufficient conditions for minima (maxima) of nonlinear functionals subjected to linear constraints are derived. Two classes of functionals are considered: (a) convex (concave) functionals for which necessary and sufficient conditions for global minima (maxima) are obtained, and (b) more general functionals possessing continuous second derivatives for which necessary and sufficient conditions for local optima are obtained. In the first case the theorems presented here are special cases of the well-known Kuhn-Tucker theorems. Some simple examples are included.

* For period January 1 through March 31, 1961.

**Optimization of Process Performance,** L. Lapidus, E. Shapiro, S. Shapiro, and R. E. Stillman, *Journal of the American Institute of Chemical Engineers,* **7,** No. 2, 288-294 (June, 1961).

The growing availability of fast, large memory digital computers has made it practical to consider the physical implementation of control system designs incorporating appropriate strategies for automatic process optimization. The control system is taken to consist of the process to be optimized together with the interconnected digital computer. In the present paper a number of such programs or algorithms are discussed for carrying out a search of the possible settings of the process input (independent) variables in such a way as to locate an extremal of the possible values of a chosen objective function. The magnitude of these variables is determined from measurements taken of the dependent variables in the process. It is shown that for the particular process used as an example it is desirable to alter the search strategy as the optimization proceeds in order to locate the extremal in a minimum amount of time. The emphasis at the beginning of the search is on speed in moving towards the optimum and at the end on accuracy.

**Paper-to-Magnetic Tape Converter,** D. K. Close, L. W. George, R. E. McGayhey, and E. A. Wheeler, *Electromechanical Design,* **5,** No. 4, 24-27 (April, 1961).

The paper explains how the IBM 7765 Converter transcribes paper tape information to magnetic tape at 150 characters per second. Off-line conversion operation makes possible the entering of paper tape information into computing systems by 200 bits-per-inch magnetic tape. The paper tape reader features chad (fully perforated) and chadless (partially perforated) reading, and center roll, strip and reel feeding with simplified reel controls. The magnetic tape

writer features character-by-character (incremental) writing on a demand basis and semi-automatic tape loading. In keeping with the policy of standard modular packaging and lower costs of higher quality production, the paper tape reader and magnetic tape writer were designed to be used as a component of other systems as well as the IBM 7765. The use of solid-state circuitry throughout the system and packaging to achieve most efficient serviceability were considered essential.

**Photography Speeds Printed Circuit Design,** F. E. Barrows and R. S. Ladd, *Electronics,* **34,** No. 14, 102-104 (April 7, 1961).

The design of printed circuit boards has been automated through a rearrangement of known engineering and photographic techniques. A transparent, pre-bored plastic template and brass buttons are used to photographically produce the initial artwork. Lines and marginal information are added to make the final artwork, which is reduced and used to make detail drawings and assembly drawings. Engineering time is substantially reduced with an equal or better degree of accuracy.

**Photoionization of Triarylmethyl Leuconitriles,** A. H. Sporer, *Transactions of the Faraday Society,* **57,** No. 6, 983-991 (June, 1961).

Two photoreactions of triarylmethyl leuconitriles have been observed, dye formation and cleavage of substituents on the amine nitrogens. The cleavage reaction is most easily observable in solvents having a low dielectric constant and occurs with a quantum yield of about 0.02. This reaction apparently occurs in photoexcited molecules in the triplet state. Cleavage also occurs in solvents with a high dielectric constant but is masked by the second photoreaction, dye formation, which occurs with a much higher quantum yield. Dye formation does not occur in the singlet excited state or in the triplet excited state. It is therefore proposed that the reaction occurs when the molecule undergoes internal conversion. The dye-forming reaction occurs with a quantum yield close to unity in ethanol and with a quantum yield of 0.25 in water.

**The Perception of all Patterns Produced by a Seven-Line Matrix,** E. T. Klemmer, *Journal of Experimental Psychology,* **61,** No. 4, 274-282 (April, 1961).

Two experiments investigated the reproduction of linear visual patterns following brief exposures. The patterns were produced by randomly selecting lines from a 7-line matrix in the form of a block figure 8. The 128 patterns of which this source is capable were ranked for difficulty and the common features of the better-seen patterns identified as continuity, symmetry, inclusion of a closed loop, and meaningfulness. The measure of perception by a post-stimulus cuing technique was also studied.

**Polymers and the Theory of Numbers: Molecular Weight Distributions from Rheological Measurements,** W. L. Peticolas and E. Menefee,* *Nature,* **189,** No. 4766, 745 (March 4, 1961).

A method for the determination of molecular-weight distributions of linear polymers from the measurement of rheological properties has been developed from a mathematical extension of the molecular theories of rheology. The procedure involves the novel use of a classical theorem of number theory and appears to be one of the very few physical applications of this branch of mathematics.

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**Potentials in a Conductor of Varying Cross Section,** R. Jaggi, *The Physical Review,* **122,** No. 2, 448-449 (April 15, 1961).

A Bernoulli voltage, $V_B$, proportional to the square of the current $I$, may be expected in a conductor of varying cross section. Previous experiments to detect $V_B$ are discussed. It is pointed out that in such experiments a Hall voltage, $V_H \propto I^2$, due to the magnetic field of the current $I$ ("eigen-Hall effect" EHE), is superposed on $V_B$. The ratio $V_H/V_B$ is calculated. Experiments are performed on a bismuth sample of varying cross section. The dependence of the measured voltages upon temperature and cross-sectional area shows that the EHE is dominant over the Bernoulli effect.

**Producing Powder Metallurgy Parts,** P. V. Schneider, *Tool and Manufacturing Engineer,* **46,** No. 5, 81-86 (April, 1961).

The advantages of powder metallurgy fabrication are discussed, comparing the process to conventional metal forming processes. A number of representative case studies of complex configurations are reviewed which illustrate the scope of the powder metal process. Ideal shapes are illustrated, along with practical and impractical contours. A brief comparison of low, medium, and high density applications is made, and tolerance capabilities are indicated. A flow chart for sintered metal processes is included which visually illustrates a number of process variables.

**Providing an Engineering Environment for Modern Computers,** J. F. McGovern, *Plant Management and Engineering,* **23,** No. 4, 20-23 (April, 1961).

An outline is given of the important considerations in proper environment so essential to the efficient and reliable performance of computer units.

**A Quantitative Assay for the Number of Chromotophores on a Chromoprotein; its Application to Phycoerythrin and Phycocyanin,** S. S. Brody and M. Brody, *Biochimica et Biophysica Acta,* (Netherlands), **40** (June, 1961).

A nondestructive assay for the number of chromophore groups, $R$, associated with a chromoprotein (e.g., phycoerythrin, phycocyanin) and the molar extinction coefficient $\epsilon_m$, can be made with the aid of the chromoproteid's particle weight, specific extinction coefficient and fluorescence life time, and fluorescence yield. The $\epsilon_m$ and $R$ for phycocyanin and phycoerythrin were determined to be respectively $8 \times 10^4$

$l$/mole cm and 26 and $1.5\times10^4$ $l$/mole cm and 30. The $\epsilon_m$'s are lower and the $R$'s higher than those obtained previously by chemical analysis.

**Quantum Effects in Diffusion: Internal Friction due to Hydrogen and Deuterium Dissolved in $\alpha$-Iron,*** W. R. Heller, *Acta Metallurgica,* **9,** 600-613, (June 1961).

This work is an experimental and theoretical study of internal friction due to hydrogen and deuterium dissolved in $\alpha$-iron. A torsion pendulum is employed which can be used in a Collins cryostat at temperatures in the range 4.2° to 300°K. A peak of damping is found in the range 105° to 120°K corresponding to that earlier studied by Gensamer and co-workers. An additional peak associated with hydrogen is found at 30°K and, correspondingly, one associated with deuterium is found at 35°K. Magneto-mechanical damping is found at all temperatures, with a peak in the range 4.2° to 15°K depending upon treatment of the metal specimen. Theoretical arguments are advanced which suggest that the isotope-shifted peaks are due to atoms dissolved in the undistorted lattice, whose motion must be treated quantum-mechanically to account for the experimental results. Tunneling and localized lattice distortions around the dissolved atom seem to be required by the data and are within the scope of a reasonable theory.

* The experimental work described in this paper was carried out at Shell Development Co., Emeryville, California, while the theoretical interpretation has been carried through at the IBM Research Center.

**Recording and Reproduction of NRZI Signals,** R. S. Schools, *Journal of Applied Physics,* (Supplement), **32,** No. 3, 42S-43S (March, 1961).

A systematic theoretical study of a non-return-to-zero type of recording and reproduction in digital magnetic tape systems was undertaken to better understand their details. The dependence of tape magnetization and of output signal pulse width and amplitude on the major system parameters has been investigated and determined. These parameters are the magnetic field distribution of the recording head, WRITE current wave-form tape thickness and hysteresis characteristics, head-to-tape spacing, reading gap length, and bit density. A portion of this study concerns the extension of the sinusoidal theory to include the reproduction of signals resulting from saturation recording. This is done by a Fourier analysis of the tape magnetization and a term-by-term summation of harmonic responses to obtain the resultant signal. The results show why high writing field gradients, high tape $B$-$H$ "squareness," and thin tapes are needed for high-density recording. They indicate possible reasons for emf pulse-peak position asymmetries during readback. Two examples are included here, showing for one case the signal amplitude and pulse width vs bit density, compared with experimental measurements. Also, the field distribution above the magnetized tape is presented, indicating the influence of the presence of the READ head.

**rf Gate with $10^9$ Carrier Suppression,** R. J. Blume, *The Review of Scientific Instruments,* **32,** No. 5, 554-556 (May, 1961).

A 10.7 Mc/sec cw reference oscillator drives the cathode of a planar triode grounded-grid amplifier, which is normally cut off by −20 v on its plate. The grounded planar grid forms a perforated region in the wall of a copper can which otherwise totally shields both the cw oscillator and the planar cathode. Radio-frequency energy, which leaks capacitively from that cathode through the grounded grid to the negative plate, is bypassed to ground at the plate through a conducting diode. A positive gate voltage applied to the plate switches off the bypass diode and causes the ground grid stage to amplify the rf voltage on its cathode. The following power amplifier stage, whose input is dc coupled, develops about 100 v rf output during the positive gate. When the gate is off, the output of the power amplifier is $\leq 10^{-7}$ v. The carrier suppression ratio is therefore $\geq 10^9$, or 180 db. The ungated cw signal is continuously available. Circuitry, leakage measurement, and shielding are described in detail.

**Selective Dissemination of New Scientific Information with the Aid of Electronic Processing Equipment,** H. P. Luhn, *American Documentation,* **12,** No. 2, 131-138 (April, 1961).

Improvement of scientific communication is sought through machine-assisted dissemination of new information. A service system is described in which a new document is characterized by a vocabulary or pattern of keywords. This pattern is then compared with the vocabularies, or "profiles," characterizing each of the participants of the service. If a given degree of similarity exists between the two, the affected participants are notified by a card carrying an abstract. The recipient signifies whether the information is in fact relevant or not by returning or not returning a stub provided with the card. His affirmative response, which may include his request for a copy of the document, is reflected on his profile by incorporating the pattern of the accepted item. Profiles are kept current by discarding patterns after they have reached a certain age. The feedback includes notification of authors as to the reception of their work. The service also facilitates participants' referral of information to others and generally endeavors to promote interchange of information by personal contact.

**Self-Dual Quadratic Program,** W. S. Dorn, *SIAM Journal,* **9,** 51-54 (March, 1961).*

Two programming problems, one a maximization and one a minimization, are said to be dual if (1) the existence of an optimal solution to one implies the existence of an optimal solution to the other, and (2) the optimal values of the objective functions are identical. A class of quadratic programs whose dual programs are equivalent to the original program are defined. It is shown that such programs always have a solution and that they take on their optimal values at an extreme point of the constraint set.

* For period January 1 through March 31, 1961.

**Silicate Melts with Indications of Ino Structures,** E. C. DeWys, *Minerological Magazine* (London) **32,** No. 251, 640-643 (December, 1960).*

Evidence is presented for the existence of silicon-oxygen chains up to 1000 A length of $CaMgSi_2O_6$ at temperatures a little above the melting point.

* For period October 1 through December 31, 1960.

**Simplifying Switching Circuits with Boolean Algebra,** G. A. Maley, *Electro-Technology,* **67,** No. 5, 101-106 (May, 1961).

Digital computers are designed today with the transistor and junction rectifier as basic switching elements. Mass fabrication substantially lowers the cost of some simple circuit configurations but not the complex circuits. Since mass fabrication requires that a computer or a switching network be constructed from as few different types of components as possible, the use of a universal connective is dictated. A universal block is a connective from which an entire logic net may be constructed without the aid of other connectives. The circuits discussed herein are all universal connectives and are called NAND connectives since their logic configurations are basically AND connectives feeding inverters. Though the discussion is limited to only the NAND connective, the methods presented also hold for the NOR connective if negative logic is used. This is possible since both connectives are actually duals of each other.

**Simultaneous Preparation of Library Catalogs for Manual and Machine Applications,** R. E. Durkin and H. S. White, *Special Libraries,* **52,** No. 5, 231-237 (May/June, 1961).

A system has been devised which permits the production of regular library 3" x 5" catalog cards and library announcement bulletins on an economical basis through the use of IBM unit record machine equipment. At this same time, as a side product of the punched card input, the system permits a machine library-circulation-control system, the printout of machined catalogs and reading lists, and a punched card input for an information retrieval or Selected Dissemination of Information system (SDI).

**Slow-Sweep Modification of the Tektronix Type 162 Waveform Generator,** R. J. Blume, *Review of Scientific Instruments,* **32,** No. 6, 743-744 (June, 1961).

A modification of a widely used instrument is described, which enables it to generate linear voltage sweeps lasting for hours, and affording considerable advantages over motor-driven potentiometers used for the same purpose.

**Step-by-Step Design Techniques Multi-layered Thin Film Networks,** W. N. Carroll, and F. F. Jenny, *Electronics,* **34,** No. 20, 90-93 (May 19, 1961).

Thin film passive networks and interconnections can reduce size and weight of electronic assemblies without appreciably increasing costs. Results of a study program are described.

**Spin and Hyperfine Structure of Arsenic-76*,** R. L. Christensen, D. R. Hamilton,** H. G. Bennewitz,† J. B. Reynolds,‡ and H. H. Stroke,§ *The Physical Review,* **122,** 1302-1316 (May 15, 1961).

Hyperfine structure in the $^4S_{3/2}$ ground state of the radioactive atom $As^{76}$ has been investigated by the method of magnetic resonance in an atomic beam produced by microwave discharge dissociation of arsenic vapor. $\Delta F=0$ resonances were observed within both the $F=5/2$ and $F=7/2$ atomic levels at several values of magnetic field up to about 5 oe, indicating that the spin of the $As^{76}$ nucleus is 2. An analysis of multiple quantum transition spectra within the same $F$ states gave a measurement of two of the hfs intervals: $\Delta\nu_{7/2,\,5/2}=\pm(117\pm4)$ Mc/sec and $\Delta\nu_{5/2,\,3/2}=\pm(69\pm16)$ Mc/sec, with the same sign for both. From the value of the hfs constant $A$, the magnitude of the magnetic field at the arsenic nucleus is $(1.33\pm0.15)\times10^5$ oe in reasonable agreement with the variation in this field among similar atoms. The value of $gJ$ has been found to be $1.994\pm0.003$ for arsenic.

* Work performed at Princeton University and supported by the U. S. Atomic Energy Commission and the Higgins Scientific Trust Fund.
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**A Technique for Implementing Synchronous Sequential Relay Circuitry,** R. L. Gamblin, M. P. Marcus, and C. J. Tunis, AIEE Conference Paper No. CP 61-842, presented at the *AIEE Summer General Meeting,* Cornell University, Ithaca, N. Y., June 19, 1961.

Dc relays, an ac source, and diodes provide a means for implementing sequential relay circuitry. This system has the advantage of eliminating the necessity of making or breaking current with relay contacts, eliminates critical races, and offers a generalized method for realizing sequential clocking.

**Theory of Localized Contributions to the Chemical Shift. Application to Fluorobenzenes,*** M. Karplus** and T. P. Das,† *Journal of Chemical Physics,* **34,** No. 5, 1683-1692 (May, 1961).

An expression for the magnetic shielding tensor is obtained by the use of single-determinant Hartree-Fock molecular wave functions. For nuclei of atoms in which the change in the second-order (paramagnetic) contribution is dominant, LCAO theory is employed to express the shielding in terms of localized bond parameters (ionic character, hybridization, and double bonding) and to compare it with the related treatments of the quadrupole coupling constant. Application of the formulation to the multifluorobenzenes provides an explanation of the available experimental chemical shift data and permits the prediction of shift values for other compounds. Of particular interest is the demonstration that double bonding in the *C-F* bond plays an important role in the fluorobenzenes. Also, the presence of an "ortho" effect in the shift is isolated by a comparison of experimental and theoretical results and tentatively explained in terms of charge repulsions.

* Much of the work was done while the authors were at the Departments of Physics (T.P.D.) nad Chemistry (M.K.) of University of Illinois, Urbana.
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**Theory of Magnetostriction in Cobalt-Manganese Ferrite,** John C. Slonczewski, *The Physical Review,* **122,** No. 5, 1367-1372 (June 1, 1961).

The magnetostrictive effect of an orbitally degenerate magnetic ion in a cubic ferromagnet is calculated in detail using crystal-field theory. In contrast to our previous work, it is not assumed that interatomic exchange energy is large compared with spin-orbit energy. The results are applied to the effect of cobalt in cobalt-manganese ferrite. It is found that the theory is consistent with experimental results for the magnetostrictive parameters $\lambda_{100}$ and $\lambda_{111}$ in the compound $Co_{0.245}Mn_{0.747}Fe_{1.99}O_4$ from 225° to 355°K. By fitting theory to experiment, a trigonal splitting of about 630 $cm^{-1}$ for the ground state of the cobalt ion is inferred. The trigonal splitting has less than half its value in cobalt-iron ferrite.

**Thermal Conductivity of Pure Indium,** R. E. Jones and A. M. Toxen, *Proceedings of the VIIth International Conference on Low Temperature Physics,* G. M. Graham and A. C. Hollis Hallett, Eds., University of Toronto Press, pp. 222-224, 1961.

The thermal conductivity of a pure indium specimen was measured in the normal and superconducting states in the range of temperatures 1.3° to 4.2°K. Near the transition temperature the ratio of conductivities $K_s/K_n$ exhibited the finite slope with temperature characteristic of electronic conduction limited by phonon scattering. The results were compared with a simple model proposed by Kadanoff and Martin and the agreement was found to be good.

**Theory of Majority Decision Elements,*** S. Muroga,† I. Toda‡ and S. Takasu,‡ *Journal of The Franklin Institute,* **271,** No. 5, 376-418 (May, 1961).

A decision-making organization whose output is either 1 or 0 according to which of the numbers, 1 or 0, in its inputs is predominant, is defined as the majority decision element. The Boolean function represented by such an element is called the *majority decision function.* Elements of this sort occupy an important role in the computer field. The present paper deals with various problems concerned with a single element of this sort; that is, in Section 3, the algebraic properties, and a necessary condition for realizability of a given function; in Section 4, the types of functions realizable by a single element; in Section 5, the determination of structure of the element for a given function by means of linear programming; and in Section 6, properties of the functions of a small number of variables realizable by a single element.

* Work performed at Electrical Communication Laboratory, Nippon Telephone and Telegraph Public Corporation.
† Formerly with Electrical Communication Laboratory, Nippon Telephone and Telegraph Public Corporation.
‡ Electrical Communication Laboratory, Nippon Telephone and Telegraph Public Corporation.

**A Thermodynamic Analysis of the System Anorthite-Akermanite,** E. C. DeWys, *Minerological Magazine,* London, **32,** No. 251, 644-649 (December, 1960).*

From thermodynamic considerations of the system anorthite-akermanite, it appears that the melts in this system are ionic in nature. The liquidus relation in this system would thus seem to afford confirmation of the theory, based on conductivity measurements, that silicate melts such as molten anorthite dissociate into such ions as $Ca^2$ and $(Al_2Si_2O)^{2-}$.

* For period October 1 through December 31, 1960.

**Three-Dimensional Core Memory Accommodates One Million Bits,** *Electronics,* **34,** No. 19, 68-71 (May 12, 1961).

Storage unit handles 16,384 words, each of 72 bits length, by a three-dimensional process of word selection and READ. The memory cycle time for selecting any word at random from the system is 2.18 μsec.

**Transistor Circuit Simulator,** R. H. Breedlove and A. R. Berding, *Electronics,* **34,** No. 22, 56 (June 2, 1961).

A transistor circuit simulator designed to determine bias point limits, ac gain, and input impedance for transistor Class A amplifier stages is described. With the simulator, more accurate results can be achieved in considerably less time than has previously been possible.

**Transmission-Type Piezoelectricity Detector,** R. J. Blume, *Review of Scientific Instruments,* **32,** No. 5, 598-599 (May, 1961).

Description of a simple circuit, developed for use by crystallographers, which indicates whether a crystal is piezoelectric. It appears to be more sensitive and convenient than the oscillating detectors commonly used.

**Treated and Untreated Paper and Boards,** Thomas D. Callinan, *Insulation* **7,** No. 6, 64-75 (May, 1961).

The present status and anticipated progress in the field of electrical insulating papers is discussed. The increasing importance of engineering and physics in a technology which was usually considered a subdiscipline of chemistry is established.

**Unit Cells and Space Groups of a Series of N-(ω-dimethylaminoalkyl)-phthalimide Methiodides,*** James E. Weidenborner and L. Edward Godycki,** *Acta Crystallographica,* **14,** Pt. 6, 695 (June, 1961).

Pharmacologic tests have shown that the curare-like activity of monoquaternary N-(ω-dialkylaminoalkyl)-phthalimides is a function of the methylene chain length. In an attempt to establish a relationship between structure and paralyzing activity, three compounds in a series of N-(ω-dimethylaminoalkyl)-phthalimide methiodides were selected for single-crystal x-ray diffraction studies. The crystallographic data obtained show increasing crystal-structure symmetry as the length of the methylene chain is increased.

* Work done at Chemistry Department, St. Louis University, St. Louis, Missouri.
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**Uniqueness in the Optimum Design of Structures,** T. C. Hu* and R. T. Shield,** *Journal of Applied Mechanics,* **28,** 284-287 (June, 1961).

A procedure was developed by Drucker and Shield for the determination of the optimum design of a sandwich shell or structure. The uniqueness of the optimum design obtained by this procedure is investigated and it is shown that all optimum designs admit a common collapse mode. This result is used to prove the uniqueness of minimum-weight designs obtained in previous work.

* Work done while T. C. Hu was at Brown University, Providence, R. I.

** Brown University, Providence, R. I.

**Vapor Pressure and Solid Vapor Equilibrium of CdSe,** G. A. Somorjai, *Journal of Physical Chemistry,* **65,** 1059-1061 (June, 1961).

Cadmium selenide equilibrium vapor pressures were measured in the temperature interval 600° to 1000°C using a Bourdon gauge and a dew point apparatus, and the degree of dissociation of the vapor was determined by comparison of the two measurements. Based on the data, CdSe is believed to undergo thermal dissociation according to the reaction $CdSe(s)=Cd(g)+\frac{1}{2}Se_2(g)$. The dissociation pressure of CdSe can be expressed by the equation $\log P_{mm}=-10020/T°K+9.8$. For the reaction $\Delta H=68.5$ kcal/mole at 1100°K.

**Zur Frage der Vorzeichenumkehr des Magnetfeldes beim Meissnereffekt II. Diffuse Oberflächenstreuung.** (On the Possibility of Sign-reversal of a Magnetic Field Penetrating a Superconducting Layer, II. Scattered Surface Dispersion) R. Sommerhalder and H. Thomas, *Helvetica Physica Acta,* **34,** Fasc. 3, 265-271, (May, 1961).

Our recently published calculations of the penetration of a longitudinal magnetic field through the wall of a superconducting hollow cylinder, according to Pippard's nonlocal theory with specular reflection of the electrons at the surfaces, have been extended to cover the case of diffuse scattering of the electrons at the surfaces.

It is shown by numerical analysis that the wall thickness, above which the magnetic fields inside and outside the hollow cylinder have different signs, is about 750 A larger, and the maximum field attenuation ratio available for experimental detection of the sign reversal, about twice as low for diffuse as for specular surface scattering. Both results do not depend upon the value of the coherence length.

Because of the strong similarity between the BCS and Pippard kernels, these results should also be fairly representative for the BCS theory.