## TABLE OF CONTENTS

Publications and Reports v
Personnel vii
Introduction ix

### Physical Electronics

1. **Electron-Emission Problems**
   1. Thermionic Work Function and Conductivity of Oxide-Coated Cathodes
   2. Thermionic Emission from Ultrafine-Grain Oxide-Coated Filaments
   3. Deterioration of Oxide-Coated Cathodes under Low Duty-Factor Operation
   4. Purified Standard Diodes
   5. Determination of the Field-Emission Properties of Single Tungsten Crystals by a Photometric Method
   6. Photoelectric Emission
   7. Effect of Impurity Surface States on the Photoelectric Threshold in Semiconductors 7

2. **Studies with Gaseous Discharge**
   1. Investigation of Low-Pressure Mercury Arcs

3. **Experimental Techniques**
   1. Spectral Emissivity of Tungsten
   2. Ionization Gauge Study
   3. An Electronic Circuit for the Operation of an Ionization Gauge

### Microwave Gaseous Discharges

1. 100-Megacycle Breakdown
2. Positive Ion Analysis

### Solid State Physics

1. Quantum Theory of Antiferromagnetism
2. Soft X-Ray Vacuum Spectrograph
3. Paramagnetic Resonance
4. The Theory of the Transport Phenomena in Metals

### Low-Temperature Physics

1. Helium Liquefiers
2. Measurement of Pressure-Variation of Second Sound Velocity in Liquid Helium II
3. Investigation of Dipole Interaction in Crystals
4. Cooling Liquid Helium by Adiabatic Demagnetization
5. Measurement of Magnetic Susceptibility
6. Magnetic Cooling

### Radio-Frequency Spectroscopy

1. Molecular-Beam Research
   1. The Fourth Atomic-Beam Apparatus
2. Nuclear Magnetic Resonance
   1. Optical Detection of Radio-Frequency Resonance in Excited Atomic States
   2. Factors Influencing the Positions of Nuclear Magnetic Resonances
   3. Liquid Nitrogen Magnet
   4. Simplified Circuit for Nuclear Magnetic Resonance Experiments
3. Microwave Spectroscopy
   1. Intensity Measurements and Line Shapes of Formaldehyde
   2. Precision Stark Measurements
   3. Sulphur
VI. Tube Research and Development

A. Magnetron Development
   1. High-Power 10.7-Cm Magnetron
   2. Magnetron Research
   3. Cathode Research

B. Microwave Tubes
   1. Microwave Noise Studies
   2. Debunching Forces in a Beam of Finite Diameter
   3. Electron Beam Measuring Technique
   4. Dense Electron Beams in Axial Magnetic Fields

C. The Generation of Millimeter and Infra-Red Radiation by Accelerated Electrons

VII. Communications Research

A. Multipath Transmission
   1. Speech and Music
      a. Field tests
      b. New receiver
      c. Three-path propagation interference
   2. Television

B. Statistical Theory of Communication
   1. Analogue Electronic Correlator
   2. Digital Electronic Correlator
   3. Detection of Small Signals in Noise
   4. Experimental Determination of System Functions by the Method of Correlation
   5. Optimum Linear System Design Criteria
   6. Application of Wiener's Techniques in Transient Synthesis
   7. Techniques of Optimum Filter Design
   8. Amplitude and Conditional Probability Distributions of a Quantized Time Function
   9. Felix (Sensory Replacement)
   10. Speech Studies
      a. A short-time correlator for speech waves
      b. The effect of syllabic rate on speech intelligibility
   11. Pulse Coding of Picture Signals
   12. Pulse-Code Magnetic Recorder
   13. Twin-Track Recorder for Slow Phenomena

C. Transient Problems
   1. Transient Theories

D. Active Networks
   1. The Synthesis of Servomechanisms

E. Locking Phenomena in Microwave Oscillators
   1. The Mutual Synchronization of Oscillators
   2. Effects of Starting Transients on Synchronized Behavior
   3. A Suppressed-Carrier AM System

VIII. Air Navigation

IX. Miscellaneous Problems

A. Electronic Differential Analyzer
B. Analog Devices for Network Problems
   1. Automatic Impedance-Function Analyzer
   2. The Dipole Potential Analog
   3. The Electronic Isograph
   4. A Panoramic Display for the Electronic Isograph
   5. Electronic Commutator
C. Offset Waveguide Junction