Contents

Introduction 1

Personnel 2

Publications and Reports 4

Research Projects

I Microwave and Physical Electronics
   A High-Power Magnetron Research 5
   B Cathode Research 7
      1 Cathode Interface Studies 7
      2 The Interface as a Blocking Layer 11
      3 Work Functions and Conductivity of Oxide Cathodes 14
      4 Spectral Emissivity of Tungsten 14
      5 Electron Emission in Accelerating and Retarding Fields 14
   C Ionization Gauge Research 14
   D Properties of Cathode-Ray Tube Screens 14
   E Determination of Emission Properties of Single Crystals 14
   F Construction of 5-'1M Oxford Type Tube 15
   G Travelling-Wave Amplifier Tubes 16
      1 Theoretical Considerations 16
      2 Experimental Studies 17

II Microwave Physics
   A Microwave Spectroscopy 18
      1 Microwave-Frequency Bridge (5 mm) 18
      2 Sweep Spectroscope 18
      3 Audio-Frequency Bridge 18
      4 Nuclear Magnetic Moment of Hydrogen 19
      5 Caesium Hyperfine Structure 19
   B Molecular Beam Research 20
   C Low Pressure Gas Discharges 20
   D Low Temperature Research
      1 Helium Liquefi ers 22
      2 Studies on Liquid Helium 22
      3 Studies on Beryllium 22
      4 Superconductivity at 1 25 cm 23
      5 Magnetic Nuclear Resonance Experiments 24
      6 Adiabatic Demagnetization 31
      7 Phase Transitions in the Hydrogen Halides 31
   E Ferromagnetism at Microwave Frequencies 33

III Modern Electronic Techniques Applied to Physics and Engineering
   A Design and Construction of a Microwave Accelerator 34
   B Ultrasonics Research Program 37
      1 Scope and Purpose 37
      2 Ultrasonics as a Tool 37
      3 Pulse Technique 38
      4 Absorption Mechanisms in Liquids 40
      5 Measurement Projects in 15-Mc/sec Range 42
      6 Extension of the Frequency Range 49
   C Development of Flash Tube 53
   D Cyclotron R-F Project 53
   E Three-Cm Sweep-Frequency Oscillator 54
### IV Communications and Related Projects

**A Modulation Studies**  
Spectrum Utilization Efficiency of  
Power Utilization, Signal-to-Noise Ratios  
1 General Analysis of the Transmission of Information  
2 Pulse Modulation Studies  
3 Properties of Random Noise  
4 The Action of Limiters and Discriminators in FM Receivers in the Presence of Noise  
**B Stabilized Oscillator Problems**  
**C Multipath Transmission**  
**D Wideband Amplifier Studies**  
**E Response of Networks to Frequency Transients**

### V Miscellaneous Problems

**A Locking Phenomena in R-F Oscillators**  
**B Electronic Differential Analyzer**  
**C Electronic Potential Mapping**  
**D Transient Phenomena in Waveguides**  
**E Broadbanding of Arbitrary Impedances**  
**F Elementary Properties of the Partition Function in the Order-Disorder Problem**  
**G Remarks on Approximation of a Specified Amplitude and Phase by a Linear Network**