Contents

Introduction 1

Personnel 2

Publications and Reports 4

Research Projects

I Microwave and Physical Electronics 5
- A High-Power Magnetron Research 5
- B Cathode Research 9
  - 1 Cathode Interface Studies 9
  - 2 Conductivity and Work Functions of Oxide Cathodes 9
  - 3 Spectral Emissivity of Tungsten 9
  - 4 Electron Emission in Accelerating and Retarding Fields 10
- C Ionization Gauge Research 10
- D Properties of Cathode-Ray Tube Screens 10
- E Determination of Emission Properties of Single Crystals 10
- F Construction of 5-MM Oxford Type Tube 11
- G Traveling-Wave Amplifier Tubes 11

II Microwave Physics
- A Microwave Spectroscopy 12
  - 1 Microwave-Frequency Bridge 12
  - 2 Sweep Spectroscope 12
  - 3 Nuclear Moment of Hydrogen 12
  - 4 Caesium Spectrum 13
  - 5 Asymmetric Top Molecules 13
- B Molecular Beam Research 16
  - 1 Hyperfine Structure of Hydrogen 16
  - 2 Mass Spectrograph 19
  - 3 Second Molecular Beam Resonance Apparatus 20
- C Low-Pressure Gas Discharges 21
- D Low-Temperature Research 23
  - 1 Helium Liquefiers 23
  - 2 Superconductivity at Microwave Frequencies 23
  - 3 Magnetic Nuclear Resonance Experiments 23
- E Paramagnetism and Ferromagnetism at Microwave Frequencies 27

III Modern Electronic Techniques Applied to Physics and Engineering
- A Design and Construction of a Microwave Accelerator 28
- B Ultrasonics Research Program 29
  - 1 Ultrasonic Measurements in Liquified Gases 29
  - 2 Elastic Constants and Attenuation in Single Crystals 30
  - 3 Ultrasonic Absorption in Metals 34

IV Communications and Related Projects
- A Modulation Studies Spectrum Utilization, Efficiency of Power Utilization Signal-to-Noise Ratios 45
  - 1 Pulse Modulation Studies 45
  - 2 Properties of Random Noise 46
  - 3 Noise Reduction and Range in Radar and Communication 46
- B Stabilized Oscillator Problems 47
- C Multipath Transmission 47
- D Response of Networks to Frequency Transients 47

V Miscellaneous Problems
A Locking Phenomena in R-F Oscillators 49
B Electronic Differential Analyzer 49
C Electronic Potential Mapping 52
D Broadbanding of Arbitrary Impedances 52
E Active Networks 53
F Mathematical Problems 53
G Synthesis of Optimum Linear Systems 54