TABLE OF CONTENTS

Personnel vii
Publications and Reports xv
Introduction xx

RADIO PHYSICS

I. Microwave Spectroscopy 1
   A Computer Solution for Allowed Energy Bands for Periodic Potentials 1
   Incoherent Phonon Propagation in Anisotropic Media 5

II. Radio Astronomy 9
   Observations of Microwave Emission from Atmospheric Oxygen 9
   Long-Wavelength Radio Astronomy in Space 19
   Four-Millimeter Radio Telescope 21
   Thermal Load for Radiometer Calibration 21

III. Far Infrared Spectroscopy 25
    Sensitivity and Response Characteristics of the Golay Pneumatic Detector 25

IV. Geophysics 31
    Plasma Diffusion in a Magnetic Field 31
    Perturbation of a Plasma by a Probe 32
    Line-Shape Studies of Mercury Resonance Radiation at Zero Magnetic Field 33

V. Magnetic Resonance 37
    Theory of Sidebands in the Spectra of Coherently Modulated Systems 37

VI. Physical Acoustics 39
    Interaction between Concentric Cylindrical Sound Waves 39
    Shock Wave Transmission and Attenuation 42
CONTENTS

PLASMA DYNAMICS

VII. Plasma Physics
   Impurity Photoconduction of InSb in Magnetic Fields 45
   Steady-State Beam Plasma Discharge 51
   Laser Interferometer 55

VIII. Plasma Electronics
   Beam Plasma Discharge: System C 63
   Computer Display System for Analyzing Instabilities 65
   Electron Cyclotron Resonance Discharge 66
   Anomalous Scattering of Laser Radiation from a Plasma 68
   Thomson Scattering from a Hollow-Cathode Arc Plasma 81

IX. Plasma Magnetohydrodynamics and Energy Conversion
   Constant-Pressure, Liquid-Metal, MHD Conduction Generator 85
   Losses in Superconducting Nb-Zr_{25\%} Solenoids at Low Frequencies 89
   Magnetohydrodynamic Induction Machine of Finite Length 92
   Penetration Coefficient for an Ion in a Partially Mobile Film 104
   Electron and Ion Emission from a Tungsten Monocrystal 107

COMMUNICATION SCIENCES AND ENGINEERING

X. Statistical Communication Theory
   Work Completed 113
   Oven Controller Using a Two-State Modulation System 113
   Optimum Pre-emphasis with a Bandwidth Constraint 113
   Stimulation of Phase-Locked Loop Demodulators 113
   Characterization of a Class of Nonlinear Systems 113
   Transform Analysis of Nonlinear Systems with Sampled Input and Output 114

XI. Linguistics
   On the Syntax of the Intransitive Verb 'wait' 119
   On the Phonology of tort, tolt, tert, telt in Old Church Slavonic and Russian 121
   Historical Development of the French Syntactic Construction: Ce + ETRE + noun or pronoun 123
CONTENTS

XII. Cognitive Information Processing

Cognitive Processes 129
  Bilingual Facilitation of Short-Term Memory 129
Picture Processing 131
  Two-Dimensional Synthesis of High Spatial Frequencies in Picture Processing 131
  Minimization of Coincidence Time 134
  A Property of R. ± C Networks 137
Sensory Aids 138
  Two-Dimensional Acoustic Pattern Presentation 138
  Time Expansion of Ultrasonic Echoes as a Display Method in Echolocation 140
  Computer-Aided Simulation of a Mobility Aid 142
  Electromechanical Pattern Simulator 143
  Picture Brailler 145
  On-Line Braille Cell for the TX-0 Computer 147

XIII. Communications Biophysics 149
  Rhythmic Afterdischarge to Flashes 149

XIV. Neurophysiology 157
  Toward a Theory of the Reticular Formation 157
  A General Theory of Observation and Control 157
  Results of Biological Tests with La+++ 159
  Results of Biological Tests with Cs+ and Rb+ 160
  Extension of the Membrane Hypothesis 160
  Olfactory Processes 163
  Entoptic Phenomena and Visual Illusions 165
  Physiological Amplifier 167

XV. Neurology 169
  Sampled-Data Characteristics of Hand-Tracking and Eye-Tracking Systems 174
  Markov Modeling Technique for Predictable Visuo-Motor Tracking 180
  Saccadic Suppression 190
  Adaptive Control of the Arterial System: Lumped-Parameter Transmission-Line Analysis 191
  Photosensitive Neurons of the Crayfish Sixth Ganglion as a Dual System. Each Neuron Carrying the Same Signal Information 197
CONTENTS

XVI. Network Synthesis
    Bounds on the Natural Frequencies of LC Structures 211
    Bounds on Impedance Functions of R, ±L, ±C, T Networks 214

Author Index 226