

## TABLE OF CONTENTS

Personnel		vii
Publications and Reports		xiv
Introduction		xxii
I.	Physical Electronics	1
II.	Soft X-Ray Spectroscopy	7
III.	Physical Chemistry	9
IV.	Low Temperature Physics	11
	Nuclear Magnetic Resonance in Solid Methane	11
V.	Statistical Thermodynamics	15
	Electron-Vibration Interaction and the Generalized Born-Oppenheimer Approximation	16
VI.	Microwave Spectroscopy	19
	Electron Paramagnetic Resonance in Ferroelectric Potassium Tantalate	19
	Line Shapes of Paramagnetic Chromium Resonance in Ruby	23
VII.	Optical and Infrared Masers	35
VIII.	Nuclear Magnetic Resonance	37
	Self-Diffusion in Liquid Methane and Ethane	37
	"Selection Rules" for Rotational Inelastic Scattering	39
	Hyperfine Structure and Isotope shift in $\text{Hg}^{195}$ and $\text{Hg}^{195*}$	40
	Study of D-C Discharges in a Large, Spherical Vessel	40
	The Perturbation of a Plasma by a Probe	43
IX.	Microwave Electronics	47
	High-Perveance Hollow Electron-Beam Study	47
	Fast Waves in High-Density Electron-Beam Waveguides	48
X.	Molecular Beams	53
	Bromine Experiment	53
	Neutrality-of-Molecules Experiment	54
	Cesium Beam Tube Investigation	54
	Superconducting Lead Cavity	56

## CONTENTS

XI.	Radio Astronomy	57
XII.	Physical Acoustics	59
	The Influence of Turbulence on Sound Propagation over a Plane Boundary	59
	Heat-Maintained Oscillations	59
	Instability of Liquid Conductors	60
XIII.	Noise in Electron Devices	63
	Wave Representation of Amplifier Noise	63
Plasma Dynamics		
XIV.	Plasma Physics	69
	Harmonics of Electron-Cyclotron Emission from a Mercury-Vapor Discharge	70
	Bremsstrahlung from and Resistivity of a Highly Ionized Plasma	72
	A Transient Microwave Radiation Pyrometer	76
XV.	Plasma Electronics	81
	Extension of a Bidirectional Waveguide Theorem	82
	A New Derivation of Some Waveguide Theorems	87
	A Large-Signal Steady-State Solution for a One-Dimensional Plasma Coupled to a Traveling-Wave Circuit	90
	Electron Beam-Plasma Interaction Experiments	93
	Interaction between an Electron Beam and Plasma	95
	High-Energy Cyclotron Resonance of Electrons in a Plasma	103
	High-Frequency Method of Measuring Plasma Density	104
	Probe Measurements in the Hollow-Cathode Discharge	108
	Large-Signal Electron-Stimulated Plasma Oscillations	113
	Investigation of Superconducting Transition of Nb-Zr Alloys	118
	Neutral Particle Burnout by Molecular Ion Injection into a Magnetic Mirror	126
	Energy Extraction Blanket for a Fusion Reactor	128
XVI.	Plasma Magnetohydrodynamics and Energy Conversion	133
	Reflection and Refraction of Magnetoacoustic Waves at an Interface	134
	Parametric Generator	138
	Further Results of Velocity-Profile Measurements	142
	Magnetohydrodynamic and Electrohydrodynamic Surface Shocks and Antishocks	146

## CONTENTS

### Communication Sciences and Engineering

XVII.	Modulation Theory and Systems	163
XVIII.	Statistical Communication Theory	165
	Power Amplification with Two-Terminal Nonlinear Systems	165
	Errata	169
XIX.	Process Analysis and Synthesis	171
XX.	Processing and Transmission of Information	173
	Picture Processing	174
	Laboratory Equipment	174
	Color-System Investigations	175
	Threshold Measurements of Grain Visibility	175
	The R(d) Function for a Discrete Source with a Distortion Measure	175
	Infinite-Memory Binary Symmetric Channels	179
	Majority Decoding of Convolutional Codes	183
XXI.	Artificial Intelligence	189
XXII.	Speech Communication	191
	Performance of the Articulatory Analog of the Speech Mechanism: A Report on the Status of Research	191
	Reduction of Speech Spectra to Descriptions in terms of Vocal-Tract Area Functions	198
XXIII.	Signal Detection by Human Observers	205
XXIV.	Mechanical Translation	207
	Status of Research	207
	Linguistic Analogues of the Free-Variable	208
	Correspondence at the Grammatical Level	212
XXV.	Linguistics	231
	On the Limitations of Context-Free Phase- Structure Description	231

## CONTENTS

XXVI.	Communications Biophysics	239
	Models for the Dynamic Behavior of the Cochlear Partition	242
	Some Results of Computer Simulation of Neuronlike Nets	258
	A Three-Dimensional Optical Illusion	267
	The Relationship Among "Photic Driving," Responses to Single Flashes, and the Resting EEG	274
XXVII.	Neurophysiology	285
	Neapolitan Studies	288
	Color Vision in the Frog	292
	Design of Microelectrodes	293
	Electrochemiluminescence	296
	Oceanographic-Survey Electrodes	301
	Olfactory Electrodes	302
	The Iron-Wire Neural Nets	303
	Apparatus	305
	Olfaction in the Frog	306
XXVIII.	Neurology	309
	The Dynamic Characteristics of a Muscle Model Used in Digital-Computer Simulation of an Agonist-Antagonist Muscle System in Man	309
	Transient Responses of Human Motor Coordination System	315
	Optokinetic Nystagmus	326
XXIX.	Sensory Aids Research	329
	Bounds on Information Transfer for a Particular Class of Channels	329
XXX.	Circuit Theory and Design	335
XXXI.	Network Synthesis	337
	A Normal Form for a Matrix Pertinent to RLC Networks without Mutual Inductance	337
	Synthesis of Two-Element-Kind Networks by Means of Coordinate Transformations	345
	Canonic Realizations of RC Driving-Point Admittance. Part II	360
XXXII.	Computer Research	371
XXXIII.	Stroboscopic Research	373
	Author Index	374