

TABLE OF CONTENTS

Personnel		vii
Publications and Reports		xiv
Introduction		xxiii
I.	Soft X-Ray Spectroscopy	1
	Volumetric Photoelectron Investigation of Nickel	1
II.	Physical Chemistry	5
	The Elastic Constants of Ammonium Chloride near the Lambda Transition	5
III.	Microwave Spectroscopy	9
	Microwave Phonon Experiments	9
	Spin-Lattice Relaxation	12
	Experiments on Doped Potassium Tantalate	17
	Double-Resonance Experiment	20
IV.	Nuclear Magnetic Resonance and Hyperfine Structure	21
	Dielectric Susceptibility Tensor for an Atomic Vapor	21
	Hyperfine Structure and Isotope Shift in Radioactive Cadmium	26
	Level Crossings in Mercury 195 and 195*	28
	The Detailed Analysis of a Plasma	29
	The Magnetic Moment of Mercury 197 by Means of Optical Pumping	31
	Perturbation of a Plasma by a Probe	31
V.	Microwave Electronics	35
	Transverse Free Waves on Electron Beams	35
VI.	Molecular Beams	45
	Cesium Beam Tube Investigation	45
	Measurement of Frequency Stability	45
	Plasma Dynamics	
VII.	Plasma Physics	49
	Far Infrared Interferometer for the Measurement of High Electron Densities	49
	Theory of Fast-Wave Amplification of Microwaves by Electrons	60

CONTENTS

VIII.	Plasma Electronics	71
	Electron Beam-Plasma Interaction Experiments	71
	A Stability Proof for Magnetohydrodynamic Waveguides	76
	Low-Frequency Transverse Beam-Plasma Instability	80
	Interaction of a Magnetohydrodynamic Fluid with a Lumped Circuit	83
	Scintillating Probe for Plasmas	89
	Production of Ion Beams	89
	Scattering of Light from Electrons	90
	Use of Fissile Nuclides in Fusion Reactor Blankets	91
IX.	Plasma Magnetohydrodynamics and Energy Conversion	95
	Work Completed	95
	Random Theory of Turbulence	95
	Hydromagnetic Waveguides	95
	Design and Construction of a Magnetohydrodynamic Flow System	95
	A-C Properties of Superconductors	96
	Half-Cycle Plasma Parametric Generator	96
	Continuity of the Tangential Electric Field in Magnetohydrodynamic Machines	106
	Work Function of Monocrystalline Tantalum in a Cesium Vapor	109
	Electrical Conductivity of a Nonequilibrium Plasma	110
	Communication Sciences and Engineering	
X.	Statistical Communication Theory	115
	Work Completed	115
	Optimum Laguerre Series Expansion of Functions	115
	Measurement of Second-Order Correlation Functions by Orthogonal Expansions	115
	A Study of Error Criteria for Square-Law Devices	115
	Prediction of Singular Time Functions	115
	Estimation of Signal-to-Noise Ratio	115
	A Functional Study of Duffing's Equation	115
	A Two-State Modulation System	115
	Design of Filters for Non Mean-Square-Error Performance Criteria by Means of a Continuous Adjustment Procedure	119
	Prediction of Singular Time Functions	126
	Analog Simulation of a Phase-Locked Oscillator	137

CONTENTS

XI.	Processing and Transmission of Information	141
	Code Construction for Two-Way Channels	141
XII.	Speech Communication	157
	Speech Synthesis	157
	Reduction of Speech Spectra to Descriptions in Terms of Vocal-Tract Area Functions	162
XIII.	Mechanical Translation	167
	Sentence Parsing with a Self-Organizing Heuristic Program	167
	German Word-Order Rules	168
	Arabic to English Translation	171
XIV.	Linguistics	177
	On pon,át, and obrazovát, Type Verbs in Russian	177
XV.	Communications Biophysics	181
	Evidence for Localized Responses to Electrical Stimulation in the Cochlea	181
	Errata	193
XVI.	Neurophysiology	195
	Reliable Computation in the Presence of Noise	195
	Cognitive Systems	196
	Status of Other Research	196
	Photographic Method for the Study of Vision from a Distance	197
XVII.	Neurology	205
	Accomodation Tracking	205
	Dependence of Accuracy of Eye Movements on Prediction	212
	Phototube Glasses for Measuring Eye Movements	214
	Finger Tremor	216
	Sampled-Data Properties of the Human Motor Coordination System	220
	Frequency Response of a Spindle Receptor	223
	On-Line Use of a General-Purpose Digital Computer for Biological Experiments	227
	Effect of Pharmacological Agents on Control of Eye Movements	231

CONTENTS

XVIII.	Cutaneous Sensory Mechanisms	237
	Neurophysiological Effects of Early Sensory Restriction	237
	Tail-Flip Reflex in Goldfish	244
XIX.	Sensory Aids Research	251
	Studies of Template-Matching Character Recognition	251
	A System Enabling Tactual Perception of Visible Patterns	259
	Comparison of Tactile and Visual Reading Rates	267
XX.	Circuit Theory and Design	273
	Prime-Number Multiplier Chains	273
XXI.	Computer Research	275
	Expanded Instruction Code for the TX-0 Computer	275
	Author Index	283