

## TABLE OF CONTENTS

Personnel	vii
Publications and Reports	xv
Introduction	xxi

### GENERAL PHYSICS

I.	Molecular Beams	1
	Two-Cavity Maser Molecular Resonance Clock	3
	Neutrality of Atoms	9
	Low-Temperature Helium Beam Experiment	13
	Cesium Beam Tube Investigation	15
	Computer-Aid Calculation of Frequency Stability	15
	Velocity of Light	17
II.	Microwave Spectroscopy	19
III.	Radio Astronomy	21
	Millimeter Radiometer Developments	21
IV.	Optical and Infrared Spectroscopy	23
	Techniques of Far Infrared Interferometry	27
V.	Ultrasonic Properties of Solids	39
VI.	Geophysics	41
	Coulomb Scattering in a Magnetic Field – Matrix Element Calculations	42
	Optical Radar Results and Ionospheric Sporadic E	42
	Observations of the Upper Atmosphere by Optical Radar in Alaska and Sweden (Part I)	43
VII.	Noise in Electron Devices	47
	Measurement of Amplitude Noise in Optical Cavity Masers	47
	Noise Performance of Abrupt-Junction Varactor Frequency Doubles	51
VIII.	Magnetic Resonance	57
	Status of Current Projects	59
	Nuclear Magnetic Resonance of Polar Liquids in Electric Fields	59
	Self-Diffusion in Liquid Ethane	60

## CONTENTS

IX.	X-ray Diffraction Studies	61
X.	Soft X-ray Spectroscopy	63
XI.	Mechanism of Enzymatic Reactions	65
XII.	Physical Acoustics	67
	Hypersonic Velocity and Absorption in Liquids	67
	Longitudinal Waves in a Weakly Ionized Gas	70
	Coupling of Diffusion and Pressure Waves in a Weakly Ionized Gas	72
	Instability in Time-Symmetric Flows	75
	Shock-Wave Transmission and Attenuation	77
XIII.	Electrodynamics of Moving Media	79

## PLASMA DYNAMICS

XIV.	Plasma Physics	81
	Reflection of Guided Waves from a Plasma Column in an Axial Magnetic Field	81
	RF Absorption by a Plasma near the Ion Cyclotron Harmonics	86
	Microwave Measurements of Electron Diffusion in a Weakly Ionized Flowing Gas	92
XV.	Plasma Electronics	99
	Beam-Plasma Discharge: System A	102
	Beam-Plasma Discharge: System C	104
	Beam-Plasma Discharge: System D	106
	Interaction of an Electron Beam with a Hot-Electron Plasma	109
	Further Analysis of Interactions of an Electron Beam with Ions in a Warm Plasma	111
	Instabilities in Plasmas with Beams Injected across the Magnetic Field	118
	Electron Cyclotron Resonance Discharge	125
	The Hollow-Cathode Discharge as a Laser	129
	Hollow-Cathode Discharge III Experiment	130
	Argon Excited-State Densities in a Hollow-Cathode Discharge	134

## CONTENTS

XVI.	Plasma Magnetohydrodynamics and Energy Conversion	141
	Velocity Profiles for Magnetohydrodynamic Flows in Rectangular Ducts	143
	Magnetohydrodynamic Power Generation with Liquid Metals	149
	Experimental Measurements of the Thermal Conductivity of Cesium Vapor	153
	Prediction of Magnetohydrodynamic Induction Generation Performance	156

### COMMUNICATION SCIENCES AND ENGINEERING

XVII.	Statistical Communication Theory	165
	Kernels Realizable Exactly with a Finite Number of Linear Systems and Multipliers	167
	Time-Domain Synthesis Technique for Nonlinear Systems	179
	Model for Magnetic Tape Noise	186
	Correlation Functions of Quantized Gaussian Signals	192
	An Application of Volterra Functional Analysis to Shunt-Wound Commutator Machines	198
XVIII.	Process Analysis and Synthesis	209
	Investigation of Handwriting Signals	210
XIX.	Processing and Transmission of Information	229
	Decoding Bose-Chandhuri-Hocquenghem Codes	232
	Modular Threshold Functions	241
	The Computation Problem with Sequential Decoding	247
XX.	Artificial Intelligence	249
XXI.	Speech Communication	253
	Studies of the Dynamics of Speech Production	253
XXII.	Mechanical Translation	259
	Comit	259
	Some Recent Developments in Logic Translation	260
XXIII.	Linguistics	271
	Note on the Motivation for Using Transformational Rules in Phonology	271
	On the Development of turt tirt tult tilt in Russian	274
	Finite State Representations of Context-free Languages	276

## CONTENTS

XXIV.	Cognitive Information Processing	281
	Cognitive Processes	284
	Dyslexic Performance on Transformed Text	284
XXV.	Communications Biophysics	287
	Intrinsic and Induced EEG Rhythms in Metabolic Disorders in Relation to Higher Mental Functions	288
	Crosscorrelation of Accelerometric Recordings of Move- ment Disorders in Man	293
XXVI.	Neurophysiology	313
	Amyloplast Statoliths and Geotropism	316
XXVII.	Neurology	319
	Remote, On-Line, Real-Time Computer System for Biological Experimentation	319
	Active Development in Response to Mechanical Deformation in a Multi-unit Smooth Muscle	325
	Effect of Eye Movements on the Visually Evoked Response	332
	Component Analysis of the Abdominal Photoreceptor Walking- Movement System in the Crayfish	336
	Dynamics of Human Horizontal Eye-Movement Mechanism	343
XXVIII.	Cardiovascular System Studies	353
	Work Completed	353
	Bio-medical Engineering	353
XXIX.	Circuit Theory and Design	355
XXX.	Network Synthesis	357
XXXI.	Computer Research	359
XXXII.	Advanced Computation Research	361
XXXIII.	Stroboscopic Research	363
	Author Index	365