TABLE OF CONTENTS

Personnel		vii
Public	ations and Reports	xvi
Introdu	uction	xxi
	GENERAL PHYSICS	
I.	Molecular Beams	1
1.	Optimization of Modulation Frequency in Square Wave Phase Modulation	1
	The Two-Cavity Maser as a Possible Frequency Standard	3
	Investigation of the Vortex State in Type II Superconductors by Means of an Atomic Beam	4
	Quark Search	5
II.	Molecular Energy Transfer and Spectroscopy	9
	Resonance Fluorescence	9
	Infrared-Optical Double Resonance	9
III.	Microwave Spectroscopy	11
	Work Completed	11
	The Magnetic Field Dependence of the Temperature Coefficient of InSb's Hall Constant	11
	Superconductive Tunneling	11
	Green's Function Solution of the Boltzmann Equation in the Anomalous Skin-Depth Region	12
IV.	Atomic Resonance and Scattering	1 9
	Spin-Exchange Scattering	1 9
v.	Radio Astronomy	25
	20-Channel Microwave Spectrometer	25
	Radiometric Detection of Atmospheric Ozone	26
	Calibration Source for a Microwave Radiometer	26
	Inference of the Atmospheric Temperature Profile from Simulated Microwave Measurements from Space	2
	Report on the H-109 Alpha Line Survey	34
	Flux of the Radio Source W49 at 7.83 GHz	38
	1.75-cm Interferometer	3.0
VI.	Optical and Infrared Spectroscopy	4
	Work Completed	4
	Further Infrared and Raman Measurements of the	4:

VII.	Geophysical Research	53
	High Magnetic Fields	53
	Preliminary Experiments with a Fast Z-Pinch Capacitor Discharge: The Generation of High Pressures in Solids	53
	Upper Atmospheric Physics	59
	Optical Radar Observations of Mesospheric Aerosols in Norway during the Summer 1966	59
VIII.	Magnetic Resonance	67
	Nuclear Spin Interactions in Solids	67
IX.	Physical Electronics and Surface Physics	69
	Desorption, Dissociation, and Recombination of Halogen Gases on Metal Surfaces	69
	Screening of a Point Impurity in the Surface Region of an Electron Gas	78
	Contact-Potential Measurements of the Adsorption of Nitrogen on (110) Tantalum	83
	Thermionic and Adsorption Properties of Polycrystalline Refractory Metals Exposed to Oxygen	87
x.	Physical Acoustics	95
	Possibility of Radiation-Induced Sound Amplification In a Gas	95
	Light Scattering Off Surface Wave Phonons	97
	Ion-Density Response to a Rectangular Pulse of Sound in a Plasma	101
XI.	Electrodynamics of Media	105
	Quantum Form of Manley-Rowe Relations	105
XII.	Physical Optics of Invertebrate Eyes	109
	Interference Filters in the Corneas of Diptera	109
	Superposition Optics - A New Theory	113
	PLASMA DYNAMICS	
XIII.	Plasma Physics	123
	Interaction of a Plasma with an m = 1 RF Magnetic Field	123

XIV.	Gaseous Electronics	
	Effects of Hydrodynamic Turbulence on a Weakly Ionized Argon Plasma	
	Calculations of the Time-Dependent Electron Velocity Distribution Function in an Argon Afterglow Plasma	134
	Doppler Broadening of Electron-Cyclotron Resonance Absorption of Microwaves	138
XV.	Plasmas and Controlled Nuclear Fusion	143
	Active Plasma Systems	143
	Beam-Plasma Discharge: System D	143
	System C: Excitation of an Ion-Cyclotron Resonance	147
	Interaction of a Spiraling Electron Beam with a Plasma	154
	Computer Simulation of the Beam-Plasma Interaction	156
	Dynamics of the Plasma Boundary	159
	Cyclotron Resonance of Charged Particles in the Presence of Nonuniform Electric Field and Static Magnetic Field	165
	Applied Plasma Physics Related to Controlled Nuclear Fusion	173
	Neutral Particle Beams with Large $\Delta \mathrm{E}/\mathrm{E}$	173
	Plasma Magnetohydrodynamic Flows, Waves, and Instabilities	179
	Magnetohydrodynamic Wave Propagation Transverse to Electric Current Density	179
XVI.	Energy Conversion Research	193
	Status of Research	193
	Alkali-Metal Vapor Studies	193
	Nonequilibrium Generator	193
XVII.	Spontaneous Radiofrequency Emission from Hot-Electron Plasmas	195
	Identification of a High-Frequency Microinstability	195
xvIII.	Interaction of Laser Radiation with Plasmas and Nonadiabatic Motion of Particles in Magnetic Fields	201
	Radiation-Cooled Argon Ion Laser	201
	Resonant and Nonresonant Diffusion in a Helically Perturbed Magnetic Field	205

COMMUNICATION SCIENCES AND ENGINEERING

XIX.	Statistical Communication Theory	213
	Work Completed	213
	Static and Dynamic Analysis of a Feedback-Controlled Two-State Modulation System	213
	A Study of Noise in a Two-State Amplifier	213
	A Nonlinear Record Scratch Filter	213
	Measurement of Symmetry of Amplitude Probability Distribution of Random Noise	213
	The Impulse Response of the Pinna	214
	An Investigation of "Electrophonic Hearing"	214
	The Pinnae's Role in Monaural Localization	214
	Hard-Limiting of Sinusoids in Gaussian Noise	214
	Single-Bit Sampling through Two-State Modulation	214
	The Delay of Analog Signals by Monostable Switching Circuits	214
	Investigation of Switching Jitter in Physical Electronic Switches	215
XX.	Processing and Transmission of Information	221
	Optical Image Estimation in a Turbulent Atmosphere	221
	Quantum Communication Systems	230
	Block Codes for Discrete Sources and Certain Fidelity Criteria	240
	Information Transmission via Spatial Modulation of Waveforms	247
XXI.	Detection and Estimation Theory	257
	A State-Variable Approach to the Solution of Fredholm Integral Equations	257
XXII.	Speech Communication	259
	Cineradiographic Study of Korean Stops and a Note on "Aspiration"	259
XXIII.	Linguistics	273
	French Truncation Rule	273
	Tone Patterns in Chinese Regulated Verse	284
	On 'Animate' as a Semantic Marker	286
	English Phonology: Selected Topics	290

XXIV.	Cognitive Information Processing	303
	Optimum Threshold Level for the Reading Machine Opaque	202
	Scanner	303
	Reading Machine Studies	305
	The First Hundred Milliseconds of Vision	308
	Images and Frequency-Domain Noise	321
xxv.	Communications Biophysics	325
	On Extracellular Potentials in a Volume Conductor	326
	Pulse-Duration Modulator	332
	Psychophysics	333
	Binaural Signal Detection	334
	Detection and Triggering Device for Research on Bat- Echolocation Systems	337
	Stimulus Timer	338
	Capacitive-Transducer Instrument for Measuring Displacement of the Middle Ear in Animals	339
	Electrical Impedance Measurements on Chick Cerebral Cortex in Culture	344
	Central Origin of Asymmetry in the Carotid Sinus Reflex	350
XXVI.	Neurophysiology	355
	Synthesis and Linearization of Nonlinear Feedback Shift Registers — Basis of a Model of Memory	355
	Neural Nets of Connectivity One That Form Closed Loops without External Inputs	367
	Decidability in Shift-Register Theory	370
XXVII.	Computation Research	371
	Polynomial Root Finding	371
	Modification of the IBM Scientific Package for General Use	372
	Confluent Hypergeometric Function	374
	Replacement of Infinite Limits of Integration by Finite Ones — An Illustration	375
Author I	ndex	381

QPR No. 86 vii