## TABLE OF CONTENTS

Personnel Publications and Reports Introduction		vi:
I.	Physical Electronics	1
	Physical Electronics in the Solid State	]
	Conduction in Zinc Sulfide Single Crystals	1
	Characteristics of Semiconductor Junctions	3
	Surface States on Semiconductors	4
	Experimental Techniques	4
	A Vacuum-Tube-Transistorized Electrometer Millivoltmeter Circuit	4
	Transistor-Regulated Power Supply	5
II.	Microwave Gaseous Discharges	$\epsilon$
	Microwave Noise Radiation from Plasmas	$\epsilon$
	RF Plugs for Discharges in a Magnetic Field	12
	Plasma and Sheath Potentials in Low-Pressure Microwave Discharges	16
III.	Plasma Dynamics	20
	Studies of Magnetohydrodynamic Shocks	20
	Channeling and Compression of a Plasma	2 ]
IV.	Solid State Physics	22
v.	Low Temperature Physics	23
VI.	Thermoelectric Processes and Materials	24
	Anisotropic Thermoelectric Effects	24
	Thermal Conductivity Studies	25
VII.	Microwave Spectroscopy	27
	Phonon-Spin Absorption Coefficients in Paramagnetic Crystals	27
	Spectroscopy of Free Atoms	28
	Antiferromagnetic Resonance in Anhydrous Manganese Chloride (MnCl <sub>2</sub> )	28

## CONTENTS

VIII.	Nuclear Magnetic Resonance and Hyperfine Structure	30
	Nuclear Magnetic Resonance	30
	Nuclear Spin Interaction in Molecules	30
	Hindered Internal Rotation	31
	Hyperfine Structure of Radio Thallium	32
	The g-Factor of the 5s 5p $^3\mathrm{P}_1$ Level of Cadmium	32
	Heavy Absorption of a Spectral Line	32
IX.	Microwave Electronics	38
	Klystrons	39
	Linear Space-Charge Theory of Gap Interaction	39
	The Squeezer (High-Efficiency Bunching)	43
	Plasma Studies	45
	Traveling-Wave Experiments	45
	Parametric Instabilities in Plasmas	46
	Approximate Field Solutions	47
	Measurements of the Phase Constant of the Slow Wave of a Helix with the Use of the Resonance Method	49
X.	Atomic Beams	52
	Hyperfine Structure of Bromine	52
	Cesium Maser	52
XI.	Stroboscopic Research	54
	Design and Construction of a Luminescence Camera	54
XII.	Frequency Modulation	57
XIII.	Statistical Communication Theory	58
	Noise-Level Estimation	58
	Connectivity in Random Graphs — Two Limit Theorems	64
	Minimization of Truncation Error in Series Expansions of Random Processes	70
	Fourier Transforms of Positive Functions	79
	Resolution of a Random Process and Properties of the Components	86
	Canonical Forms for Nonlinear Statistical Estimators	91
XIV.	Process Analysis and Synthesis	105

## CONTENTS

XV.	Processing and Transmission of Information	106
	Information Loss Associated with Decision-Making in Additive Gaussian Channels	107
	Coding for a Binary Erasure Channel	108
	Patterns of Digits for Convolution Codes	109
	A Bound on the Crosscorrelation Functions of a Set of Binary Sequences of Finite Length	112
XVI.	Artificial Intelligence	129
XVII.	Statistical Thermodynamics	130
	The Relation of Irreversible Thermodynamics and Thermostatics	130
XVIII.	Speech Communication	133
	Speech Analysis with the Aid of a Digital Computer	133
	The Role of Duration in Vowel Identification	136
	Detectability of Small Irregularities in a Broadband Noise Spectrum	139
	Dynamic Analog Speech Synthesizer	142
XIX.	Physical Acoustics	145
	Simple Example of Magnetomechanical Wave Motion	145
	Mode Coupling on a String in a Magnetic Field	147
	Acoustic Noise Source Distribution in a Turbulent Jet	149
	Acoustic Amplifier	150
XX.	Mechanical Translation	152
XXI.	Communications Biophysics	153
	Dispersion Measures of Evoked Electrocortical Activity	155
	Response of an Idealized Neural Population to a Train of Repetitive Stimuli	157
	An Investigation of the Finite-Time Sample Autocorrelation Function of the EEG	163
XXII.	Neurophysiology	168
	Effect of Touch Stimuli on Pain and Temperature Sensations	168
	Optic Nerve	176
	Nerve Models	178
	Autonomic Conditioning	179

## CONTENTS

XXIII.	Signal Detection by Human Observers	181
	Sequential Observations of Signals in Noise	181
XXIV.	Network Synthesis	183
XXV.	Circuit Theory Work in Progress	184 184
XXVI.	Noise in Electron Devices	185
XXVII.	Linguistics	186