

TABLE OF CONTENTS

Personnel	vi
Publications and Reports	ix
Introduction	xi
I. Physical Electronics	1
Electron Emission Problems	1
A Redetermination of the Crystallographic Variation of Electron Field Emission from Tungsten	1
Energy Dependence of Electron-Produced Poisoning of Oxide Cathodes	2
Low Pressure Gas Discharge	2
Study of the Positive Column Plasma	2
Experimental Studies	2
Ionization Gauge	2
An Infrared Radiation Pyrometer	3
II. Microwave Gaseous Discharges	4
Introduction	4
High-Density Microwave Gaseous Discharges	4
Probe Studies	7
III. Solid State Physics	9
Soft X-ray Spectroscopy	9
Microwave Study of Semiconductors	10
Energy Levels of Impurities in Silicon Carbide	11
IV. Low Temperature Physics	13
Summary of Program of Low Temperature Physics	13
The Viscosity of Liquid Helium	14
Measurement of Second-Sound Pulse Amplitudes in Liquid Helium II	14
Thermoelectric Forces	15
V. Microwave Spectroscopy	17
Introduction	17
Paramagnetic Resonance in Oxygen Gas	17
Paramagnetic Resonance in Metals	18
Paramagnetic Resonance in Ammonium Chromium Alum	19
VI. Atomic Beam Research	20
VII. Magnet Laboratory Research	21
VIII. Microwave Tube Research	22
Introduction	22
Noise in Electron Beams	22
Propagation of Signals on Electron Beams	26
Low-Noise Gun Design	28

	Helix Couplings	29
	Backward-Wave Oscillator	32
IX.	Multipath Transmission	33
	Transatlantic FM Study	33
	Narrow-Band Limiting	34
X.	Communication Research	38
	Information Theory	38
	Introduction	38
	A New Proof of Shannon's Theorem for Noisy Channels	39
	Second-Order Correlation	41
	Wiener's Method of Nonlinear System Characterization	41
XI.	Transistor Circuits	42
	Introduction	42
	Bias Stabilization of Junction Transistors	42
	Temperature Control	42
	Transistor Sawtooth Generator	44
XII.	Semiconductor Noise	45
	Introduction	45
	Noise and Channel Effect in P-N Junctions	45
	Problems in the Measurement of Noise Amplitude Probabilities	46
	Modulation Noise in Semiconductor Devices	46
	Noise Analyzer and Noise from Microwave Devices	47
	Spectrum of Excess Noise from Germanium Filaments	48
XIII.	Microwave Components	51
	Introduction	51
	T-Ridge Waveguides	51
	Ferrites at Microwave Frequencies	53
	Square or Circular Waveguide Completely Filled with Ferrite	53
	Square or Circular Waveguide with a Sliver of Ferrite along the Z-axis	53
	Rectangular Waveguide with a Thin Slab	54
	Comments	54
XIV.	Surface Waves	56
XV.	Stable-Frequency Microwave Oscillator	59
XVI.	Visual Replacement Projects	60
	Step-Down Detector	60
	Acoustical Training Aids	62
XVII.	Speech Analysis	65
XVIII.	Neurophysiology	66
XIX.	Communications Biophysics	67
	Introduction	67

	Effect of Noise on Intensity Functions of N_1	67
	Note on a Probabilistic Model for the Behavior of Neural Elements (Peripheral Auditory System)	69
	Analog Correlator for Electroencephalography	71
	The Time-Gated Amplitude Quantizer (TGAQ)	72
XX.	Analog Computer Research	74
	Introduction	74
	Computer Systems	74
	Energy and Power in Nonlinear Systems	74
	Investigations and Applications of the Theory of Signal Flow Graphs to Analog Computers	76
	Computer Elements	78
	Square-Law Network	78
	Delay Lines	79
	Applied Network Theory	79
	Potential Analogs	79
	RC Filter Frequency Transformations	79
	Lowpass to highpass transformation	80
	Lowpass to bandpass transformation	80
	Duality of Ideal Transformers	83
XXI.	Network Synthesis	85
	Research Objectives	85
	Regarding a Rational Approximation to e^{-s}	86
XXII.	Shop Notes	91
	Multiplying with the Help of a Triangular Wave	91