Contents

Nonlinear Oscillations and Waves. Classical Results				
2.1	Oscilla			
	2.1.1	A Marble in the Chute		
	2.1.2	Spring Pendulum and Nonlinear Optics .		
	2.1.3	Nonlinear Landau Damping		
• •	~	and Amplification		
2.2	Solitons			
	2.2.1	The Fermi-Pasta-Ulam Paradox		
	2.2.2	Solitons as Particles		
	2.2.3	Solitons and Shock Waves		
2.3		xcited Oscillations		
	2.3.1	Examples and Definitions		
	2.3.2	Competition and Synchronization		
	2.3.3	Self-Excited Oscillations		
		in Chains and Continuous Systems		
2.4	Bifurc			
	2.4.1	Acquisition of a New Quality		
	2.4.2	Bifurcations of Equilibrium States		
	2.4.3	Bifurcations of Periodic Motion		
	2.4.4	Bifurcations –		
		Changes of Stability in Periodic Motion .		
2.5	Modulation			
	2.5.1	The Role of Small Parameters		
	2.5.2	Running Mandelstam Lattices.		
		Modulation of Waves by Waves		
	2.5.3	Generation of Modulation		
	2.5.4	Self-Modulation		
	2.5.5	Recurrence		
	2.5.6	Modulation Solitons		
Chaos				
3.1	Histori	ical Remarks		
3.2	Marble in an Oscillating Chute			
3.3		stic Self-Excited Oscillations		
	3.3.1	The Lorenz Attractor		
	3.3.2			
	3.3.3	•		

		3.3.4 Scenarios for the Birth		
		of Strange Attractors	72	
	3.4	Chaos and Noise	75	
		3.4.1 Dimension and Entropy	75	
		3.4.2 The Cantor Structure		
		of a Strange Attractor	76	
		3.4.3 Dimension and Lyapunov Exponent	78	
		3.4.4 Deterministically Generated		
		and Random Signals	81	
4.	Structures			
	4.1	Order and Disorder – Examples	85	
	4.2	Attractors and Spatial Patterns	90	
		4.2.1 Examples of Equations	90	
		4.2.2 Multistability. Defects	92	
	4.3	Self-Structures	98	
		4.3.1 Convective Self-Structures	98	
		4.3.2 Localization Mechanisms	100	
		4.3.3 Self-Structures		
		in Three-Dimensional Media	101	
		4.3.4 Interaction of "Elementary Particles"	103	
		4.3.5 Birth and Interaction of Spiral Waves	105	
	4.4	Attractors – Memory – Learning	107	
		4.4.1 How to Remember	107	
		4.4.2 "Camera + TV + Feedback" Analogue	109	
		4.4.3 Critical Phenomena	112	
		4.4.4 Structures in Neuron-Like Media	113	
5.		bulence	117	
	5.1	Prehistory	117	
	5.2	Basic Models of Dynamic Theory	120	
	5.3	Turbulence and Structures	122	
		in Two-Dimensional Fields		
		5.3.1 Experiments	122	
		5.3.2 Development of Turbulence		
		and Multi-Dimensional Attractors	125	
	5.4	Spatial Evolution of Turbulence	127	
		5.4.1 Flow Dimension	127	
		5.4.2 Spatial Bifurcations	129	
	5.5	Discussion	130	
6.	Nonlinear Physics – Chaos and Order			
	6.1	The Where and the How		
	6.2	Randomness Born out of Nonrandomness 1		
	6.3	An Unstable Path and Steady Motion.		
		Are They Incompatible?	136	
	6.4	Does Chance Rule the World?	137	
	6.5	What is the Character of Nature?		
		Integer or Fractal?	139	

6.6	Fractal Fingers	141	
6.7	Self-Organizing Structures	143	
6.8	Singles	145	
6.9	The New Life of an Old Problem	145	
6.10	Spatial Evolution of Disorder	146	
6.11	What Does Your Camera See		
	When It is Watching TV?	147	
6.12	Multistability and Memory	148	
6.13	Nonlinear Dynamics in Society	149	
Color Plates			
Literature			
Acknowledgements of the Figures			
Subject Index			