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REPRINTS	
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Broken Symmetry

Coherent Matter Field Phenomena in Superfluids, by P. W. Anderson • Some Recent Definitions in the Basic Sciences, edited by A. Gelbert, Vol. 2, pp. 21-40 (Belfer Graduate School of Science, Yeshiva University, New York,	
1965-66).	229
Considerations on the Flow of Superfluid Helium, by P. W. Anderson ● Rev. Mod. Phys. 38, 298-310 (1966).	249
Broken Symmetry, Emergent Properties, Dissipative Structures, Life and Its Origin: Are They Related? by P. W. Anderson and D. L. Stein ● Self-Organizing Systems: The Emergence of Order, edited by F. E. Yates (Plenum Press, New York, in press)	262
press/.	202

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Theory of Anisotropic Superfluidity in He ³ , by P. W. Anderson and W. F. Brinkman ● The Helium Liquids: Proceedings of the 15th Scottish Universities Summer School in Physics, 1974, edited by J.G.M. Armitage and I. E. Farquhar, pp. 315-416 (Academic Press, New York, 1975).	287
Topology	
Principles of a Classification of Defects in Ordered Media, by G. Toulouse and M.Kléman J. Phys. (Paris) Lett. 37, L-149-151 (1976).	389
Investigation of Singularities in Superfluid He ³ in Liquid Crystals by the Homotopic Topology Methods, by G. E. Volovik and V. P. Mineev ● Sov. Phys. JETP 45(6), 1186-96 (1977).	392
Phase Slippage without Vortex Cores: Vortex Textures in Superfluid ³ He, by P. W. Anderson and G. Toulouse ● Phys. Rev. Lett. 38 , 508-511 (1977).	403
Bose Systems	
On the Quantum Mechanics of Helium II, by O. Penrose ● Phil. Mag. 42, 1373-1377 (1951).	407
Bose-Einstein Condensation and Liquid Helium, by O. Penrose and L. Onsager ● Phys. Rev. 104, 576-584 (1956).	412
Application of the Methods of Quantum Field Theory to a System of Bosons, by S. T. Beliaev ● Sov. Phys. JETP 34(7) , 289-299 (1958).	421
Energy-Spectrum of a Non-Ideal Bose Gas, by S. T. Beliaev ● Sov. Phys. JETP 34(7) , 299-307 (1958).	432
A "Fermi-Liquid" Description of the Kondo Problem at Low Temperatures, by P. Nozières ● J. Low Temp. Phys. 17, 31-42 (1974).	441

CONTENTS

Quantum Solids

Conductivity from Charge or Spin Density Waves, by P. A. Lee, T. M. Rice, and P. W. Anderson • Solid State Commun. 14, 703-709 (1974).	453
Electric Field Depinning of Charge Density Waves, by P. A. Lee and T. M. Rice ● Phys. Rev. B 19 , 3970-3980 (1979).	460
Sliding Charge Density Waves, by P. A. Lee Nature 291, 11-12 (1981). 	471
Renormalization Group	
 Exact Results in the Kondo Problem II. Scaling Theory, Qualitatively Correct Solution, and Some New Results on One-Dimensional Classical Statistical Models, by P. W. Anderson, G. Yuval, and D. R. Hamann Phys. Rev. B 1, 4464-4473 (1970). Errata. 	473
A Poor Man's Derivation of Scaling Laws for the Kondo Problem, by P. W. Anderson ● J. Phys. C 3, 2436-2441 (1970). Errata.	483
Scaling Theory of the Asymmetric Anderson Model, by F.D.M. Haldane ● Phys. Rev. Lett. 40, 416-419 (1978). Errata have been included in the text, Phys. Rev. Lett. 40, 911 (1978).	489
Ordering, Metastability and Phase Transitions in Two-Dimensional Systems, by J. M. Kosterlitz and D. J. Thouless ● J. Phys. C 6, 1181-1203 (1973).	493
Scaling Theory of Localization: Absence of Quantum Diffusion in Two Dimensions, by E. Abrahams, P. W. Anderson, D. C. Licciardello, and T. V. Ramakrishnan	
 Phys. Rev. Lett. 42, 673-676 (1979). 	516

Scaling Theory of the Metal-Insulator Transition in Amorphous Metals, by W. L. McMillan • Phys. Rev. B 24, 2739-2743 (1981).	520
Quantum Critical Phenomena, by J. A. Hertz • Phys. Rev. B 14, 1165-1184 (1976).	525

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