

CONTENTS

VOLUME XI

<i>Preface</i>	v
<i>Contents</i>	vii
<i>Contents of previous volumes</i>	xi
<i>Ch. 1. Spin-polarized ^3He–^4He solutions, A.E. Meyerovich</i>	1
1. Introduction	3
1.1. Spin-polarized quantum systems	3
1.2. ^3He – He II solutions: nearly an ideal Fermi gas	5
1.3. Interaction of quasiparticles: a choice of a model. Quantum gases	8
2. Macroscopic description of polarized solutions	12
2.1. Equations of spin dynamics	12
2.2. Fermi liquid description of degenerate solutions	17
3. Dilute spin-polarized solutions. Thermodynamics	23
4. Transport phenomena and magnetokinetic effects	31
4.1. Viscosity, thermal conductivity and absorption of sound	31
4.2. Spin diffusion, spin thermal and pressure diffusion. Spin second viscosity	39
5. Transverse spin dynamics and spin waves	41
5.1. Theoretical results	41
5.2. Experimental data on the spin dynamics	49
6. ^3He superfluidity in $^3\text{He} \downarrow$ – ^4He solutions	53
6.1. Temperature of the superfluid transition	53
6.2. BCS phase of a polarized solution	55
6.3. Inhomogeneous phases: superfluid liquid crystals	59
7. Other spin-polarized ^3He Fermi systems. Concluding remarks	65
7.1. Solid, liquid and gaseous $^3\text{He} \downarrow$	65
7.2. Unusual phases of $^3\text{He} \downarrow$	68
7.3. Concluding remarks	70
References	71
<i>Ch. 2. Long mean free paths in quantum fluids, H. Smith</i>	75
1. Limitations of hydrodynamics	77
2. Fluid slip at boundaries	79
2.1. The slip length	79
2.1.1. Maxwell–Boltzmann gas	84
2.1.2. Fermi liquid	85
2.1.3. Phonons and rotons	86
2.1.4. Superfluid Fermi liquid	87
2.2. Stationary flow	88
2.2.1. Poiseuille flow	88
2.2.2. Flow around spheres and cylinders	91
2.3. Time-dependent flow	92
2.3.1. Surface impedance	92

2.3.2. Sound propagation and attenuation	93
2.3.3. Vibrating wire	96
3. Flow at arbitrary Knudsen numbers	96
3.1. Molecular flow	97
3.1.1. Maxwell–Boltzmann gas	103
3.1.2. Fermi liquid	104
3.1.3. Phonons and rotons	105
3.1.4. Superfluid Fermi liquid	106
3.2. Poiseuille flow	107
3.3. Surface impedance	110
4. More general scattering laws	114
4.1. Andreev reflection	114
5. Comparison with experiment	117
5.1. Normal ^3He	117
5.2. Superfluid ^3He	119
5.3. ^3He – ^4He mixtures	120
5.4. Liquid ^4He	121
5.5. Solids	123
6. Conclusion	123
References	124

Ch. 3. The surface of helium crystals, S.G. Lipson and E. Polturak 127

1. Introduction	129
1.1. The phases of solid helium	129
1.2. Surface physics with solid helium	131
2. The morphology of helium crystals	132
2.1. Crystal shapes in the absence of gravity: the Wulff construction	132
2.2. Surface stiffness	138
2.3. Crystal shapes in a gravitational field	139
2.4. Analogy between crystal shapes and ferromagnetism	140
2.5. Classical calculations of the evolution of equilibrium crystal shapes	141
2.6. Are equilibrium morphologies obtainable?	145
2.7. The roughening transition: elementary theory	149
2.8. Experimental results on crystal shapes and roughening transitions	151
3. Recent theoretical advances regarding roughening	156
3.1. Roughening temperatures	156
3.2. Critical behaviour of facet sizes and surface stiffness	159
4. The growth of helium crystals	161
4.1. Rough surfaces: theory of the growth resistance	161
4.2. Crystallization waves	163
4.3. Transmission of sound through the interface	166
4.4. Experiments using charged helium surfaces	167
4.5. Theory of the Kapitza resistance of helium surfaces	168
4.6. Experiments on the Kapitza resistance	168
4.7. Growth of faceted surfaces	170
4.8. Experimental work on facet growth	171
4.9. Growth of crystals from dilute ^3He – ^4He mixtures	174
5. Substrate-induced phenomena	176
5.1. Solid multilayer growth on matching crystalline substrates	177
5.2. The wetting transition	182

6. Conclusion	184
Note added in proof	185
References	185
<i>Ch. 4. Neutron scattering by ^4He and ^3He, E.C. Svensson and V.F. Sears</i>	189
1. Introduction	191
2. Liquid ^4He	192
2.1. Anomalous dispersion	193
2.2. Temperature dependence of $S(Q, \omega)$ at low Q	194
2.3. The momentum distribution and the condensate fraction	199
2.4. Static structure factor and pair correlations	202
3. Liquid ^3He	206
4. Concluding remarks and future directions	209
References	212
<i>Ch. 5. Characteristic features of heavy-electron materials, H.R. Ott</i>	215
1. Introduction	217
2. Typical features of heavy-electron materials	220
2.1. Electrical resistivity	220
2.2. Magnetic susceptibility	222
2.3. Low-temperature specific heat	223
2.4. Thermal conductivity	225
2.5. Hall effect	227
3. The renormalization of energy scales	228
4. Other properties	229
4.1. Volume effects	229
4.2. Magnetic fields	234
4.3. Spectroscopy	235
5. Superconductivity in heavy-electron materials	237
5.1. CeCu_2Si_2	238
5.2. UBe_{13}	242
5.3. UPt_3	255
5.4. Unconventional superconductivity?	261
6. Magnetic ordering in heavy-electron materials	262
6.1. NpSn_3 , U_2Zn_{17}	263
6.2. CeAl_2 , UCd_{11}	268
6.3. Other examples	272
6.4. Heavy electrons in a magnetically ordered material, UCu_5	273
7. Conditions for the formation of the heavy-electron ground state	276
8. Concluding remarks	283
Note added in proof	284
References	285
<i>Author Index</i>	291
<i>Subject Index</i>	306