

# Contents

<i>Preface</i>	<i>page xi</i>
1 General principles	1
1.1 Salt fingers	1
1.2 The early years: from Jevons to Stommel	5
1.3 Diffusive convection	7
1.4 Scale analysis	9
1.5 Non-dimensionalization and governing parameters	11
1.6 Turner angle	13
2 The linear instability problem	17
2.1 Conditions for instability	17
2.2 Growth rates and spatial scales	19
2.3 The flux ratio	22
2.4 Effects of horizontal gradients	27
3 The unbounded gradient model	32
3.1 Flux-gradient laws	32
3.2 Secondary instabilities: Stern–Kunze constraint and Holyer modes	34
3.3 Weakly nonlinear models	37
3.4 Phenomenological and empirical models	39
3.5 Numerical simulations	47
3.6 Laboratory experiments	51
4 The two-layer system	58
4.1 Interfacial flux laws	58
4.2 Salt-finger interfaces	62
4.3 Diffusive interfaces	69

5	The bounded layer model	76
5.1	Diffusive layer	76
5.2	Salt-finger layer	84
6	Collective instability	93
6.1	Approaches	93
6.2	Parametric flux-gradient model	96
6.3	Physical interpretation	98
6.4	Specific solutions	100
6.5	Nonlinear effects	101
7	Thermohaline intrusions	108
7.1	Linear theory	109
7.2	Extensions: rotation, baroclinicity and ambient turbulence	125
7.3	Nonlinear effects	134
7.4	Laterally bounded fronts	143
7.5	Sidewall heating experiments	151
7.6	Oceanographic observations	155
8	Thermohaline staircases	171
8.1	Observations	172
8.2	Staircase origins	189
8.3	Instability of the flux-gradient laws	195
8.4	Mechanics of layer-merging events	204
9	The unified theory of secondary double-diffusive instabilities	212
10	Double-diffusion in active environments	216
10.1	The interaction of salt fingers with shear flow	217
10.2	Low fluxes and thick interfaces	221
10.3	The interaction with intermittent turbulence	222
10.4	Microstructure signatures of salt fingers in the ocean	228
10.5	Inverse modeling of thermohaline staircases	243
11	Large-scale consequences	248
11.1	Effects of salt fingers	248
11.2	Effects of diffusive convection	268
12	Beyond oceanography	275
12.1	Astrophysics	276
12.2	Geology and geophysics	286
12.3	Chemistry	295
12.4	Materials science and engineering	299
12.5	Other applications	306

13	Perspectives and challenges	311
13.1	Perceptions	312
13.2	Barriers	313
	<i>References</i>	316
	<i>Index</i>	340

*Color plates section is between pages 176 and 177.*

