

Contents

page

1. Introduction	1
1.1 Preamble	1
1.2 Waves in waters	1
1.3 Observations - Their interpretations	5
a) Lake Michigan	5
b) Lake of Lugano (North basin)	9
c) Lake of Zurich	15
d) Lake Ontario	19
e) Other lakes and ocean basins	21
1.4 Aim of this work	24
2. Governing equations	26
2.1 Equations of adiabatic fluid flow	26
2.2 Vorticity, potential vorticity, topographic Rossby waves	28
2.3 Baroclinic coupling - the two-layer model	35
a) Prerequisites	35
b) Two-layer equations	36
c) Approximations	37
d) Scale analysis	40
e) Boundary conditions	44
2.4 Continuous stratification	45
a) Modal equations	45
b) Scale analysis	55
2.5 TW-equation in orthogonal coordinate systems	57
a) Preparation	57
b) Cylindrical coordinates	58
c) Elliptical coordinates	58
d) Natural coordinates	60
e) Cartesian-coordinate correspondence principle	61
3. Some known solutions of the TW-equation in various domains	62
3.1 Circular basin with parabolic bottom	62
3.2 Circular basin with a power-law bottom profile	65
3.3 Elliptic basin with parabolic bottom	67
3.4 Elliptic basin with exponential bottom	71
a) Basin with central island	71
b) Basin without island	75
3.5 Topographic waves in infinite domains	79
a) Straight channel	80
b) Channel with one-sided topography	80
c) Shelf	82
d) Trench	83
e) Single-step shelf	83
f) Elliptic island	85
4. The Method of Weighted Residuals	87
4.1 Application to the TW-equation	87
4.2 Symmetrization	93

	page
5. Topographic waves in infinite channels	95
5.1 Basic concept	95
5.2 Dispersion relation	98
5.3 Channel solutions	105
5.4 Velocity profiles	111
5.5 Alternative solution procedures	114
5.6 Hyperbolically curved channels	118
6. Topographic waves in rectangular basins	122
6.1 Crude lake model	123
6.2 Lake model with non-constant thalweg	126
a) Numerical method	126
b) New types of topographic waves	130
c) Convergence and parameter dependence	134
d) The bay-type	136
7. Reflection of topographic waves	137
7.1 Reflection at a vertical wall	138
7.2 Reflection at an exponential shore	141
7.3 Reflection at a $\sin^2$ -shore	143
a) Numerical method	
b) Reflection patterns	
8. Review and outlook: Restrictions of this study	152
A list of unsolved problems	
8.1 A brief summary	152
8.2 Validity of TW-equations	152
8.3 Single or multivalued dispersion relation	153
8.4 Bay-type modes	154
8.5 A list of unsolved problems	155
a) On the computational side	155
b) On the physical side	155
8.6 Measurements, observations	156
Appendix A	157
Appendix B	161
Appendix C	163
References	168
Author Index	174
Subject Index	175