

CONTENTS

PREFACE	vii
1 PRELIMINARIES	3
<i>Definitions</i>	4
<i>Basic Theorems</i>	6
<i>Regular Neighborhoods</i>	7
<i>General Position</i>	8
2 HEEGAARD SPLITTINGS	14
<i>Cubes with Handles</i>	15
<i>Splittings and Diagrams</i>	17
<i>Genus One Splittings</i>	20
3 CONNECTED SUMS	24
<i>Primes</i>	27
<i>Existence of Factorizations</i>	29
<i>Uniqueness of Factorizations</i>	32
4 THE LOOP AND SPHERE THEOREMS	39
<i>Double Curve Surgery</i>	41
<i>Proof of the Loop Theorem</i>	47
<i>Proof of the Sphere Theorem</i>	50
<i>The Projective Plane Theorem</i>	54
5 FREE GROUPS	56
6 INCOMPRESSIBLE SURFACES	58
7 KNESER'S CONJECTURE ON FREE PRODUCTS	66
8 FINITELY GENERATED SUBGROUPS	69
9 MORE ON CONNECTED SUMS: FINITE AND ABELIAN SUBGROUPS	75
<i>Group Homology</i>	75
<i>Finite Groups: The Nonorientable Case</i>	76
<i>Subgroups with Higher Homology</i>	80
<i>Abelian Groups</i>	84
10 I-BUNDLES	88
<i>Products</i>	89
<i>Twisted Bundles</i>	91
<i>Surface Subgroups of Finite Index</i>	98

11	GROUP EXTENSIONS AND FIBRATIONS	100
	<i>Algebraic Preliminaries</i>	101
	<i>Bundles</i>	103
	<i>Proof of Theorem 11.1</i>	110
12	SEIFERT FIBERED SPACES	115
	<i>Fuchsian Groups</i>	118
	<i>Bundles with Period Structure Groups</i>	121
	<i>Cyclic Normal Subgroups</i>	125
	<i>Centers</i>	131
	<i>Cyclic Actions on $S^1 \times S^1 \times S^1$</i>	132
13	CLASSIFICATION OF P^2 -IRREDUCIBLE, SUFFICIENTLY LARGE 3-MANIFOLDS	136
	<i>The Analogue for Surfaces</i>	137
	<i>Hierarchies</i>	140
	<i>Classification Theorems</i>	143
	<i>Peripheral Systems</i>	149
	<i>Remarks and Examples</i>	150
14	SOME APPROACHES TO THE POINCARÉ CONJECTURE	154
	<i>Contractible Open 3-Manifolds</i>	155
	<i>A Characterization of S^3</i>	157
	<i>Splitting Homomorphisms</i>	158
	<i>The Mapping Class Group</i>	162
	<i>Involutions on Homotopy 3-Spheres</i>	164
15	OPEN PROBLEMS	169
	<i>The Fundamental Groups</i>	169
	<i>Peripheral Systems</i>	172
	<i>Hopficity</i>	175
	<i>Residual Finiteness</i>	176
	REFERENCES	185
	INDEX	192
	SYMBOLS AND NOTATION	194